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ORIGINAL ARTICLE

Decreased Job Security Without Change in Safety During Hydrocarbon Industry Recession

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Economic recessions may decrease an organization's investment in maintenance, training and safety management, and may thus have a negative impact on safety. The present study examines how job security and safety changed during and after a major recession in the Norwegian hydrocarbon industry. Interviews with HSEQ officers in ship-owning companies informed our hypotheses about what effects the recession may have had on safety perception among crew members. Three cross-sectional surveys of maritime hydrocarbon workers were conducted in 2013 ($N = 829$), 2015 ($N = 444$), and 2017 ($N = 555$). The results showed that although the crew's perceptions of job security decreased from 2013 to 2017, their perceptions of safety climate did not change. Attitudes to safety and to reporting declined from 2013 to 2015, then improved from 2015 to 2017, indicating that the recession had a temporary effect on the crew's motivation and intention to comply with the safety regulations. Potential organizational and individual explanations are discussed.

Keywords: safety climate; job insecurity; recession; hydrocarbon industry; maritime workers

Introduction

Safety in high-reliability organizations results from an interplay between human reliability and the organization's allowances for optimal human performance. While an employee's motivational and attitudinal states may be a direct cause for accidents (Rothblum, 2000), these are in turn influenced by managerial decisions about work-hours and workload, requirements for competency and training provided, availability of safety equipment and procedures, and the emphasis of safety in the management's communication (Dekker, 2002; Reason, 1990). Merchant vessels have safety challenges additional to those of shore-based industries, such as long work hours, motion, vibrations, noise and tight time schedules that may lead to fatigue, poor sleep quality, and motion sickness. Compounding this, some sectors or timeframes may be particularly subject to sub-contracted work with uncertain future work opportunities.

Following a sharp decline in oil and gas prices in 2014, the offshore resupply industry had to restructure its operations and reduce operating costs. The Petroleum Safety Authority in Norway expressed concern that the cost-cutting measures could have negative impacts on health, safety and environment (Sundberg, 2016). Although a number of studies have looked at safety issues in the maritime industry (Andrei, Griffin, Grech, & Neal, 2020; Hetherington, Flin, & Mearns, 2006), few studies have examined changes in safety climate perceptions and attitudes during recession. The crew's perception of safety climate may be a relevant indicator, since several studies have associated it with safety outcomes (Christian, Bradley, Wallace, & Burke, 2009; Hetherington et al., 2006; Nahrgang, Morgeson, & Hofmann, 2007). The present study contributes to existing literature by examining whether maritime workers' perceptions of safety climate, safety attitudes, and job insecurity changed over time following loss of revenues in the hydrocarbon industry.

Recession and job insecurity

The Norwegian hydrocarbon industry faced a significant challenge between September 2014 and January 2016, when the oil prices dropped from an average of 100 USD to 30 USD per barrel (Statistics Norway, 2016). The severity of the situation was clear by the end of 2014, and the industry implemented several cost-cutting measures. Estimates from the Norwegian government indicate that nearly 1 of 4 employees in the Norwegian hydrocarbon related industries lost their jobs during the period from 2013 to 2016 (Norwegian Ministry of Finance, 2017). The industry is characterized by long-term investments and strong union worker protection. This may have led the recession to affect sub-contracted parties in particular, such as workers at on-hire offshore supply vessels.

Recessions may lead to fear of lay-offs or being made redundant. Job insecurity reflects an individual's worries about losing their current job (Sverke, Hellgren, & Näswall, 2002). Job insecurity is a subjective perception (De Witte, 2005), which can lead to an uncomfortable feeling and

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a state of powerlessness. For instance, personality and previous unemployment experiences may influence how secure a person feels in their current job (Lübke & Erlinghagen, 2014). Employees may feel insecure even if their job is objectively secure and vice versa, which can be aggravated by poor communication from the management (Burchell, 1999). It may therefore be reasonable to measure not only the perceived risk of being made redundant, but also intentions to leave voluntarily, and whether one is comfortable in one's current employment.

Unlike other types of work stressors such as conflict and time pressure, job insecurity serves as a constant stressor that cannot readily be resolved (Lee, Huang, & Ashford, 2018). Prolonged job insecurity may in fact have more detrimental effects on a worker's psychological health than actually being made redundant (Dekker & Schaufeli, 1995). Perceived job insecurity therefore constitutes a major source of stress, which may both distract from working safely, and may lead the workers to give safety a lower priority in day-to-day work decisions. Probst and Brubaker (2001) found that employees who reported high levels of job insecurity were more often involved in workplace injuries and accidents than workers who reported low job insecurity.

The fact that job insecurity perceptions are subjective indicate that it need not correspond directly to the company's financial state (Burchell, 1999; Erlinghagen, 2007; Mau, Mewes, & Schöneck, 2012), as a range of other factors and conditions can influence it. Education level, type of work and employment type have been associated with job insecurity perceptions (Anderson & Pontusson, 2007; De Witte, 2005; Erlinghagen, 2007; Näswall & De Witte, 2016). The personality trait 'negative affectivity' may lead workers with a pessimistic perspective on their job prospects in the industry to perceive their job to be less secure than other workers (De Witte, 2005). Sverke and Hellgren (2002) suggested that one should distinguish between subjective antecedents of job insecurity (perceived employability, perceived control, family responsibility and a need for security) and objective antecedents (characteristics of the labor market, organizational change and an uncertain future for the organization). In the same vein, Lübke and Erlinghagen (2014) proposed that both individual characteristics like age, gender, health and education, and context like labor market characteristics, unemployment rate and welfare-state institutions may determine self-perceived job insecurity. A review (Keim et al., 2014) found that job insecurity increased with objective predictors such as age, manual labour, organizational change, and temporary work, and with subjective predictors such as a tendency to see events as being out of one's control, role ambiguity and conflict, and organizational communication, while it was moderated by country of origin, unemployment rate and organizational change.

