The final publication is available in: International Journal of Transportation Science and Technology 7 (2018) 291–307, doi.org/10.1016/j.ijtst.2018.10.006

Framework conditions of occupational safety: Comparing Norwegian Maritime Cargo and Passenger Transport

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Abstract

Seafaring is among the most hazardous occupations, and more knowledge is needed to inform preventive measures. One way of developing such knowledge is to compare different sub-sectors, to shed light on factors influencing occupational safety. Previous research has indicated a higher risk of serious occupational injuries in coastal cargo transport compared to passenger transport, hypothesizing that this could be due to the safety culture in coastal cargo transport. The aims of the present paper are to: 1) Compare organizational safety culture and working conditions in Norwegian cargo and passenger transport at sea, 2) Examine safety outcomes (safety behaviours and crewmember accidents) of safety culture and working conditions in the passenger and the cargo sector, and 3) discuss how safety culture and working conditions are influenced by the framework conditions of the the passenger and the cargo sector. study is based on a small-scale survey to crewmembers on vessels registered in the Norwegian Ship Register (NOR), both at passenger vessels (N=84) and coastal cargo vessels (N=73). Results indicate that crew members in the coastal cargo sector experience more work pressure, and that they rate their organizational safety culture as lower than respondents in the passenger transport sector. Moreover, results indicate that work pressure and poor organizational safety culture are closely related to unsafe working behaviours, which in turn is associated with personal injuries on board. However, as a positive organizational safety culture is related to safer working behaviours, future research should examine how organizational safety culture can be employed to reduce the impact of negative framework conditions in maritime transport on occupational safety.

Keywords: *Safety culture, maritime transport, cargo, passenger, Norway*

1. Introduction

1.1 Background and Aims

Maritime transport is the backbone of world trade: As much as up to 90 % of the goods traded globally are transported by sea (Alderton & Winchester, 2002). Thus, much of what we use and consume in our everyday lives either has been, or will be transported by sea (United Nations, 2016). Sea transport also dominates long distance transport of goods in Norway (St. melding nr. 31 2003-2004). Shipping is, however, a dangerous industry, due to both occupational accidents on board vessels and shipping accidents, involving e.g. foundering, grounding. Although the mortality rate of seafarers has declined, it is still one of the most hazardous occupations in the world (Ek et al, 2014). In the period 2011-2016, there were on average 100 fatalities and 935 injuries annually, reported in the European Marine Casualty Information Platform (EMSA, 2017). There were on average 15 fatalitites and 424 injuries annually on Norwegian ships (NOR and NIS) in the period 2004-2013 (Nævestad et al 2015). In the present study we focus on two types of maritime transport in Norway, operating under different framework conditions: coastal cargo transport and border crossing passenger transport. The former of the two sectors is also referred to as coasters (i.e. smaller cargo vessels) (Hansen et al, 2002), while the latter can be referred to as ROPAX (roll-on/roll-off passenger), or cruise ferries, which often is used to describe passenger ferries with facilities for more than 500 passengers.

The passenger and the cargo sector are chosen because of an interesting paradox: previous research indicates that passenger vessel crews have a higher risk than coaster crews of all occupational accidents, but a substantially lower risk of serious injury and fatal accidents (Hansen et al, 2002). It is suggested that the lower risk of coaster crews of all occupational accidents could indicate under-reporting and poorer organizational safety culture on board coaster vessels than on other vessels (Hansen et al, 2002). Subsequently, we could perhaps hypothesize that the higher levels of reporting and lower risk of serious occupational injuries on board passenger vessels, could indicate that these vessels have a better organizational safety culture.

The aims of the study are therefore: 1) to compare organizational safety culture and working conditions in Norwegian cargo and passenger transport at sea, 2) examine safety outcomes (safety behaviours and crewmember accidents) of safety culture and working conditions in the passenger and the cargo sector and 3) discuss how safety culture and working conditions are influenced by the framework conditions of the the passenger and the cargo sector.

Working conditions refer to factors like manning level on board, work pressure, and demanding working conditions. Organizational safety culture is measured by means of a 11-item survey based on the Global Aviation Information Network (GAIN) questionnaire (GAIN, 2001).

The data have been collected as part of a research project titled "Safety culture in private and professional transport: examining its influence on behaviours and implications for interventions - SafeCulture", which is funded by the Transport 2025 program of the Norwegian Research Council.

1.2 Previous Research

In this section, we present previous research relevant to the aims of the study, regarding variables influencing safety outcomes (aim 2), variables influencing organizational safety culture and working conditions (aim 1), and factors related to framework conditions in passenger and cargo transport (aim 3). We formulate hypotheses based on this research.

1.2.1 Variables influencing safety outcomes

Hansen et al (2002) studied 1993 occupational accidents among crew aboard Danish merchant ships in the period 1993-1997. As noted, this study finds that passenger vessel crews have a higher risk than coaster crews of all occupational accidents, but a substantially lower risk of serious injury and fatal accidents. Additionally, this study finds that demographic and work-related variables influenced safety outcomes: 1) Foreigners had a considerably lower accident risk than Danish citizens (see also: Ádám et al (2014)), 2) Age was a major risk factor for accidents causing permanent disability, but younger seafarers had a higher risk 3) Change of ship and the first period aboard a ship were identified as risk factors, 4) Walking from one place to another aboard the ship caused serious accidents, and 5) The most serious accidents happened on deck. It should also be mentioned that Hansen et al (2002) found that personal accident patterns on passenger ships differed substantially from cargo ships. A later study by Jensen et al (2004), including 6461 seafarers from 11 countries, finds the following factors to be related to personal accident involvement: 1) Seafarers' age (<35 years), 2) Tour lengths (<117 days), 3) Position, i.e. rating, 4) Work in engine room, 5) Nationality, 6) Self-assessed occupational safety ("How is your occupational safety": 1=very bad, 5=very good) and 7) Use of protective equipment.

1.2.2 Organizational safety culture

Organizational safety culture can generally be defined as "safety relevant aspects of culture in organizations" (Hale, 2000; Antonsen, 2009; Nævestad, 2010). In the present study, we define safety culture specifically as safety relevant ways of thinking or acting that are (re)created through the joint negotiation of people in social settings (Nævestad, 2010). Although work on organizational safety must address both formal and informal aspects of safety, it may be useful to think of organizational safety culture as the informal aspects of safety in organizations to distinguish it from the formal aspects of safety in organisations (rules, procedures, organizational charts etc.) (Antonsen, 2009). We may refer to the formal aspects of safety as safety structure or safety management system (SMS), comprised of management policy, appointment of key safety personnel, reporting systems, hazard identification and risk mitigation, safety performance monitoring, etc. (Thomas 2012).

One of the main purposes of the International Safety Management (ISM) code of the International Maritime Organization's (IMO), made statutory in 1998, was to contribute to a positive safety culture in the maritime sector through requiring SMS. Lappalainen et al. (2012) conducted a study of the ISM-code, on a literature review and 94 interviews conducted with key stakeholders in the maritime sector. This study concludes that the (formal) ISM code seems to have improved the (informal) safety culture and the safety level in the maritime industry.

Although research finds a relationship between safety culture and safety performance in the maritime sector, there are few studies of maritime safety culture compared to other sectors

(Bjørnskau and Nævestad 2013). In a study published in 2005, Håvold concluded that his searches for literature on the topic only had generated a couple of studies about safety culture and climate in shipping (Håvold, 2005). Four years later, Håvold and Nesset (2009) maintained that there still were few studies of safety culture at sea. The number of studies of safety culture in maritime transport sector has, however, increased in recent years.

Ek and Akselsson (2005) assess safety culture on board six Swedish passenger ships in international traffic, using observations, questionnaires, and interviews. They conclude that results indicate a generally good existing safety culture, compared with other transport sectors. They found differences in individuals' safety culture perceptions between: a) ships, b) vessel type (high-speed craft versus ROPAX), and c) hierarchical working position.