Safety in the maritime industry

The maritime industry is one of the most hazardous occupations in the world (Håvold & Nesset, 2009). Roberts (2002) found that seafarers were 26.2 times more likely to have a fatal accident at work compared with other British workers. There are additional work-related hazards for maritime workers in the hydrocarbon industry, as it combines threats from both the industrial and the marine environment, involving potentially volatile and noxious hydrocarbon products. Hazards in the hydrocarbon industry include uncontrolled blowouts from hydrocarbon wells, exposure to toxic substances, explosions and fire, collisions, diving accidents, and transportation accidents (Mearns & Flin, 1995). Furthermore, a high cost of interrupting operations may increase the propensity to take risks. Uncontrollable weather conditions may complicate both normal operations and emergency operations. There are thus continuous catastrophic threats for the workers on the installations, in related industries and in the resupply chain.

Due to the inherent risks in the offshore hydrocarbon industry there have been continuous efforts to reduce the risk of human or technological error. Safety management systems, worker's attitudes and awareness are critical barriers in accident prevention. Hydrocarbon companies tend to be high-reliability organizations (Laporte & Consolini, 1991) with high demand for cost effective operations and a constant focus on safety behavior. An integrated model of workplace safety based on a literature review (Beus, McCord, & Zohar, 2016) emphasized the role of 'safety climate' as one of the antecedents of safety.

According to Zohar (2000), safety climate consists of employees having shared perceptions of safety-related procedures, practices and behaviors that are rewarded and supported. Zohar (1980) proposed that safety climate delineates which kinds of behaviors that are expected, rewarded and supported through signals and patterns in the organization's safety policies, practices and procedures. Zohar (2000) further argued that the safety climate perceptions can be understood as 'procedures-as-patterns', in the sense that workers develop an understanding of the 'relative priority of safety' and are thus less focused on individual procedures. Although there is some debate about how to conceptualize and measure safety climate (Griffin & Neal, 2000; Guldenmund, 2000), it remains a coherent concept (Zohar, 2010). Safety climate may generalize to other individual constructs related to safety, such as safety attitudes and safety compliant behavior.

The balance between safety, production goals and economic growth can be a dilemma for high-reliability organizations (Mearns, Whitaker, & Flin, 2003). There is reason to assume that a significant shift in revenues and an increased focus on effectivity and cutting costs may have an impact on safety-related behavior and priorities in the hydrocarbon industry. Safety climate serves as a roadmap for workers to assess the company's assignment of priority to competing values, for instance in weighting safety against productivity goals. Thus, an aspect of safety climate is the extent to which the espoused safety priorities correspond to how they are enacted in the day-to-day work (Zohar, 2000). If companies repeatedly fail to emphasize safety, workers may assume that it is subordinate to other goals, which in turn may weaken the safety climate and lead workers to base their decision on other values than safety (Zohar, 2000, 2010). This is also emphasized in Griffin and Neal's (2000) widely

accepted distinction between safety compliance and safety participation. Safety compliance involves carrying out prescribed safety activities to maintain workplace safety (e.g., wearing protective equipment, following safety procedures) whereas safety participation consists of discretionary behaviors that likewise impact workplace safety, though often indirectly (e.g., attending safety meetings, assisting coworkers under risky conditions).

Economic determinants of safety

The interest in job insecurity and its content, causes and consequences has increased over the last decades, as new technology, economy and safety policies have led to changes and developments in the work environment (Shoss, 2017). Previous studies have indicated that organizational restructuring and job insecurity are associated with negative outcomes, such as an increase in occupational injuries and accidents (Probst & Brubaker, 2001). The pursuit of multiple goals may be a major safety threat in resource-constrained systems (Dekker, 2001). Economic pressure from the financial recession may change employment relations, in the sense that jobs are outsourced to staffing agencies or complex subcontracting chains (McDermott & Hayes, 2018). Overall, this may weaken the regulatory oversight and create hazardous work practices as contractors attempt to cut costs due to economic pressure (Quinlan, Hampson, & Gregson, 2013).

A review by Hofmann, Jacobs, and Landy (1995) supported Zohar (1980) in demonstrating that the management's commitment to safety was an important factor for maintaining a healthy safety climate during a recession. A lack of management commitment to safety issues was associated with workers appraising workplace safety as less important. A marked downturn in the maritime industry during the global economic recession in 2009 led to a growing concern that reduced revenues would lead to an increased risk of maritime accidents (Bateman, 2014), and workers are more satisfied with the safety when their company has economic success (Schneider et al., 2003).

However, there are inconclusive findings for the relationship between profit and safety risks, which may indicate that it is not subject to a single type of mechanism with linear effects. Boone and Van Ours (2006) proposed two possible types of relationships between a company's economic viability and safety. Counter-cyclical effects are when a recession causes safety problems due to redundancy processes, for example due to efficiency taking a priority over safety. On the other hand, pro-cyclical effects may contribute to uphold or increase safety standards during a recession, for example due to reduced workload per employee when offshore activity is reduced. Such pro-cyclical effects of recessions have been seen for health and safety (Catalano et al., 2011; Davies, Jones, & Nunez, 2009; Sønderstrup-Andersen & Bach, 2018). Madsen (2011) found that aviation companies that expected to break-even on profit targets were more inclined to take safety risks compared to companies anticipating high or low profit targets. Accidents are costly, and during recessions companies could be more motivated to avoid the loss of revenues caused by accidents. Moreover, the safety-record may be considered when hiring or renewing contracts for employees or for contractors, which may increase attention to safety when a recession increases competition.

Current study, hypotheses and approach

Based on the theoretical framework outlined above, we expect economic recessions to be associated with perceptions of safety and job security. The 2014 recession in the hydrocarbon industry provides a natural experiment to observe these relationships. Three extant datasets (collected in 2013, 2015 and 2017) measured safety perceptions among offshore maritime employees at time points preceding and throughout an economic recession. In order to develop and validate our research hypotheses, we performed four semi-structured interviews with experienced health, safety, environment and quality (HSEQ) officers. The interviews informed our understanding of how the ship-owning companies approached the recession in the hydrocarbon producing industry from 2013 to 2017 (as described in the Results section). The main purpose of the interviews was to set expectations for our two hypotheses about how safety factors and job insecurity had developed over time.

Our first hypothesis aimed to explore how the workers on offshore vessels perceive the safety climate, safety focus and safety attitudes over three time points. The 2013, 2015 and 2017 surveys measured before, during, and towards the end of the recession, respectively. According to the interviewees, the work to uphold and improve safety standards continued unabated during the recession. The HSEQ officers argued that the recession had not led to a decrease in safety climate or attitudes. Rather, they described that the safety-work had improved and that safety attitudes had become more internalized among the workers during this period. The interviews indicated that pro-cyclic mechanisms such as those outlined by Boone and Van Ours (2006) could have led to an increased safety awareness on board. Thus, our first hypothesis with four sub-sections will be as follows (all applying across the three time points, 2013, 2015, and 2017):

> *Hypothesis 1a: Safety climate will show a linear increase.*
> *Hypothesis 1b: Safety focus will show a linear increase.*
> *Hypothesis 1c: Safety attitude will show a linear increase.*
> *Hypothesis 1d: Reporting attitude will show a linear increase.*

According to the HSEQ officers, the economic recession forced the companies to consider several cost-reducing strategies, including staffing reductions and changes to work shift schedules. This is in line with previous literature showing that economic austerity measures have an impact on health and job insecurity (Burke, Ng, & Wolpin, 2015; Sverke et al., 2002). The crewmembers thus had reason to be concerned about their future job prospects. From this, our second hypothesis was as follows:

Hypothesis 2: Job insecurity perceptions among vessel employees will increase from 2013 to 2017.

In the interest of transparency and improving the reproducibility and robustness of the research, we made the dataset and analysis scripts available online, along with a pre-registration of the hypotheses and the analysis plan. A pre-registration (Nosek, et al., 2018; van't Veer & Giner-Sorolla, 2016) involves specifying the research question, hypothesis, sample, or analysis approach in advance of collecting the data or doing the analysis. Readers can check the public and time-stamped registration against the published article. This ensures that the research is carried out as intended, and avoids biases from undeclared design or analysis choices (p-hacking, Head, et al., 2015) or from the hypothesis specification being influenced by the results (HARK-ing, Kerr, 1998). Such an approach makes it clear to the reader what part of the research sought to confirm a-priori hypotheses, as opposed to exploring the dataset to generate hypotheses for future confirmation (referred to in the following as 'unregistered analyses'). The pre-registration and dataset for the current study are available online (https://osf.io/38agv and https://osf.io/u2zwb). The current article tests hypotheses 1 and 2 in the pre-registration, while hypotheses 3 and 4 will be tested elsewhere.

Method

Design and procedure

In order to specify hypotheses about the relationship between recession and safety, we consulted relevant literature and performed semi-structured interviews with four HSEQ officers in the maritime industry (Brooks, et al., 2015). Each interview lasted about 90 minutes and focused on the HSEQ officers' views on how the safety management work had developed in their company and in the maritime industry over the past five years. The research project's industry partner identified four ship-owning companies that stood out as having been sub-contracted most frequently over the past decade. We contacted the HSEQ officers of these companies directly, and all four of them were willing to be interviewed. If the views emerging in these interviews had been conflicting and that more informants appeared to be necessary to reach a consensus, we would have requested interviews with HSEQ officers of additional ship-owning companies. However, the views were found to be sufficiently consensual that we chose to use the four initial informants to specify our hypotheses.

The interview guide asked the HSEQ officers about the changes their company had experienced in the period 2013–2017 on seven variables (safety climate, safety focus, compliance with safety practices, safety training, safety attitudes, incident reporting attitudes, and job insecurity). Each variable had one main question and a set of optional follow-up questions. The main questions were evaluative open-ended questions to encourage the interviewees to speak freely and to gain as much information as possible. As a complement to the discussion, the interviewees were asked to draw a line graph of how the three aspects had changed from 2013 to 2015 and to 2017. This allowed us to have specific predictions from each informant, and to average across them.

The four interviews were partially transcribed and the audio recordings were subjected to a template analysis to structure the findings. A template analysis uses hierarchical coding to structure the interviews according to their content, and adapts the coding scheme to the topics revealed in the discussions (Brooks et al., 2015). Two raters initially analyzed the interviews independently, and the subsequent comparison revealed a high degree of inter-rater agreement. Minor differences in labelling of some of the themes were resolved through discussion. The template analysis revealed seven main themes that occurred in all of the interviews: (1) Recession; (2) Safety climate; (3) Safety management attitudes; (4) Safety practices; (5) Incident reporting attitudes; (6) Safety training; and (7) Job insecurity. This analysis of the interviews presented a lead-user perspective that we used to set the research hypotheses for how we would analyze the survey data. When the hypotheses for the survey data had been determined, they were formalized into a pre-registration along with an analysis plan for testing whether the hypotheses were supported (the pre-registration is available online at https://osf.io/38agv).

Three cross-sectional surveys of safety and work-environment issues were collected in 2013, 2015, and 2017. The surveys were in Norwegian. The sample consisted of all crewmembers on vessels from different ship-owning companies that were on hire for a major hydrocarbon producing company in Norway (henceforth referred to as the client company). The surveys cannot be used to identify responses from given individuals, vessels or ship-owning company, which precludes analysis of within-person changes over time. Crewmembers completed their responses during rest time on board the vessel.

All vessels received 30–40 surveys to be distributed to the two alternating shifts on board. Surveys were delivered to each vessel by company mail, bundled separately for the two shifts. Each survey was accompanied by an addressed and postage paid envelope to return the survey directly to the university researchers. Crewmembers had the option of returning the envelopes individually or collectively through regular or company mail service. There was no deadline for when to return the surveys, as the researchers did not control when the surveys were delivered to the vessels, the handling of shift rotation, and how the vessels organized the mail return. Most surveys were returned within the first four months after they were delivered to the ship-owning companies, but some surveys were also returned up to ten months after delivery. Returned surveys were manually coded to a datafile. **Table 1** provides an overview of the number of vessels and response rates across the three time points. Management encouraged crewmembers to participate in the study, but it was neither mandatory nor rewarded. The data collection was done in accordance with local ethical guidelines, and were registered at the Norwegian Centre for Research Data (www.nsd.uib.no), project numbers 32364, 40412, and 51881. The first page of the survey provided informed consent information, and specified anonymity and details about how data would be handled.