As far as we know, there are few studies comparing organizational safety culture on board cargo and passenger vessels. Although Håvold & Nesset (2009) include passenger and cargo vessels (tank and dry cargo) in their study involving 141 vessels and 2558 responses, their aim is scale development. The authors conclude that the study confirms the usefulness of safety culture/climate factors as predictors of unsafe behaviour. Lu and Tsai (2010) studied container vessels, focusing on the influence of safety culture on seafarers' safety behavior. This study also revealed a positive relationship between safety culture and safety behaviour.

Oltedal and Wadsworth (2010) examine the relationship between risk perception and safety culture among general cargo, bulk and tanker crews (N=989). They found that safety-oriented shipboard management style, performance of proactive working practices and good reporting practices contribute to a better perception of shipboard safety, while a high demand for efficiency contributes to a more negative perception of the safety level.

1.2.3 Working conditions

There are several challenges related to working conditions (e.g. stress, time pressure, fatigue) in the maritime sector, e.g. long work weeks, nonstandard work days, extensive night operations, and periods of intense effort alternating with periods of monotony, long periods away from home etc. (Hetherington et al 2006; Wadsworth et al 2008).

Although, there are few studies comparing working conditions in maritime cargo and passenger transport, working conditions in coastal cargo transport have been examined in several studies. This research has pointed to relatively intense working patterns in coastal shipping (Starren et al., 2008; Smith et al., 2006). Interviewees in the study of Nævestad (2017) report that deck workers in coastal cargo transport with low manning levels and many port calls often have a high work load, because of many loading operations (requiring work before, during and after) and maintenance work. They stated that this may lead to irregular working patterns and little rest. Smith et al (2006) report that in terms of effort, coastal seafarers rated maintenance and loading tasks as highest, although navigation and watch keeping also required moderately high effort.

Previous studies have also pointed to work pressure in passenger transport, in ferry transport, which run according to a fixed schedule with many departures each day. In a study of Norwegian car ferry workers' compliance of safety-related procedures, Aalberg and Bye (2017) describe how ferry companies are fined if they do not keep to their schedules. Ferry personnel have devised several strategies on how to meet schedules, as being delayed, or even worse,

canceling a departure, may damage the navigator's reputation both among colleagues, and at the shipping management (Aalberg and Bye 2017).

Thus, we see that work pressure is a common challenge in many subsectors in the maritime sector. Oltedal and Wadsworth (2010) note that work pressure is one of the most common themes in safety surveys, and thus they include demand for efficiency as a factor in their safety culture survey. Bhattacharya (2015) also has conclusions relevant for the relationship between working environment and safety culture, as he refers to excessive workload and availability of quality rest (the factor "job demands") as barriers to an effective safety culture.

In addition to stress and work pressure, several studies also focus on fatigue, stressing that this is a key safety challenge in the maritime sector (MAIB, 2004; Phillips, 2014). Seafarers share several important work characteristics influencing fatigue, for instance long working hours, sleep disturbances, due to, for instance, motion noise, and night work (Lützhöft et al, 2007; Allen et al., 2008).

1.2.4 Framework conditions

Bjørnskau and Longva (2009) compare organisational safety culture scores in different transport sectors: road, rail and aviation. They find that the organizational safety culture scores differ substantially in different transport sectors. They also find that these differences are in accordance with safety performances of the sectors, suggesting that the safest lines of transport have the highest organizational safety culture scores. (Bjørnskau & Longva 2009). The authors point to the different framework conditions of the sectors to explain this, focusing on a) competition/economy, b) rules/enforcement, c) type of transport (cargo, people) and d) costs of accidents.

Previous studies point to competition and economy as a key framework condition influencing the level of work load and work pressure in maritime transport. Oltedal and Wadsworth (2010) state that, as shipping is an international and global activity, increased competitiveness, cost reduction and demand for efficiency will always, to a certain degree, be present. Størkersen (2017) underlines the importance of framework conditions for working conditions in Norwegian coastal cargo transport. In the daily conflict between protection and production, the latter often wins in this sector. In a study based on qualitative interviews (N=54), participant observation and small-scale survey data (N=77), Størkersen et al (2011) found that a third of the small-scale survey respondents reported that they put themselves in danger to get the job done, while about 40 % violate procedures to get the job done, especially because of efficiency demands. Maritime accident investigations and studies show that leading bridge officers and other crew members must constantly balance considerations related to economy and safety, and that the premises for safety to a great extent are set by shipping companies and owners of the cargo (Mostad, 2009; Størkersen et al, 2018). Such goal conflicts may be a source of stress, and the way they are handled at all levels are key to safety (Perrow, 1999; Reason, 1997).

In some types of passenger transport (e.g. high-speed passenger vessels), Størkersen (2018) point to the tenders as an important framework condition. The high-speed passenger vessels that operate on Norwegian coastal routes are privately owned, but their service is contracted by Norwegian counties through competitive tendering based on Norwegian competition law and EU regulations, which require the least costly vendor to be selected if other criteria are found to be equal (Størkersen 2018).

In addition, it is important to note that the type of transport also is a key framework condition. In a previous study from the road sector, interviewees stressed that the safety level in passenger transport is higher than in cargo transport, as people are more "valuable" than goods (Nævestad & Phillips 2013). This is generally also reflected in rules/enforcement in passenger and cargo transport. Likewise, some subsectors within maritime cargo transport (petroleum) are known to have stricter regulations, a high safety focus from the transport buyers (oil companies) and a higher safety level (Mostad 2009). These suggested differences in safety focus and regulations between subsectors are in line with the differences in the risk of serious occupational injuries in maritime subsectors reported by Hansen et al (2002). As noted, Hansen et al (2002) found a higher serious occupational accident risk in coaster vessel transport, and lower risk in passenger transport and gas transport.

1.2.5 Hypotheses based on previous research

Based on existing research, we may hypothesize that: 1) Working conditions are challenging in the coastal cargo sector, with high work pressure, little time to rest and irregular working patterns (Størkersen et al 2011, Starren et al 2008). We know little about working conditions in ropax. 2) We expect negative working conditions to be related to low safety culture scores in coastal cargo (Nævestad 2017), while research from maritime passenger transport (Ek and Akselsson 2005) indicates a relatively high safety culture level. 3) We expect a relationship between safety culture and safety behaviours (Håvold and Nesset 2009, Lu and Tsai 2010), reflecting the different safety culture levels in the passenger and the cargo sector. 4) We expect a relationship between working conditions and safety behaviours (Størkersen et al 2011), reflecting the different levels in the passenger and cargo sector. 5) Additionally, we may expect a higher incidence of serious occupational accidents in coastal cargo than in passenger transport (Hansen et al 2002). 6) We also expect demographic variables (e.g. age) to influence seafarers' risk of occupational accidents (Hansen et al 2002; Jensen et al 2004). 7) We expect safety behaviours to influence seafarers' risk of occupational accidents (Jensen et al 2004). 8) Finally, we expect relatively challenging framework conditions in coastal cargo, related to economy and competition. Previous research says little about framework conditions in ROPAX.

2. Methods

2.1 The SafeCulture Project

The data in this project have been collected as part of the SafeCulture project, which is funded by the Norwegian Research Council, and undertaken by the Institute of Transport Economics - TØI (Norway), the National Technical University of Athens - NTUA (Greece), Sintef (Norway) and the Norwegian University of Science and Technology (NTNU). The project is exploring safety culture in land and sea based, professional and private transport in Norway and Greece. The main aims of the project are to examine safety culture and behaviour in road and sea transport, and to clarify implications for safety intervention strategies. The present paper is an expanded an improved version of a paper which was presented at the 8th International Congress on Transportation Research (ICTR 2017). Although the SafeCulture project focuses on cargo and passenger transport in Norway and Greece, the present paper only focuses on cargo and passenger transport in Norway. This is done to examine the importance of sector and framework conditions without the possible confounding influence of nationality. The influence of national

maritime safety culture, compared to sector focus on safety and organisational safety culture, is examined in another paper, which compares Norwegian and Greek cargo and passenger transport (Nævestad et al under review). Thus, although the survey that we have used includes several questions measuring national culture, we do not show results for these, as we only compare the passenger and the cargo sector in Norwegian maritime transport in the present study.

Table 1 sums up the different methods used in the present study

Table 1 Samples, survey themes and analyses used in the present study

Samples: Cargo: N=73, Passenger: N=84
Key survey themes (questions): -Background variables (15) -Safety behaviors (4) -Occupational injuries (1) -Working conditions (4) -Organisational safety culture (11)
Comparison of means (Anova) -Organisational safety culture index -Demanding working conditions index -Unsafe behaviours index
Regression analyses. Dependent variables: -Personal injuries -Unsafe behaviours index -Organisational safety culture index

2.2 Recruitment of Respondents

The respondents were recruited through the Norwegian researchers' contact with Norwegian shipping companies. Thus, all the respondents work on ships that are operated from Norway, i.e. the shipping companies are located in Norway. Web links to the questionnaires were distributed by the shipping companies to all employees working on board vessels, along with an introductory text explaining the purpose of the survey, and stressing that the surveys were confidential.

2.3 Sample

A share of 47 % (N=73) of the respondents worked in cargo transport, while the rest worked in passenger transport (N=84). Among the 73 respondents on board cargo vessels, 16 % worked

on bulk vessels, 22 % on general cargo, 18 % on silo vessels, 41 % on live fish carriers and 4 % on other cargo vessels. The 84 respondents in the maritime passenger transport were distributed on six different vessels travelling to three different countries. Due to small numbers of respondents on the vessels, we divide these 84 respondents on three different lines: Line 1 (N=41), Line 2 (N=19), Line 3 (N=24). These were all from the same company. The cargo vessel respondents were from five different companies: Cargo 1 (N=12), Cargo 2 (N=13). Cargo 3 (N=27), Cargo 4 (N=4) and Cargo 5 (N=17). The 47 % of cargo respondents is comprised of: Bulk vessel: 8 %, General cargo: 10 %, Silo vessels: 8 %, Live fish carriers: 19 %, Other cargo: 2 %. Ninety-one per cent of resepondents are Norwegian, 6 % are from another Nordic country, while 3 % are from other countries, mainly Western European. Eight per cent of the 157 respondents are women.

Table 1-3 sum up the characteristics of the respondents and their vessels on key background variables.

Table 1: Age distribution among the cargo (N=73) and passenger vessel (N=84) respondents.

	< 26	26-35	36-45	46-55	56+	Total
Cargo	16 %	23 %	22 %	30 %	8 %	100 %
Passenger	6 %	20 %	24 %	33 %	17 %	100 %

Table 1 indicates that there are more seafarers in the youngest group in cargo transport and more seafarers in the oldest age group in passenger transport. The difference is not statistically significant. Table 2 indicates higher shares of respondents with more experience in passenger transport. Chi-square analysis indicate that differences are significant (P=0,027).

Table 2: Experience distribution among the cargo (N=73) and passenger vessel (N=84) respondents.

	0-5 years	6-10 years	11-15 years	16-20 years	> 20 years	Total
Cargo	21 %	22 %	11 %	15 %	32 %	100 %
Passenger	6 %	14 %	19 %	20 %	41 %	100 %

Table 3: Position/line of work among the cargo (N=73) and passenger vessel (N=84) respondents.

	Captain	Deck officer	Deck crew	Chief engineer	Engine officer	Engine crew	Catering	Apprentice	Other	Total
Cargo	21 %	23 %	16 %	6 %	3 %	8 %	10 %	8 %	6 %	100 %
Passenger	1 %	18 %	2 %	0 %	25 %	7 %	24 %	0 %	23 %	100 %

There are more captains and deck crew in the cargo sample, and more engine officers, catering personnel and “other” in the passenger sample. These differences reflect the average manning level and positions in the passenger and the cargo sector. The average manning level on cargo vessels is 6 people (min: 2, max: 10). In passenger transport, the average manning level on Line 1 is 258, Line 2: 97, Line 3:77. Comparing port calls per week, the average level for bulk vessels is 15, while it is 16 for general cargo, 10 for silo vessels, 6 for live fish carriers, 9 for other cargo, 7 for passenger Line 1, 25 for Line 2 and 28 for Line 3.

2.4 Survey Measures

1) Background variables (15 questions): sex, nationality, age group, seafarer experience, position/area of work, employment status, vessel type, vessel size, manning on board, ship

register, year vessel was built, days on board and days off, work schedule, number (and share) of nationalities on board, number of employees in the shipping company.

2) Safety performance (5 questions) (see 2a-2e below):

2a) Safety behaviours: (4 questions) the survey originally included seven questions on safety behaviours, but we removed four items and made an index with four questions after a stepwise "Scale if item deleted" analysis, where we removed items until removing items did not lead to a higher Cronbach's Alpha. The index is composed of the following questions (Cronbach's Alpha: .855). How often do you think the following events tend to occur for every 100 working days/nights on board?:

- I violate procedures to get the job done
- I refrain from using the required protection equipment in my work
- I accept small risks because the "situation demands it" (e.g. because of time pressure, bad weather)
- I work, even though I am so tired that safety may be compromised

(Answer alternatives: 1) Never, 2) 1-2 times, 3) 3-5 times, 4) 6-10 times, 5) 11-15 times, 6) 16-20 times 7) More than 20 times, 8) Do not know/not relevant). The last answer alternative is excluded in the index.

2b) Work place safety assessment: "All in all, how do you assess the safety of your work place situation (applies both to personal injuries and ship accidents)?" Answer provided in a scale 1-10 where very bad=1 and very good=10

2c) Safety compromising fatigue: "Sometimes I am so tired during working hours that safety is compromised" (Answer alternatives: 1=totally agree - 5=totally disagree, 6=Do not know/not relevant)

2d) Work accidents: "Have you been injured in your work on board in the course of the last two years?" (Answer alternatives: 1) No 2) Yes, a little injury which did not require medical attention, 3) Yes, a little injury which required medical attention, 4) Yes, an injury which required medical attention and a period of sick leave).

2e) Ship accidents: "Has the vessel been involved in a shipping accident in the two last years?" (Answer alternatives: 1) No, 2) Yes)

What kind of ship accident? Several answers are possible. 1) Grounding, 2) Collision, 3) Contact damage (dock, bridge etc.), 4) Foundering, 5) Other accident (please specify)

3) Working conditions: (4 questions): How often do you think the following events tend to occur for every 100 working days/nights on board:

- Your shift change is delayed because of work operations, for instance port calls?
- You work more than 16 hours in the course of a 24-hour period?
- You are interrupted when you are off duty

(Answer alternatives: 1) Never, 2) 1-2 times, 3) 3-5 times, 4) 6-10 times, 5) 11-15 times, 6) 16-20 times 7) More than 20 times, 8) Do not know/not relevant)

We removed the eighth answer alternative and made a "Demanding working conditions index" of these three questions (Cronbach's Alpha: .738). The survey also included a question on work pressure:

- Sometimes I feel pressured to continue working, even if it is not perfectly safe (Answer alternatives: 1=totally disagree - 5=totally agree, 6=Do not know/not relevant).

4) Organisational safety culture (11 questions): We made an organisational culture index, consisting of 10 questions from the GAIN-scale on organisational safety culture (Cronbach's Alpha=0.882). One of the original GAIN questions has been reformulated, and it is used twice: once applying to the "ship management" and once applying to the "shipping company", as both

management levels are important for safety on board vessels. Thus, we use 10 of the questions from the GAIN-scale, but our organisational safety culture index consists of 11 questions. We have used the GAIN scale in previous research from different transport sectors (Bjørnskau & Longva, 2009; Nævestad & Bjørnskau, 2014). The GAIN-scale is presented in the "Operator's Safety Handbook" (GAIN 2001).