Table 1: Overview of the sampling procedure and response rates in 2013, 2015 and 2017. As 30 or 40 surveys were printed for each vessel and some vessels did not participate in the survey, the response rates are calculated from the vessels returning any surveys at all, and assumes an average actual crewing of 20 crewmembers.

	2013	2015	2017	Total
Vessels invited	62	37	58	157
Vessels responded	49	27	34	110
Surveys distributed	1860	1110	1780	4750
Valid surveys returned	832	447	543	1822
Response rate for included ships	85%	83%	80%	83%

Instruments

Paper booklets were sent out to the vessels to be filled out by the crew while at sea. All survey items were statements that the responders had to indicate the degree to which they agreed with by checking a box on a five-point Likert scale ranging from one ('completely disagree') to five ('completely agree'). The measures of safety attitude and reporting attitude were developed in discussions with two subject matter experts in the client company who had experience as captains on supply vessels in the hydrocarbon industry, and had worked for several years in maritime logistics safety management. Each year's survey was adjusted based on the response patterns and feedback from previous surveys. The number of items pertaining to safety climate and job insecurity was reduced in the 2017 data collection to prevent the survey from becoming too long when other items were added. The variable operationalizations were specified in the pre-registration in advance of the analysis (see more detail below) in order to demonstrate that they were not adjusted to change the results. A spreadsheet of all the items used are provided online: https://osf.io/gdpcq/.

Safety climate was measured in 2013 and 2015 with items modified from Zohar and Luria's (2005) Multilevel Safety Climate Scale (MSSC). The first 16 items asked about the extent to which the captain ensured the safety of crew and vessel (such as 'The captain reminds us to work safely when needed', corresponding to the group-level in MSSC). The next 16 items asked similar questions regarding safety provisions provided by the ship-owning company (such as 'The ship-owning company provides all the equipment needed to do the job safely', corresponding to the organizational-level in MSSC). Finally, there were 12 items asking about the extent to which the client company made safety provisions in their collaboration with the vessels and the ship-owning companies (such as '[The client company] reacts quickly to solve the problem when told about safety hazards', which was inspired by the MSSC, but not directly corresponding to the same items). Following the MSSC, we computed separate indices for safety climate at the three different levels for 2013 and 2015 and used these separate indexes in follow-up analyses. In order to shorten the survey, only six of the 44 MSSC items were repeated in 2017. This should be kept in mind when comparing the Safety climate scores of 2013 and 2015 to those of 2017. Across the 2013 and 2015 surveys, Cronbach's alpha for the 44 Safety climate items was 0.97, and for the six items that were tested in all surveys Cronbach's alpha was 0.83. To allow us to compare changes in safety climate across all three time points, a separate index was made for the six items used in the surveys at all three time points. This index did not distinguish between the three organizational levels, as there would have only been two items for each level.

Safety focus was measured with 18 items in all three surveys, with phrasings such as 'The captain never points out that safety focus can lead to lost operating hours' and '[The client company's] demands for efficiency leads us to sometimes break the safety procedures'. These items contained claims about the extent to which the captain, ship-owning company or client company appear to give priority to safety issues. Compared to the Safety climate variable, these items measure safety policy and communication of safety values, rather than actual safety provisions and procedures. Across all three surveys, Cronbach's alpha for the Safety focus items was 0.87.

The safety and reporting attitude items were developed in discussions with subject matter experts in order for the items to be suited for the current setting. *Safety attitude* was measured with three items in 2013, five items in 2015, and eight items in 2017. These items contained claims about the feelings, thoughts, and assumptions the workers have about how they should relate to safety in their daily work (such as 'It is not acceptable for me to take chances, even if I am the only person placed at risk'). Across all three surveys, Cronbach's alpha for Safety attitude items was 0.66, which suggests that the items may not measure a unitary psychometric concept.

Reporting attitude was measured with five items in 2013, eight items in 2015, and fourteen items in 2017. These items contained claims about how the workers use the reporting system for unwanted incidents, what importance they place on reporting, and what they assume the consequences of reporting would be (such as 'I report all situations that could have led to an accident'). The psychometric qualities of this scale in the current dataset will be further discussed in a forthcoming paper (see pre-registration: https://osf.io/z6gdq). Across all three surveys, Cronbach's alpha for the Reporting attitude items was 0.89.

Job insecurity was measured with eleven items in 2013 and ten items in 2017, but was not measured in 2015. Examples of item phrasing are 'I often think about leaving the ship-owning company' and 'I'm concerned that I may have to leave my job earlier than I would have liked to'. The first three items were related to being forced to leave one's job (developed by Hellgren, Sverke, & Isaksson, 2010), the next four items were related to intending to or anticipating to leave the job (developed for a previous survey in a maritime sample), and the final four items were related to disliking the job (developed by Brayfield & Rothe, 1951). Cronbach alpha of the eleven items across the two surveys was 0.82. Although inter-item reliability is thus acceptable, it can be discussed whether

all items validly represent the concept of Job insecurity. We think the argument can be made for this, since factors such as a recession can lead not only to one's job being made redundant, but also to increased intention and anticipation of leaving, and to decreased satisfaction with the job. Nevertheless, in order to get a more specific measure of the fear of being made redundant, we will also calculate and report results of the first three items (from the job insecurity scale of Hellgren et al., 2010), which will be used in follow-up analyses. Cronbach's Alpha for these three items was 0.75.

Sample characteristics

The sample consisted of workers employed at various ship-owning companies contracted to a hydrocarbon producing client company at the time of data collection. **Table 2** shows sample characteristics across the three data collections. The respondents were predominantly Nordic (by order of frequency: Norway, Denmark, Sweden, Iceland, Finland and the Faroe Islands). The majority of the respondents had permanent positions at the ship-owning companies, while some were temporarily employed or had apprenticeships. All crewmembers had full-time positions, working 12-hour shifts for working periods of two or four weeks on board the vessel.