The GAIN-scale originally consists of 25 questions measuring five themes, but we have reduced the scale to the following questions (answer alternatives range from 1=totally disagree, to 5=totally agree):

- Ship management regards safety to be a very important part of all work activities.
- The shipping company regards safety to be a very important part of all work activities.
- Ship management detects crew members who work unsafely.
- Ship management often praises crew members who work safely.
- My colleagues on board usually report all safety problems and unsafe situations that they experience in their work.
- My colleagues on board do all they can to prevent accidents and unwanted incidents.
- There are routines (procedures) on board for reporting safety problems.
- All defects or hazards that are reported are corrected promptly
- After an accident has occurred on board, appropriate actions are usually taken to reduce the chance of reoccurrence
- All crew members on board receive adequate training to work in a safe way
- Safety on board this vessel is better than on other vessels

5) Sector focus on safety (6 questions):

- On a "safety level scale" ranging from 1 to 10, where 10 equals the safety level in international commercial aviation, how would you rate your sector (i.e. sea transport of goods or passenger)?

The survey included five additional questions measuring sector focus on safety (answer alternatives range from 1=totally disagree, to 5=totally agree):

- Safety is more important than deadlines to our customers
- Safety is more important than price to our customers
- Strong competition between companies impedes safety in my sector
- I don't expect safety improvements in my sector in the next 10 years
- Society accepts the current level of accidents that we have in my sector

2.5 Analysis of quantitative data

We have used SPSS version 24 in our analyses of the quantitative data.

Comparison of means. When comparing the mean scores of different groups, we use one-way Anova tests, which compare whether the mean scores are equal (the null hypothesis) or (significantly) different.

Chi-square analysis. We use Chi square tests to compare groups' distributions on particular variables. The chi square test tests whether the actual distribution of groups on a variable is statistically significant different from a coincidental distribution, or an independent normally distributed sample.

Regression analysis. We have conducted three regression analyses to analyze the factors predicting respondents' answer on the dependent variables measuring: a) personal injuries, b) the unsafe behaviours index and c) the organizational safety culture index. We chose logistic regression analysis in the first regression analyses, as the dependent variable has two values (no=1, yes=2). The injury variable was dichotomized for this purpose. In the analyses we include different independent variables in the analyses step-wise in order to be able to examine the isolated effect of the independent variables, i.e. when the other variables are held constant. Table 6, which present the logistic regression analysis provide B values, which indicate whether the risk of personal injuries is reduced (negative B values) or increased (positive B values), when the independent variables increase with one value. In the two other analyses (Table 7, Table 8), we use hierarchical, linear regression analyses, where independent variables are included in successive steps. The most basic independent variables are included first, e.g. age, position, then the other independent variables are included. We cannot conclude about causality based on the analyses, as this is a cross-sectional and correlational study. We nevertheless use the term predict when we describe the regression analyses.

4. Results

4.1 Organisational Safety Culture

In accordance with the first aim of the study, the present section compares organizational safety culture scores in cargo and passenger transport. Table 4 shows the means on the organisational safety culture index for the different vessel types within cargo and passenger transport. The average organisational safety culture score is 43.3 points (min=11, max=55). "Other cargo" was excluded from the table, as there were only 3 respondents in this group, and Bulk and General cargo was combined because of low numbers.

Table 4: Means on the organisational safety culture index for the different vessel types within cargo (Bulk/general cargo, Silo, Live fish carrier) and passenger transport (Line 1-3). (min=11, max=55).

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Bulk/General cargo	42,4	27	4,726	33	49
Silo	36,5	13	10,548	18	50
Live fish carrier	44,4	30	4,375	36	50
Line 1	43,3	41	5,225	26	50
Line 2	44,4	19	4,788	30	50
Line 3	46,5	24	3,007	39	50
Total	43,4	154	5,779	18	50
Total cargo	42,1	73	6,722	18	50
Total passenger	44,4	84	4,742	26	50

Table 4 indicates that passenger transport scores significantly higher on the safety culture index than cargo transport. The difference between the two is statistically significant (P=0,011). The highest organizational safety culture score is in Passenger Line 3, and the

lowest in Silo. The differences between all the subsectors are significant at the 1 % level (P=0,00).

We also find significant differences between age groups (P=0,039), with the lowest scores among respondents younger than 26 years (41,3 points) and highest among respondents older than 56 years (46,7 points). We do not find significant differences between positions/lines on work on board. We also find significant differences between shipping companies (P=0,001), with the lowest scores in Cargo 5 company (38,1 points) and highest in the passenger transport company (44,4 points), although Cargo 3 scored 44,2 points.

Finally, we found significant differences (P=0,00) comparing scores on the different values (1=totally disagree, 5=totally agree) on the variable "Sometimes I feel pressured to continue working, even if it is not perfectly safe": Respondents who "totally agreed" scored the lowest (29,7 points), while those who "totally disagreed" scored the highest (44,8 points). We also found significant differences (P=0,00) comparing scores on the different values of the variable: "Sometimes I am so tired during working hours that safety is compromised" ("totally disagree": 45 points, "totally agree": 38,3 points).

4.2 Demanding Working Conditions

In accordance with the first aim of the study, the present section compares working conditions in cargo and passenger transport. As noted in section 2 "Methods", we made a "Demanding working conditions index" of three questions, asking how often respondents' shift change is delayed because of work operations (e.g. port calls), respondents work more than 16 hours in the course of a 24-hour period, or are interrupted when they are off duty. In Table 5 below, we compare mean scores for different vessel types on this index. The minimum value is 3 (never) and the maximum value is 21 (daily when I am at sea). The average score is 6.5 points.

Table 5: Means on the demanding working conditions index for the different vessel types within cargo (Bulk/general cargo, Silo, Live fish carrier) and passenger transport (Line 1-3). The minimum value is 3 (never) and the maximum value is 21 (daily when I am at sea)

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Bulk/General cargo	7,1	27	3,700	3	19
Silo	7,3	12	4,731	3	18
Live fish carrier	7,7	29	3,920	3	19
Line 1	5,9	38	2,029	3	12
Line 2	5,5	19	2,038	3	11
Line 3	5,2	22	2,654	3	15
Total	6,4	147	3,241	3,	19
Total cargo	7,4	71	3,860	3	19
Total passenger	5,6	79	2,210	3	15

Cargo transport scores significantly higher (P=0,00) on the demanding working conditions index than passenger transport. When comparing sub-sectors' (i.e. vessel type) scores on the demanding working index, we see that the most demanding working conditions are in live fish carrier, and the least demanding in passenger transport: Line 3. The differences between the sub sectors are statistically significant at the 5 %-level (P=0,031).

We do not find significant differences between age groups on the demanding working conditions index, neither between positions/lines on work on board. We do find significant differences between shipping companies (P=0,018), with the lowest scores in Passenger (5,6 points) and highest in the Cargo 4 (8,8 points).

Finally, we found significant differences (P=0,00) comparing scores on the different values on the variable "Sometimes I feel pressured to continue working, even if it is not perfectly safe": Respondents who "totally disagreed" scored the lowest (5,7 points), while those who "totally agreed" scored the highest (11,5 points). Results do not indicate significant differences comparing scores on the different values of the variable: "Sometimes I am so tired during working hours that safety is compromised".

Table 6 shows the mean scores on the variable "Sometimes I feel pressured to continue working, even if it is not perfectly safe" (1=totally disagree, 5=totally agree) for cargo and passenger transport

Table 6: Mean scores on the variable "Sometimes I feel pressured to continue working, even if it is not perfectly safe" (1=totally disagree, 5=totally agree) for cargo and passenger transport.

Sector	Mean	N	Std. Deviation	Minimum	Maximum
Cargo	1,7	73	1,054	1	5
Passenger	1,4	84	0,868	1	5
Total	1,6	157	0,969	1	5

Cargo transport scores significantly higher on the work pressure variable than passenger transport. The difference between the two are statistically significant at the 5 %-level (P=0,044). The highest perceived work pressure is in Bulk transport (2 points), while the lowest is in Passenger line 3 (1,4 points).

4.3 Safety Outcomes

In accordance with the second aim of the study, the present section compares safety outcomes in cargo and passenger transport: first we compare safety behaviours, and then we compare personal injuries.

4.3.1 Safety Behaviours

We made an index measuring unsafe behaviours consisting of four questions, measuring violations, risk taking, risk acceptance. In Table 7, we compare mean score for different groups on this variable. The minimum value is 4 (never) and the maximum value is 28 (more than 20 every 100 working days/nights on board). The average score is 8.

Table 7: Means on index measuring unsafe behaviours consisting for the different vessel types within cargo (Bulk/general cargo, Silo, Live fish carrier) and passenger transport (Line 1-3). The minimum value is 4 (never) and the maximum value is 28 (more than 20 every 100 working days/nights on board).

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Bulk/General cargo	8,4	25	2,888	4	15
Silo	11,8	13	7,057	4	25
Live fish carrier	9,2	29	5,100	4	22
Line 1	6,9	38	3,215	4	20
Line 2	6,1	16	3,594	4	18
Line 3	6,6	23	3,691	4	21
Total	7,9	144	4,417	4	25
Total cargo	9,5	70	4,883	4	25
Total passenger	6,6	77	3,407	4	21

Cargo transport scores significantly (P=0,00) higher on the unsafe behaviour index than passenger transport. The highest mean score on the index is found on board the silo vessels, while the lowest is found on board the passenger vessels, Line 2. The differences between the subsectors are significant at the 1 % level (P=0,001).

Results also indicate significant differences between age groups (P=0,004), with the highest scores among respondents younger than 26 years (9,8 points) and lowest among respondents older than 56 years (5,6 points). Differences between positions/lines on work on board were only significant at the 10 %-level (P=0,77), with Apprentice scoring the highest (11,7 points). We also find significant differences between shipping companies (P=0,00), with the lowest scores in Passenger (6,6 points) and highest in Cargo 4 company (12,5 points).

Finally, we found significant differences (P=0,00) comparing scores on the different values on the variable “Sometimes I feel pressured to continue working, even if it is not perfectly safe”: Respondents who “totally agreed” scored the highest (17,3 points), while those who “totally disagreed” scored the lowest (6,9 points). We also found significant differences (P=0,00) comparing scores on the different values of the index Demanding working conditions (P=0,004). We coded this index into three values: 1=3-7 points, 2=8-12 points, 3=13-21 points. The scores on the unsafe behaviour index increased for each increasing value on the demanding working conditions index. The unsafe behaviour index score for 3-7 points on the demanding working conditions index was 7.2 points, while it was 11,7 points for 13-21 points on the demanding working conditions index. Thus, it is indicated that unsafe behaviours are related to demanding working conditions.

4.3.2 Personal Injuries

We asked respondents whether they had been injured in their work on board in the course of the last two years. A total of 42 of the respondents (27 %) answered yes (Figure 1). The figure also shows mean scores on the unsafe behaviours index for each value on the personal injury variable.

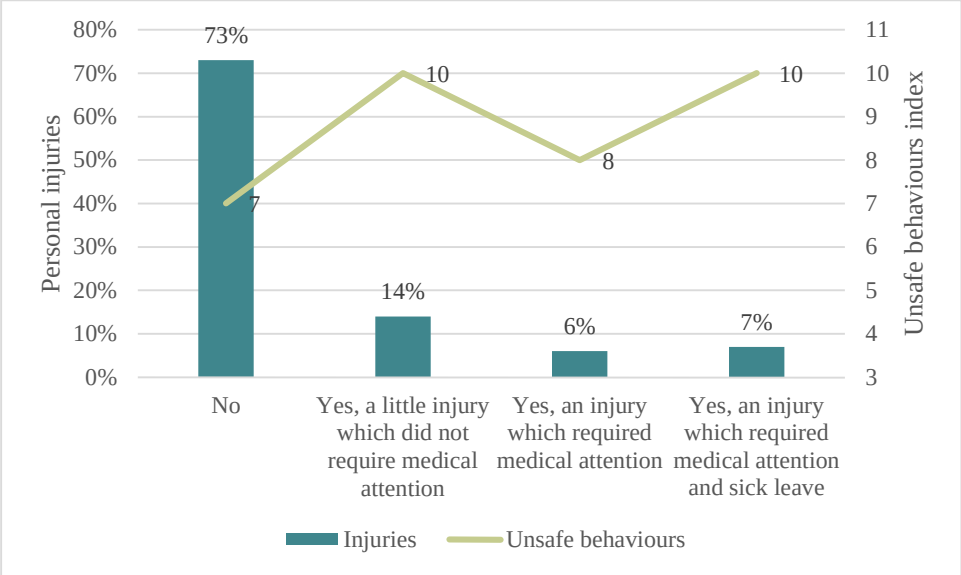

Figure 1: Respondents' response to the question: "Have you been injured in your work on board in the course of the last two years?" %(left y axis) and mean scores on the unsafe behaviours index for each value on the personal injury variable (right y axis) (N=157).

Figure 1 indicates a relationship between personal injuries and unsafe behaviours, as we see that the average Unsafe behavious index score is lower for respondents who have not experienced injuries in the last two years than for those who have experienced injuries in the last two years. Thus, it seems that respondents with safer behaviours have fewer injuries. An Anova comparison of means indicates that the differences between the mean scores on the unsafe behaviours index for each value on the personal injury variable are statistically significant at the 5 %-level (p=0.018). When we reduce the values on the personal injury variables from four to two, the Unsafe behavious index scores are 7.3 ("No injuries") and 9.8 ("have experienced injuries"), and the difference is statistically significant at the 1 %-level (p=0.003).

4.4 Sector focus on safety

In accordance with the third aim of the study, the present section compares results on questions measuring sector focus on safety in cargo and passenger transport. We also discuss the extent to which these questions measure framework conditions (see also: section 5.3 and 5.4).

The basic hypothesis motivating the study is that framework conditions (e.g. economy, competition, regulation) are different in passenger and cargo transport. We do not directly measure the individual influence of the different framework conditions in the present study, but rather base our hypotheses about these on previous research. It should however be noted that the present study includes survey measures focusing on sector focus on safety, to be used in the SafeCulture project (cf.Section 2.1). P-values are provided to indicate significant differences between the passenger and the cargo sector. Table 5 indicates significant differences between respondents from the two sectors on the two key first statements, measuring sector focus on safety.

Table 5: Mean scores on statements measuring sector culture/focus on safety. The answer alternatives on the first question range from 1-10, and on the five last questions from 1 (totally disagree), to 5 (totally agree) P-values indicate whether differences between the sectors mean scores are statistically significant (ANOVA)

Statements measuring sector culture/focus on safety	Cargo	Passenger	P-value
On a "safety level scale" ranging from 1 to 10, where 10 equals the safety level in international commercial aviation, how would you rate your sector (i.e. sea transport of goods or passenger)?	**6.56**	**7.63**	**.002**
Safety is more important than deadlines to our customers	**3.78**	**4.26**	**.014**
Safety is more important than price to our customers	**3.73**	**3.76**	**.867**
Strong competition between companies impedes safety in my sector	**2.74**	**2.57**	**.434**
I don't expect safety improvements in my sector in the next 10 years	**2.14**	**2.06**	**.686**
Society accepts the current level of accidents that we have in my sector	**2.74**	**2.50**	**.245**

The difference between the the passenger and the cargo sector on the first statement is statistically significant, and we see that respondents in passenger transport rate their safety level as higher than respondents in the cargo sector. This statement uses international commercial aviation as a reference for comparison, as previous research has shown that it may be difficult to compare answers from respondents in different contexts (e.g. sectors, countries), as their baselines and points of reference ("the safety level they take for granted") may be different (Nævestad et al 2017). Accordingly, as previous research indicates different safety levels ("reference points") in the two studied sectors (Hansen et al 2002), it may be useful to ask respondents to compare their own sector with a relatively known external sector (i.e. aviation).

The rationale for the two questions focusing on customers ("Safety is more important than price/deadlines to our customers"), is that research indicates that customer focus on safety is an important framework condition (e.g. Størkersen 2017). It could however be noted, that the concept of "customers" is quite different in cargo and passenger transport. Nevertheless, we see a statistically significant difference between cargo and passenger transport when it comes to safety vs. deadlines, indicating that customers in passenger transport places more weight on safety (vs. deadlines) than customers in cargo transport. The difference is not statistically significant between the sector on the safety vs. price question. The same applies to the question focusing on "strong competition". Competition may, however, also be perceived as strong in the studied passenger transport sector, although the baseline safety level is higher in this sector (given e.g. the customer focus on safety). This may make it difficult to compare sectors on this question. More research is needed. The two last questions ("I don't expect…" and "Society accepts…") may also assume different baseline levels in the passenger and the cargo sector, making comparisons difficult. If the safety level is perceived as very high, it may be difficult to expect further improvements. The same may apply if the safety level is perceived as very low. Likewise, society may accept both a high and a low level of accidents. Thus, these two questions are ambiguous: at least two different meanings are possible. Thus, these questions do not represent appropriate measures of sector focus on safety.