Statistical analyses

While the pre-registration described that we would perform simple linear regressions, this was expanded to one-way between-groups analyses of variance (ANOVA) in order to include control variables. Separate ANOVAs were used to test the main effect of Year on Safety climate (H1a), Safety focus (H1b), Safety attitude (H1c), Reporting attitude (H1d) and Job insecurity (H2). Respondents with valid responses on at least two thirds of the items of the relevant scales were included in the analyses. All analyses were carried out in STATA, analysis scripts and dataset are both available online (https://osf.io/u2zwb/).

Results

Hypothesis 1a predicted that perceptions of overall safety climate would increase over the time points 2013, 2015 and 2017. A one-way between-groups ANOVA was conducted to compare differences in overall safety climate scores across the three time points. The results (shown as H1a in **Table 3** and **Figure 1**) indicated that there were no significant differences in perceptions of overall safety climate across the three time points.

In 2013 and 2015 surveys included the safety climate scale with items measuring the safety climate on the level of the vessel, the ship-owning company, and the client company. In accordance with the follow-up analyses outlined in the pre-registration we also tested the effect of Year (2013 and 2015) on each of these levels separately in one-way regression analyses. The changes to safety climate were small and did not reach our cut-off for statistical significance (shown as H1a[1] in **Table 3** and **Figure 1**). As an unregistered explorative analysis of the same hypothesis, we also tested the increase over time for the six safety climate items that were used across all three years. These showed a significant increase between 2015 and 2017 (shown as H1a[2] in **Table 3** and **Figure 1**). This effect should be interpreted with caution, as the analysis was not registered in advance. Although the effect in the hypothesized direction could be used to argue for one-tailed testing, one may also want to correct for multiple testing of the same hypothesis.

Hypothesis 1b predicted that Safety focus would increase across the three measurement points. This variable did not change significantly between the years (shown as H1b in **Table 3** and **Figure 1**).

Hypothesis 1c and 1d predicted that Safety attitude and Reporting attitude would increase across the three measurement points. As shown in **Table 3** and **Figure 1**,

Table 2: Sample characteristics in percentages across the three data collections.

Year	2013	2015	2017
Scandinavian nationality	86	91.4	92.9
Captains	7.4	7.5	9.2
Vessel function			
Emergency preparedness	21.6	27.3	20.5
Supply	67.2	58.6	65.1
Anchor handling	11.2	14.2	14.4
Age category			
Under 26 years	20.3	24.8	15.1
26–30 years	16.1	14.5	14.4
31–35 years	10.8	11.4	12.9
36–40 years	11.3	10	8.4
41–45 years	12.3	9.8	10.4
46–50 years	9.7	9.8	13.8
51–55 years	10.5	7.6	8.9
Over 55 years	9.1	12.1	16.2
Employment relationship			
Permanent	86.1	86.8	82.2
Temporary	4.7	3.4	9
Apprentice	9.2	9.8	8.8
Seniority			
0–2 years	47.3	33.9	18
3–5 years	24.8	29	26.3
6–10 years	16.8	26.1	30
11–20 years	8.3	8.9	20.5
More than 20 years	2.7	2.2	5.2
Department			
Bridge	31	31.1	28.7
Deck	34.4	35.7	36.1
Engine room	27.6	28.2	29.1
Galley	6.7	4.5	6.2

Table 3: Results from one-way regressions testing pre-registered hypotheses.

	2013 mean (*SD*)	2015 mean (*SD*)	2017 mean (*SD*)	*df*	*F*	*p*	Eta square
H1a: 'Safety climate' will increase	4.151 (0.616)	4.154 (0.598)	4.164 (0.745)	(2, 1820)	0.06	0.938	<0.001
H1a[1]: 'Safety climate' for captain will increase	4.277 (0.682)	4.268 (0.656)	NA	(1, 1288)	0.06	0.811	<0.001
H1a[1]: 'Safety climate' for ship-owner will increase	4.05 (0.738)	4.108 (0.68)	NA	(1, 1280)	1.9	0.169	0.009
H1a[1]: 'Safety climate' for client will increase	4.113 (0.709)	4.067 (0.719)	NA	(1, 1274)	1.2	0.273	0.007
H1a[2]: Six 'Safety climate' items will increase	4.072 (0.701)	4.066 (0.684)	4.164 (0.745)	(2, 1823)	3.37	0.035	0.004
H1b: 'Safety focus' will increase	4.266 (0.610)	4.275 (0.585)	4.303 (0.595)	(2, 1821)	0.66	0.052	<0.001
H1c: 'Safety attitude' will increase	4.033 (0.803)	3.717 (0.653)	3.9 (0.652)	(2, 1814)	27.69	<0.001	0.03
H1d: 'Reporting attitude' will increase	3.836 (0.875)	3.11 (0.564)	3.79 (0.796)	(2, 1805)	134.68	<0.001	0.13
H2: 'Job insecurity' will increase	1.876 (0.667)	NA	2.24 (0.729)	(1, 1372)	89	<0.001	0.0609
H2[1]: 'Fear of losing job' items will increase	2.066 (0.922)	NA	2.999 (1.171)	(1, 1371)	271	<0.001	0.165

Note: All displayed p values are two-tailed. Bonferroni post-hoc group comparison for H1a[2] showed that the six-item SC approached being higher in 2017 than it was in 2013 ($p = 0.055$) and in 2015 ($p = 0.092$). Bonferroni post-hoc group comparison for H1c showed that 'Safe attitude' was lower in 2013 than it was in 2015 and in 2017 ($p < 0.001$ and $p = 0.003$), and 2017 was significantly higher than in 2015 ($p < 0.001$). Bonferroni post-hoc group comparison for H1d showed that 'Reporting attitude' was lower in 2015 than in 2013 ($p < 0.001$), and higher in 2017 than in 2015 ($p < 0.001$, all post-hoc tests two-tailed).