4.5 Results from Regression Models

4.5.1 Personal Injuries On Board as the Dependent Variable

In accordance with the second aim of the study, a logistic regression analysis was conducted with personal injuries as dependent variable, in order to examine the variables predicting personal injury among our respondents (Table 6), comparing the influence of sector controlled for other key variables. In this analysis, the injury variable, which originally had four answer alternatives (Figure 1), was dichotomized, 0=no personal injury, 1=personal injury. In Table 6, B values are provided, which indicate whether the risk of personal injuries is reduced (negative B values) or increased (positive B values), when the independent variables increase with one value. We include different independent variables step-wise in the analyses to be able to examine the isolated effect of the independent variables, i.e. when the other variables are held constant.

Table 6: Logistic regression. Dependent variable: Personal injuries on board in the last two years (dichotomized: 0: no personal injury, 1=personal injury). B values

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Age group (>26 years=0, other=1)	**-2,226*** **	**-2,106*** **	**-2,072*** **	**-2,086*** **	**-2,038*** **	**-2,051*** **	**-2,051*** **	**-2,120*** **
Position/line of work (Apprentice=0, other =1)		-,418	-,145	-,174	-,256	-,259	-,261	-,204
Unsafe behaviours index			**,098** **	**,100** **	**,102** **	**,097** **	**,096***	**,115***
Sector (passenger=0, cargo=1)				-,085	-,318	-,364	-,364	-,328
Sub-sector (Live fish carrier=0, other=1)					-,508	-,491	-,491	-,391
Demanding working conditions index						,032	,031	,030
Sometimes I feel pressured to continue working, even if it is not perfectly safe							,002	,048
Organisational safety culture								,033
Nagelkerke R^2	.158	.159	.201	.201	.208	.210	.210	.214

* p < 0.1 ** p < 0.05 *** p < 0.01

Table 6 indicates two important results. The first is that age group contributes negatively and significantly to the risk of having a personal injury, when we control for the other variables in the model. We dichotomized this variable, as results indicated that the youngest group of respondents (<26 years old) had a substantially higher share of personal injuries (65 %) in the last two years compared with the other age groups (22 %). The regression model in Step 8 indicates that this effect prevails when we control for other variables, including unsafe behaviours. Thus, the effect of age group on personal injuries is also due to other unmeasured factors.

The other main finding in Table 6 is that the unsafe behaviours index contributes positively and significantly to personal injuries, although it only contributes at the 10 %-level in Step 8. Unsafe behaviours contributed significantly at the 5 %-level in Step 6, but the effect only became significant at the 10 % level in Step 7, when work pressure was included in the model. This indicates the close association between work pressure and unsafe working behaviours on board the studied vessels.

The Nagelkerke R^2 indicates the amount of variance in the dependent variable that is explained by the independent variables in the models. In Step 8 in Table 6 the Nagelkerke R^2 is 0.214 which indicates that the independent variables explain 21.4 % of the variance in the dependent variable, personal injuries.

4.5.2 Unsafe Behaviours Index as the Dependent Variable

We saw above that the unsafe behaviours index predicted personal injuries in the last two years (although it was only significant at the 10 % level). In Table 7 we show results from a hierarchical, linear regression analysis, where independent variables are included in successive steps to examine the variables predicting respondents' unsafe behaviours. This is done in accordance with the second aim of the study, to examine variables influencing safety outcomes. Table 7 below presents the standardized beta coefficients. The contributions of the different independent variables on the dependent variables can therefore be compared directly. The scores on the dependent variable vary between 4 (never) and 28 (more than 20 every 100 working days/nights on board). As noted, this index measures violations and risk taking/ acceptance. The average score is 8.

Table 7: Linear regression. Dependent variable: unsafe behaviours index. Standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Age group (>26 years=2)	**.158***	.090	,059	.085	.089	.081	.026
Position/line of work (Apprentice=2)		.140	,094	.065	.065	.113	.122
Sector (cargo=1, passenger=2)			**-,280*****	**-.238*****	**-.178****	**-.159***	**-.160****
Sub-sector (Silo=2)				.139	.142*	.145*	.021
Demanding working conditions index					.212**	.064	.079
Sometimes I feel pressured to continue working, even if it is not perfectly safe						**.381*****	**.219*****
Organisational safety culture							**-.385*****
Adjusted R^2	.018	.026	.095	.105	.142	.261	.367

* p < 0.1** p < 0.05 *** p < 0.01

Table 7 provides three main results. The first is that sector contributes negatively and significantly to unsafe behaviours. The sector variable has two values (cargo=1, passenger=2). The negative contribution of this variable in the model, means that when the value is changed from 1 (cargo) to 2 (passenger) on the independent variable, the value on the dependent variable (unsafe behaviours index) is reduced. This indicates that, controlled for the other variables in the model, respondents in the passenger transport sector in average have safer behaviours, with fewer violations, risk taking/acceptance.

The second main result is that safety compromising work pressure contributes positively and significantly to unsafe behaviours, controlled for the other variables (including sector and sub-sector). This indicates that the more work pressure the respondents experience, the more likely they are to be involved in unsafe behaviours. For each increasing value on this variable, respondents' score on the unsafe behaviours index increases.

The third main result is that organizational safety culture contributes negatively and significantly to unsafe behaviours. This is the variable in the model with the strongest contribution. This indicates that the higher organizational safety culture scores the respondents report, the less unsafe are their behaviours. This result is interesting and important, as it indicates that organizational safety culture to some extent may reduce the negative impact of for instance sector (i.e. working in coastal cargo transport).

The Adjusted R^2 indicates the amount of variance in the dependent variable that is explained by the independent variables in the model. In Step 7 the Adjusted R^2 is 0.367 which indicates that the independent variables explain about 37 % of the variance in the dependent variable.

4.5.3 Organisational Safety Culture Index as the Dependent Variable

We saw above that the organizational safety culture index was the strongest predictor of respondents' unsafe behaviours. In accordance with the first aim of the study, Table 8 shows results from a hierarchical, linear regression analysis, where independent variables are included in successive steps to examine the variables predicting organizational safety culture. Table 8 presents the standardized beta coefficients. The scores on the dependent variable vary between 11 and 55.

Table 8: Linear regression. Dependent variable: organizational safety culture index. Standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Age group (>56 years=2)	**.195****	**.192****	**.171****	**.187****	**.196****	**.164****
Position/line of work (Chief engineer=2)		.046	.079	.078	.076	.100
Sector (cargo=1, passenger=2)			**.181****	.103	.068	.066
Sub-sector (Passenger line 3=2)				**.195****	**.188****	**.168****
Demanding working conditions index					-.128	.021
Sometimes I feel pressured to continue working, even if it is not perfectly safe						**-.368*****
Adjusted R^2	.032	.027	.053	.079	.088	.196

* p < 0.1** p < 0.05 *** p < 0.01

Table 8 provides three main results. The first is that age group contributes positively and significantly to organisational safety culture. This indicates that respondents over 56 years old in average rate their organizational safety culture higher than other respondents, when we control for the other variables in the model, e.g. position/line of work, sector, working conditions. We dichotomized the age group variable, when we saw that respondents over 56 years old rated their organizational safety culture considerably higher than other groups, although the variables measurement level did not indicate that dichotomization was necessary.

The second main result is that sub-sector contributes positively and significantly to organizational safety culture. We made the dichotomous sub-sector variable on the basis of the fact that Passenger line 3, was the sub-sector with the highest score on the organizational safety culture index. Table 8 indicates that working in this sub-sector is likely to contribute to a relatively high organizational safety culture level, when we control for other variables, e.g. age group. Thus, the high average of Passenger line 3, is not due to a sampling effect like age, or (our measurement of) demanding working conditions, which we also control for in the model.