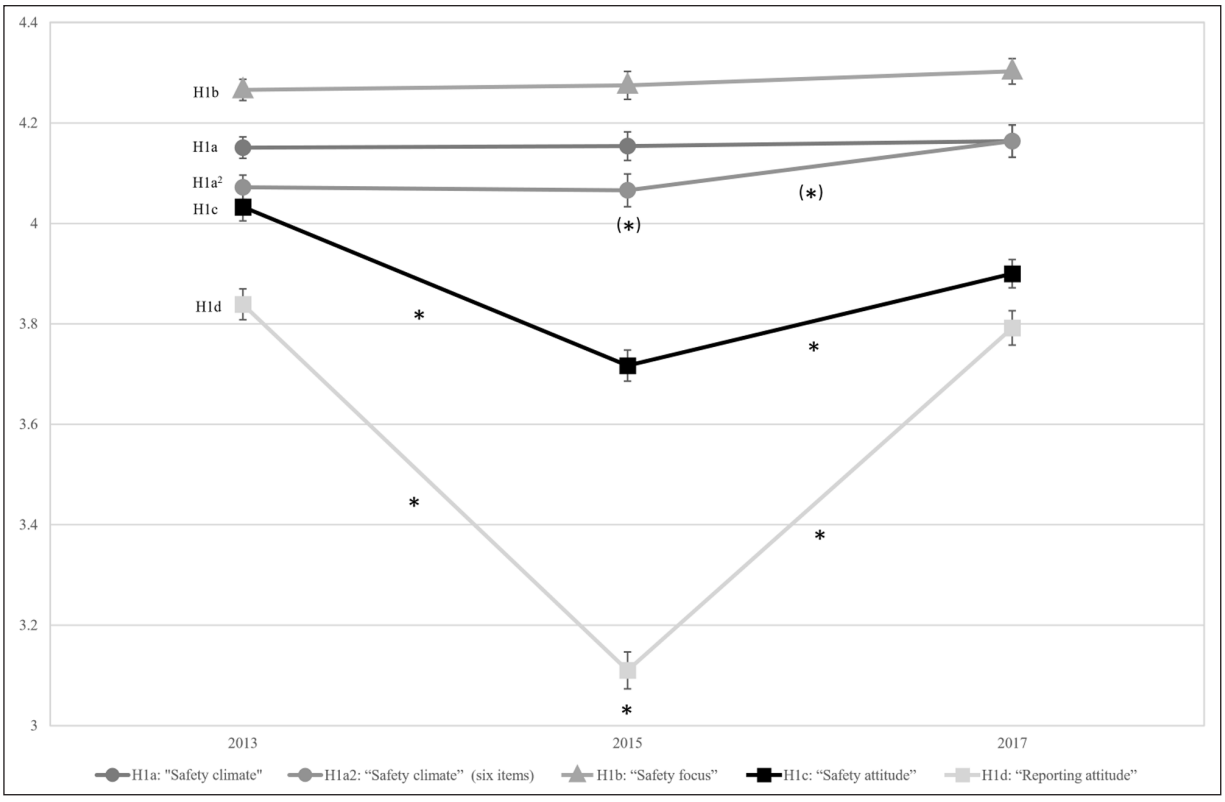

Figure 1: Change in safety climate and attitude over time. Figure 1 shows means and standard deviations for self-reported safety variables across three measurement points. Error bars show standard error of mean. Significant differences between the first and second, second and third, or first and third measurement points at $p < 0.05$ (using two-tailed Bonferroni post-hoc testing) are indicated with a star, while a parenthesized star indicates p-values significant when applying one-tailed testing as described in the pre-registration.

both variables instead decreased for the overall period (from 2013 to 2017, which was significant for H1c with two-tailed tests), and also decreased for the time-span immediately following the recession (from 2013 to 2015, significant for both H1c and H1d with two-tailed tests). On the other hand, in accordance with the hypotheses 1c and 1d, both variables increased when the economic situation improved (in the period from 2015 to 2017, significant with two-tailed $p < 0.001$ and 0.038, respectively).[1]

While the pre-registered hypotheses 1c and 1d predicted linear increases for Safety attitude and Reporting attitude, **Figure 1** indicates that the change may be polynomial. To test this, unregistered polynomial follow-up tests H1c[1] and H1d[1] were performed. For Safety attitude both linear and quadratic regressions were significant, but with larger beta values for quadratic regression (linear: $F(1,1814) = 11.07$, $p = 0.009$, quadratic: $F = 39.52$, $p < 0.001$). For Reporting attitude the linear regression was no longer significant when adding the quadratic regressions (linear: $F(1,1805) = 1.13$, $p = 0.289$, quadratic: $F = 261.71$, $p < 0.001$). This indicates that for both variables, the results are better accounted for as first declining from 2013 to 2015 and then improving from 2015 to 2017, than as a linear change across the three time points.

Hypothesis 2 stated that perceptions of Job insecurity would be higher in 2017 than in 2013. There was a significant effect in the hypothesized direction, where the variable increased between 2013 and 2017 (shown as H2 in **Table 3**). A pre-registered follow-up analysis expanded this to a two-way ANOVA with employment status as a second predictor variable (scored as 1: permanent, 2: temporary and 3: apprentice). This showed that in addition to the main effect of Year ($F(1,1238) = 20.12$, $p < 0.001$, eta squared 0.015), there was a main effect of Employment ($F(2,1298) = 7.4$, $p < 0.001$, eta squared 0.011), indicating that those with steady positions felt more secure in their jobs. There was no significant interaction to indicate that the job security developed differently for the different employment types (two-tailed $p = 0.36$).

As discussed above, the first three Job insecurity items (developed by Hellgren et al., 2010) asked about fear of losing one's job. In general, scores on this aspect were rated higher than the overall value for the variable, indicating that employees to a larger extent feared having to leave their job involuntarily, than they reported disliking or wanting to leave their job. As an unregistered follow-up of Hypothesis 2, H2[1] showed that the average score on these three items also increased between 2013 and 2017. The effect in H2[1] was larger than the effect of the pre-registered test of H2, indicating that the crew to a larger extent became more afraid of being made redundant, than the extent to which they became more intent on leaving or disliking their jobs more.

Discussion

The aim of the present study was to uncover if the 2014 recession influenced the perceptions of safety climate, safety attitudes, reporting attitudes and job insecurity among maritime workers in the hydrocarbon producing industry. The literature reviewed above (Boone & Van Ours, 2006; Boone, et al., 2011) suggested that a recession could have pro and counter-cyclical effects on worker's safety perceptions. Based on our interviews with HSEQ officers, our first hypothesis was to expect safety climate, safety focus and attitudes to linearly improve across the three measurement points.

The first hypothesis was not supported for safety climate, as the offshore vessel workers' perceptions of safety did not differ between data collections in 2013, 2015 and 2017. Neither were there significant changes between 2013 and 2015 for any of the three levels for the safety climate (i.e., on the level of the vessel, the ship-owning company, or the client company), although an unregistered analysis of the six repeated items showed an increase between 2015 and 2017. Other parts of the first hypothesis were partially supported, as safety and reporting attitudes improved from 2015 to 2017. However, this was offset by a decline from 2013 to 2015 and an overall decline from 2013 to 2017. Thus, for the most part the results did not support the expected increase in safety perceptions during the recession.

Our second hypothesis was that perceived job insecurity would increase from 2013 (pre-recession) to 2017 (amid or post-recession). This hypothesis was supported, in that perceived job insecurity was substantially higher in 2017 than in 2013. A follow-up analysis also found a main effect of the employment type, where those with temporary positions felt less secure in their jobs. Another follow-up analysis found that the effect was stronger for the items directly relating to fear of losing your job (as opposed to disliking or wanting to leave the job). In the following, we discuss these findings and their implications in more detail.

Safety climate and attitudes

Previous research on the impact of an economic recession on occupational safety in high-reliability organizations is limited and inconclusive (Boustras & Guldenmund, 2018). Our study showed that the crewmembers neither perceived the safety climate to improve over time as the HSEQ officers had expected, nor to decline as an effect of the economic hardships.

Unlike the current study, Sønderstrup-Andersen and Bach (2018) found a negative development of workplace safety following the 2008 recession in Denmark. The authors measured safety outcomes with a pre-recession survey in 2006 and a follow-up survey in 2011, and found that several of the safety activities decreased after the recession. For instance, fewer companies had prepared accident actions plans and routinely performed safety rounds in 2011 compared to 2006. The present study indicates that these findings do not necessarily generalize to the hydrocarbon industry.

The legislation and regulation of the hydrocarbon industry could mitigate a recession's negative effect on safety indicators. Offshore activity in the Norwegian sector has been strictly governed for about five decades and the Norwegian hydrocarbon producers and their subcontractors are considered to have adopted a strong safety culture (Norwegian Ministry of Labour and Social Affairs, 2018). It is possible that contextual factors specific to the industry have moderated the potential relationship

between the industry's economic hardships and safety outcomes. A continued focus on safety compliance and safety participation (Griffin & Neal, 2000) could also have produced a ceiling effect that would make it difficult to observe additional improvements.

Speaking to the complex relationship between economic factors and safety work, a qualitative study (Young & Blitvich, 2018) found no deterioration of safety performance in two industrial plants that were under major financial threat, instead finding that they had their best safety performance at the time of closure. It has been argued (Anyfantis, Boustras, & Karageorgiou, 2018) that recessions mostly affect the opportunity to buy new equipment, training and innovation. Such mechanisms may lead economic downturns to have a delayed effect, since safety systems may suffer in the long term from reduced investment in safety training and equipment. Organizations with a strong safety climate may be able to withstand changing circumstances and productivity pressure without safety practices deteriorating (Beus et al., 2016). Taken together, this suggests that the relatively short period from 2013 to 2017 may have been insufficient to observe a decay in safety climate.

The HSEQ officers we interviewed indicated that the recession had reduced the hiring of new employees in their companies, which may have been positive for safety. This corresponds to the pro-cyclical perspective, which argues that an economic decline can improve safety (Boone & Van Ours, 2006). Several studies have found improved safety (in terms of declining rates of workplace accidents and accident reports) during a recession, and conversely that safety may decline when the economy improves (Asfaw, Pana-Cryan, & Rosa, 2011; Boone & Van Ours, 2006). Fewer employees working fewer hours may contribute to a reduction in accidents and accident reports (Anyfantis et al., 2018; Boone & Van Ours, 2006; Davies et al., 2009). A stable workforce also leads the workers on the vessels to be more familiar with each other, and more familiar teams perform better than unfamiliar teams (Foushee, et al., 1986; Goodman & Leyden, 1991; Watson, Michaelsen, & Sharp, 1991; Zenger & Lawrence, 1989). It has previously been argued (see e.g. Saus, Espevik, & Eid, 2010) that maritime accidents are caused by lack of familiarity between crewmembers. As company employment policies make it more likely for more experienced employees to keep their job, a recession can lead to vessels having more competent crew that know each other better, which might further enhance the workplace safety and safety climate (de la Fuente et al., 2014, argued similarly to account for a decline in workplace accidents during a recession).

Job insecurity

Our results showed that job insecurity was perceived to be higher after the onset of the recession. Previous studies (Anderson & Pontusson, 2007; Burchell, Wilkinson, & Lapido, 2002; Erlinghagen, 2007) have linked unemployment rates to job insecurity. Sverke and Hellgren (2002) argued that organizational change in the company, such as downsizing and restructuring, as well as an uncertainty about the organization's future may lead to job insecurity. The results from our study indicates that the recession was seen by the workers as a significant threat to their jobs.