The third main result is that safety compromising work pressure contributes negatively to organizational safety culture. This means that the organizational safety culture score decreases for each increasing value on the safety compromising work pressure variable. This is the variable with the strongest contribution in the model.

The Adjusted R^2 indicates the amount of variance in the dependent variable that is explained by the independent variables in the model. In Step 7 the Adjusted R^2 is 0.196 which indicates that the independent variables explain about 20 % of the variance in the dependent variable.

5. Discussion

5.1 Working Conditions and safety Culture

The first aim of the paper was to compare organizational safety culture and working conditions in Norwegian cargo and passenger transport at sea. Based on previous research, our first hypothesis was that working conditions would be relatively challenging in the coastal cargo sector, with high work pressure, little time to rest and irregular working patterns (Størkersen et al 2011, Starren et al 2008, Smith et al 2003). Our results are in line with this hypothesis. Comparing scores on the index measuring demanding working conditions, we see that the cargo sector respondents score significantly higher than the passenger sector, indicating more cargo respondents working for long work periods (>16h), more interrupted rests etc. Results also indicate higher work pressure in the cargo sector. Previous research says, however, little about working conditions in ropax.

Our second hypothesis was that we expected negative working conditions in coastal cargo to be related to low(er) safety culture scores in this sector (Nævestad 2017), while the safety culture scores in passenger transport would be relatively high (Ek and Akselsson 2005). Our results support these hypotheses. Organisational safety culture scores are significantly higher in passenger transport than in cargo transport, especially in Passenger line 3. Regression analyses indicate that high work pressure is related to lower safety culture scores, in line with Nævestad (2017), Oltedal and Wadsworth (2010) and Bhattacharya (2015).

5.2 Safety outcomes

The second aim of the paper was to examine safety outcomes (safety behaviours and crewmember accidents) of safety culture and working conditions in the passenger and the cargo sector. Our third hypothesis was that we expected a relationship between safety culture and safety behaviours (Håvold and Nesset 2009, Lu and Tsai 2010), reflecting the different safety culture levels in the passenger and the cargo sector. Our fourth hypothesis was that we also would expect a relationship between working conditions and safety behaviours (Størkersen et al 2011), reflecting the different levels in the passenger and the cargo sector. Results indicate a

significantly higher incidence of unsafe behaviours in cargo transport (up to twice as high score in Silo compared to Line 2), and the regression analyses support both the third and fourth hypothesis: organizational safety culture was the strongest predictor of unsafe behaviours, indicating that a positive safety culture is related to less unsafe behaviours. Work pressure was the second strongest predictor of unsafe behaviours. Moreover, we found that work pressure was the strongest predictor of organizational safety culture.

Our fifth hypothesis was that we expected a higher incidence of serious occupational accidents in coastal cargo than in passenger transport (Hansen et al 2002). We have not been able to test this hypothesis because of small numbers of serious injuries (11 respondents with injuries with medical attention and sick leave). Our sixth hypothesis was that we expected demographic variables (e.g. age) to influence seafarers' risk of occupational accidents (Hansen et al 2002; Jensen et al 2004). Results support this hypothesis. In accordance with previous research (Hansen et al, 2002; Jensen et al, 2004), we also found young age (<26) to be associated with occupational accident risk on board.

Our seventh hypothesis was that we expected safety behaviours to influence seafarers' risk of occupational accidents (Jensen et al 2004). Our results support this hypothesis, although the contribution of unsafe behaviours only was significant at the 10 % level in the regression model. We foundfew multivariate analyses from the maritime sector examining the influence of safety behaviour on work accidents, controlled for other important variables (age, position, nationality, type of transport). Thus, our study contributes with knowledge about the relationship between working conditions, safety culture and behaviours, as we have a broader measure of unsafe maritime behaviours (i.e. violations/risk acceptance) than is provoded in Jensen et al (2004), focusing on the use of protective equipment.

5.3 How important are framework conditions for safety culture and working conditions in the passenger and the cargo sector?

In this study, we chose to compare the coastal cargo and passenger transport sector, as we hypothesized that framework conditions (e.g. economy, competition, regulation) are different in these sectors. Thus, the third aim of the study was to discuss how safety culture and working conditions are influenced by the framework conditions of the passenger and the cargo sector. Our eighth hypothesis was that we expect relatively challenging framework conditions in coastal cargo related to economy and competition (Størkersen et al 2011). Our results on working conditions and work pressure in coastal cargo could indicate challenging framework conditions. We have, however, not been able to directly measure, neither the framework conditions, nor the relationship between framework conditions and safety culture and working conditions in the studied sectors. We compared scores on questions measuring "sector focus on safety". Results from these do not indicate significant differences between the sectors on the question: "Strong competition between companies impedes safety in my sector". This is surprising, as previous research indicates that economy and competition is a key framework condition in the coastal cargo sector (Størkersen et al 2011). The absence of a significant difference may indicate that the level of competition also is high in the passenger sector, and thus that the level of competition is high in both sectors. It is, however, difficult to compare results between sectors on this question, as it is likely that respondents in both the passenger and the cargo sector take the baseline safety level in their sector for granted while answering the survey. Thus, when respondents in passenger and cargo refer to "the safety level in their sector", the question does not take into account that the safety levels may be different in the passenger and cargo sector. Moreover, respondents' conceptions of "strong

competition" may also be different. Consequentially, this question does not provide a good measure of sector focus on safety. Results indicate a statistically significant difference between cargo and passenger transport on the question "Safety is more important than deadlines to our customers", indicating that customers in passenger transport places more weight on safety than customers in cargo transport do. This is in line with the previously mentioned contention that "passengers are more valuable than goods" (Nævestad and Phillips 2013). The difference is not statistically significant between the sector on the safety vs. price question. Generally, we conclude that most of the questions measuring sector focus on safety are ambiguous in ways that makes comparisons across sectors difficult. Additionally, few studies describe framework conditions in passenger transport. More research is needed.

5.4 Suggestions for Further Research

This study is partly motivated by a paradox reported by Hansen et al (2002), indicating that passenger vessel crews have a higher risk than coaster crews of all occupational accidents, but a substantially lower risk of serious injury and fatal accidents. Although our numbers have been too small to corroborate this result, our data may perhaps be used to evaluate Hansen et al's (2002) possible explanation to this paradox: the lower risk of coaster crews of all occupational accidents could indicate under-reporting and poorer organizational safety culture on coaster vessels. The results of the present study may perhaps support this assertion, as it indicates that crew members in the coastal cargo sector rate their organizational safety culture as lower than respondents in the passenger (ROPAX) transport sector. Our study also indicates that safety culture is closely related to working conditions, and that both are related to safety behaviours, which in turn are related to personal injuries. This was also the result when we compared Norwegian and Greek vessels (Nævestad et al, under review).

A key weakness of the present study is that we have not been able to directly measure and compare the contribution of individual framework conditions on working conditions, safety culture and safety outcomes in passenger and cargo transport. Thus, this is an important area for future research. The main contribution of the present study is that it highlights the role of organisational safety culture and the relationship between safety culture, working conditions, safety behaviours and injuries in the Norwegian passenger and cargo sectors. Our study complements previous research indicating the importance of sector, as it suggests how the influence of (unmeasured) framework conditions on safety behaviour and occupational accident involvement is mediated by organizational safety culture and working conditions.

Figure 2 illustrates the relationships indicated by the regression analyses in the present study. It is important to note that the factors in the box "Sector framework conditions" are deduced from previous research, and not studied directly in the present study.