Job insecurity has been linked to negative outcomes such as lower job satisfaction, health and well-being, and increased workplace injuries and accidents (Probst & Brubaker, 2001; Quinlan & Bohle, 2009). This should motivate organizations to implement measures to decrease job insecurity even if it the current study does not show decreased safety over the same period. Open and honest communication from the management during uncertain times could strengthen the psychological contract between employer and employees, which may in turn decrease job insecurity (Keim et al., 2014). Further, social support (both at work and outside of work) can buffer the impact of psychological strains such as job insecurity (Lim, 2016).

Changes across the measured time points

Based on our interviews with the HSEQ officers, we set our hypotheses to predict a linear increase in safety indicators across the three time points. However, our results indicate that both safety attitudes and reporting attitudes declined during the recession. The recession resulted in a cost-cutting measures, vessels losing their contracts, and substantial increase in unemployment and loss of jobs in the hydrocarbon maritime industry. When the recession was on the mend at our third time point (measured in the first half of 2017) the maritime industry had completed major cost-cutting efforts. At this time the workers may have experienced that safety was again a prioritized issue, which may have led the safety and reporting attitudes to increase. This would match the pattern seen for six-item Safety climate, and for Safety attitude and Reporting attitude in our results (see **Figure 1**), although it does not correspond to the predictions of the HSEQ officers. Factors such as strict safety legislations and a high prevalence of high-reliability organizations continuously working to improve safety may have counteracted the effects of a recession to stabilize safety variables, and to increase safety from 2015 to 2017 when the effects of the recession receded. However, we will not interpret the finding further as it is an unregistered variant of the hypotheses.

We also found that job insecurity substantially increased from before to after the recession. Note that while we measured safety climate and attitudes at three time points, the experienced job insecurity was only measured at the first and last time points. It should be noted that while the hydrocarbon industry recession is typically seen to have improved by 2017, we found job insecurity to still be elevated compared to the 2013 level. This could indicate that although the economic conditions had improved by then, workers are left with the impression that their jobs were less secure than before. For all we know, job insecurity may have been higher still in the intervening mid-recession years where it was not measured.

Given a constant focus on cost saving measures and revenues in the maritime industry, one line of future

research could be to assess the effects of work demands and training standards on safety climate. Interviews with captains and HSEQ officers could provide increased psychological support and positive encouragement to employees in order to ensure participation and compliance to safety procedures in the maritime environment. A work ideology based on positive work beliefs such as the importance of centrality of work and beliefs in hard work could reduce distress among employees and be beneficial for health and wellbeing despite an continued focus on cost saving measures (Zoupanou & Rydstedt, 2019).

Strengths and limitations

Most research on the safety effects of recessions have been conducted in construction or manufacturing industries, and not high-reliability organizations such as the hydrocarbon industry. Moreover, previous studies have mainly measured safety as the number of accidents and incident reports, and not in terms of safety perceptions. This allows for a unique contribution of the present study.

It can be difficult to identify causes for change in employee perceptions over time, as many possible sources and moderators could lead to changes or stability. As Burchell (1999) argued in the case of job insecurity, there may also be other causal factors affecting safety perceptions besides the economic hardships in the industry. Our data did not allow us to follow responders over time, to say that a crewmember's job insecurity at one time caused reduced safety perception at a later time. One should also keep in mind that survey methodology is vulnerable to factors such as social desirability bias (Fisher, 1993), which may motivate responders to fulfill the employer's expected safety values, and to show improved safety values over time. Employees could also be motivated to exaggerate job insecurity to express solidarity with colleagues that experience hardships or to attempt to influence organizational policy.

The hydrocarbon industry stands out as being highly regulated and having a strong safety focus. The comprehensive legislation might work as a moderator on the relationship between recession and safety outcomes. It is possible that a similar study in a less regulated industry would have found the recession to have a different relationship to safety.

It would be beneficial for future studies to investigate the various dimensions of safety climate and identify factors that may promote safety climate and attitudes over time. It would also be useful to examine organizational mechanisms that could contribute to uphold the safety standards in the ship-owning companies during the recession. While our interviews with onshore HSEQ officers were useful, also interviewing captains may have provided additional perspective, as they are important role models for the crew, and are closer to experiencing the workplace safety issues. Given the authority the captains possess, they may be instrumental in directing the worker's attention to safety issues (see e.g. Sætrevik & Hystad, 2017; 2019).

This is among the first studies to investigate the impact of recession on hydrocarbon maritime workers' perceptions of safety and job security. Further research should examine the relationships between the variables to further establish what effects economic hardship and job insecurity can have on safety outcomes. Our studies are cross-sectional, and in order to uncover the underlying mechanisms one should perform longitudinal studies following a cohort of workers over time while controlling for possible confounding variables (see Mucci, et al., 2016, for such an approach).

Conclusion

Our results suggest that the companies were able to mitigate the negative safety impact that the recession's increased economic strains and production pressure may have had. In light of the theoretical framework of high-reliability organizations and the perspectives of the HSEQ officers in the ship-owning companies, it appears that resilient organizations are able to uphold workplace safety by maintaining prioritization of safety over immediate productivity concerns. As it is not possible for a single organization to control the fluctuations in the global market economy, the organization should build a resilient safety culture that may alleviate the impact that job insecurity may have on safety, similarly to what appears to have happened in the organizations we have studied here. This is not to say that we may ignore that the recession caused employees to worry about their jobs, as job insecurity has in itself been linked to employee psychological health (Keim et al., 2014; Lee et al., 2018). Even if a recession's safety issues may be mitigated, companies should attempt to alleviate a recession's consequences for individual well-being, e.g. by communicating more clearly about expected organizational changes (Burchell, 1999; Keim et al., 2014).

Note

[1] Note that for both Safety attitude and Reporting attitude, items were added in 2015 and 2017 to increase the measures' reliability and validity. To test whether the above effects could be caused by the change of item inclusion, we repeated the same tests on the mean of the three items that were used consistently across all three measurement points. The same effects were significant as in the tests above, but with smaller effects (Safety attitude $F = 3.72$, two tailed $p = 0.024$, eta squared 0.004, Reporting attitude $F = 98.97$, two-tailed $p < 0.001$, eta squared 0.099).

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Competing Interests

The authors have no competing interests to declare.

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