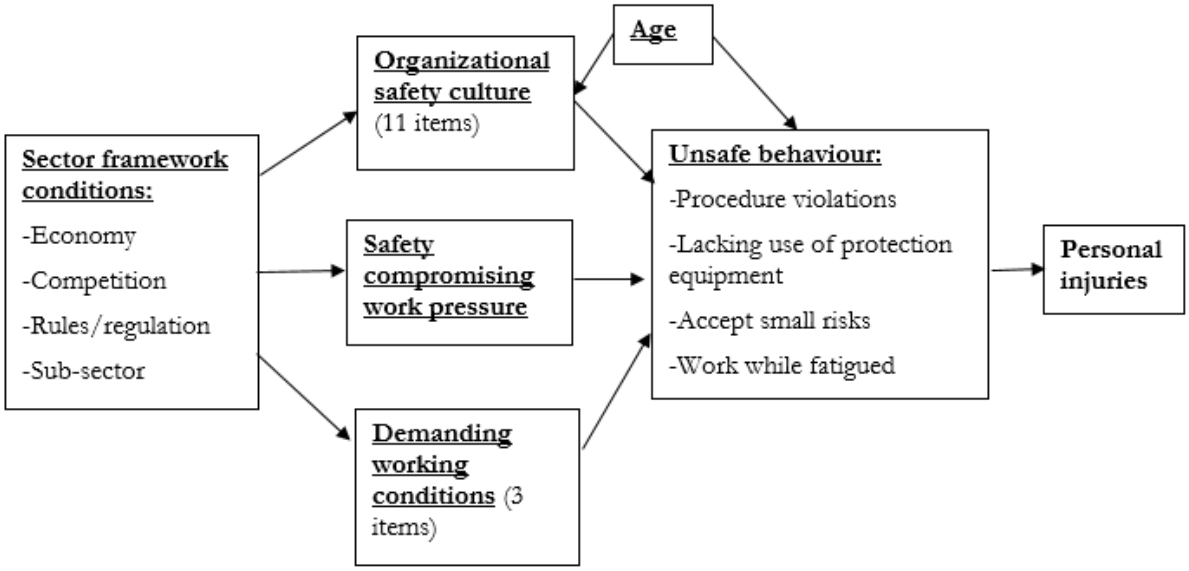

Figure 2: Illustration of relationships between risk factors related to framework conditions, safety culture, work pressure, demanding working conditions, and risk factors related to safety

Given our hypothesized importance of framework conditions, future research should develop more knowledge of the individual (and combined) contribution(s) of each framework condition, e.g. when it comes to creating a high work load and work pressure. Such knowledge is an important premise of implementing corrective measures and interventions.

Market and economy. The combination of manning level and work activities seems for instance to be important, and these factors are influenced by rules defining safe manning level and market conditions and economy influencing the economic sustainability of certain manning levels. Based on previous research it seems that the demanding working conditions for coastal cargo crews is related to the fact that they often have many port calls requiring work (before, during and after) for relatively few people on board, who have to perform several different roles and tasks, giving them little time to rest (Størkersen 2017, Starren et al 2008; Nævestad 2017). The Ropax sector on the, other hand, seems to be characterized by predefined routes, higher manning levels, more well-defined working activities and roles for people on board, probably giving more predictable work schedules and more time to rest. Previous research indicates, however, that schedules may induce work pressure and negative safety behaviours in passenger transport (Aalberg and Bye 2017; Størkersen 2018). This is probably more important in the lines of passenger transport which often have many departures (e.g. coastal ferries). Future research could examine the importance of this kind of work pressure ("stick to schedule") with the work pressure we have studied in coastal cargo. Moreover, future research could also study the importance of competition in passenger transport. We did not find significant differences between cargo and passenger transport on the variable "Strong competition between companies impedes safety in my sector". Several explanations are possible, including the one that ROPAX passenger transport also could be subject to competition, e.g. from shipping companies with vessels flying under foreign flags, employing foreign crews. This is an issue that could be examined in future research.

Rules and regulation. Manning levels are also influenced by rules defining safety manning on board vessels. Previous research also indicates that rules and regulations differ between different types of transport, suggesting that people are more "valuable" than goods, and that requirements (and thus the safety level) therefore are stricter in passenger than goods transport (Nævestad & Phillips, 2013). We have unfortunately been unable to examine the importance of safety regulation in passenger and cargo transport. This is an important area for future research, which probably also would require more qualitative approaches, e.g. qualitative research interviews with key stakeholders.

The ISM-code is an example of a relatively successful safety regulation in the maritime sector, with both positive and negative safety outcomes (Lappalainen et al 2012; Bhattacharya 2015; Størkersen 2018). Many of the shipping companies within some of the coastal cargo subsectors are small, and perhaps with lacking resources (e.g. competence, economy, time) when it comes to the implementation of and daily use of safety management systems required by the ISM-code (Nævestad 2017; Størkersen et al 2018). Moreover, given lacking resources, the safety management systems may be ill-suited for the companies' situation, the daily work tasks and activities on board, thus personnel may have a low ownership to the safety management system, and there may be a considerable gap between the formal SMS on board and the actual work practices and values. How SMS could be better adapted to the situation of small shipping companies with less resources in order to increase ISM ownership among crew on board and to increase managers' competence on organizational safety management, are discussed by Nævestad et al (2018).

Safety culture interventions. Given that it may be challenging to change framework conditions, and as our results indicate that positive organizational safety culture is related to safe maritime behaviors, future research should also examine whether and how shipping companies and vessels can develop positive organizational safety cultures. As noted, Oltedal and Wadsworth (2011) found that safety-oriented shipboard management style, performance of proactive working practices and good reporting practices contribute to a better perception of shipboard safety. It is importance to examine whether and how the impact of negative framework conditions can be reduced by developing positive safety cultures.

5.5 Methodological Limitations

Our results must be interpreted with caution. First, we have not been able to directly measure the relationship between framework conditions and safety culture and working conditions in neither of the sectors. Second, the survey on which we base our analyses only provide us with information about the frequency of events (e.g. safety behaviours), but the characteristics (e.g. severity, meaning) of the measured events may be very different in the studied sectors. For example, the questionnaire asks about the frequency on the violating of procedures, but it does not mention anything about the character of these procedures, or the severity of the violations; whether it is a "sleeping" procedure, a crucial procedure etc. This is a general weakness with questionnaire studies, indicating the importance of combining methods. The present study only relies on quantitative surveys, and qualitative data could have informed the interpretations of our results. Third, it is also important to note that our study is based on a relatively limited sample, and low numbers. It is important to remember that it only includes one passenger vessel shipping company. Thus, we compare one passenger shipping company with several cargo shipping companies, although several different passenger vessels/lines are included. We

include many vessels that we should assume have different cultures (Håvold, 2005), although they belong to the same shipping companies, but the numbers are too low for each vessel to compare. Fourth, although we see a higher share of injuries in coastal cargo, we do not have exposure measures, or a measure of risk (e.g. accidents per working hour). Fifth, we could have looked more closely at the different work processes leading to injuries on board cargo and passenger vessels. Hansen et al (2002) states, for instance, that these are very different; a point that we have been unable to follow up in the present study. Sixth, given our hypothesis that the safety levels are different in the passenger and the cargo sector, it is also possible that respondents in cargo and passenger transport take different safety levels for granted when answering, and that they therefore have different points of reference when they answer (cf. Nævestad et al 2017). This is the reason why many of the questions have absolute answer alternatives (e.g. behaviours and demanding working conditions), but it should be noted that some of the questions do have relative answer alternatives (e.g. organizational safety culture and work pressure).

6. Conclusion

The aims of the present paper were to: 1) Compare organizational safety culture and working conditions in Norwegian cargo and passenger transport at sea, 2) Examine safety outcomes (safety behaviours and crewmember accidents) of safety culture and working conditions in the passenger and the cargo sector, and 3) discuss how safety culture and working conditions are influenced by the framework conditions of the the passenger and the cargo sector. Results indicate that crew members in the coastal cargo sector experience more work pressure, and that they rate their organizational safety culture as lower than respondents in the passenger transport sector. Results also indicate that work pressure and poor organizational safety culture are closely related to unsafe working behaviours, i.e. violations, risk taking and risk acceptance, which in turn is associated with personal injuries on board. Our discussion suggests that the safety culture and working conditions of the the passenger and the cargo sector may be influenced by their different framework conditions, but we have unfortunately not been able to systematically measure and compare these in the present study. Based on this, questions for future research have been suggested.

Acknowledgements

This research was funded by the Norwegian Research Council's Transport 2025 program.

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