The journey from health and safety to healthy and safe

Exploring the factors that influence physical and psychological health in safety-critical industries

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ies institute for employment studies

FOREWORD

Shell's history in shipping began in 1892 and continues today, with a global fleet of around 2,000 managed and chartered ships and barges, and other floating units. On any given day, a Shell cargo is loaded or unloaded somewhere in the world every 5 minutes. Seafarers are at the heart of all these operations.

Shell Shipping & Maritime's top priority is to keep our seafarers free from harm and work towards a zero-incident industry. We openly share our safety knowledge and experience across the industry through engaging with our maritime Partners in Safety, and as a member of many international maritime organisations which aim to improve safety in the industry.

We are increasingly using technology to improve efficiency and safety performance. This includes new digital applications, such as the award-winning HiLo project, which analyses the weak signals that can be precursors to major safety events, helping users to identify accidents before they happen.

We are also looking at the human aspect of safety at sea. Over the last seven years, Shell Shipping & Maritime and Shell Health have worked together to look at the wellbeing and mental health of seafarers and the impact this has on safety.

This report forms part of that work and is one of the largest studies into seafarer wellbeing to have been carried out. It includes the review of nearly 700 academic papers, more than 50 publications, and 28 interviews with health professionals, experts in human factors, psychology and wellbeing from within Shell and other safety-critical industries.

In commissioning this work, we wanted to develop a base of research on which to build a suite of programmes that were directly applicable to seafarers and improving their wellbeing. We aim to provide practical materials for use on our own vessels, and to be shared across the maritime industry through groups such as Together in Safety.

We hope that this research and the work that stems from it will be a catalyst for further focus on safety at sea, helping to make more seafarers healthier and safer.

Grahaeme Henderson, Vice President, Shell Shipping & Maritime

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Executive summary

Introduction

The wellbeing of seafarers has a direct impact on their work and safety performance and shapes their experience of life at sea. Equally, seafarers' health and wellbeing is influenced by the conditions in which they work. Despite efforts to promote positive work conditions through initiatives such as The Maritime Labour Convention (MLC) 2006, there is a view that:

- companies require further information and understanding of how to improve the health of their seafarers;
- companies are not fully aware of the links between poor health (physical or psychological) on both safety and operational performance; and
- whilst interventions to improve health and wellbeing exist and are being implemented, they are fragmented, not aligned and therefore not optimally used.

Advances in shipping are being made in the technical space, using data and sophisticated analytics to identify 'weak signals', as precursors to major safety incidents.

The purpose of this research is to increase understanding of the factors affecting psychological and physical health in the seafaring community. This information will be used to identify data and interventions that could unlock the potential of health to improve safety at sea.

Research questions and methods

Four key questions shaped the research:

1. What factors influence psychological and physical health in seafaring, and other safety-critical industries?
2. How and in what ways do/can psychological and physical health influence adverse incidents?
3. What existing data could be collected on health-related factors that could impact on safety?
4. What interventions are there in seafaring, and other safety-critical industries, that could be implemented in order to bring about a positive impact on the psychological and physical health of seafarers?

Whilst the main aim of the work was to support the seafaring industry in its drive to improve wellbeing and safety, it also explores potential learning from other industries. The research reviewed publications from a wide range of safety-critical industries (50 high quality papers), including construction, nuclear, military, aviation, and rail. Views were sought from a multidisciplinary group of experts and practitioners, combining deep subject matter expertise with practical experience (28 interviews conducted).

Results

As the data was analysed and re-analysed, five main themes emerged where the evidence of influence was strongest:

Fatigue was commonly cited both as part of a causal chain leading to an adverse event or injury and as an outcome of other factors (e.g. noise and heat on vessels). Fatigue often emerged in relation to long working hours, changes in working hours, the nature of shift work in safety-critical industries and overtime.

The nature of the work environment describes the wider conditions on ship and the nature of the particular voyage. It includes issues such as heat and noise, vibrations and ship movement, the quality of food and access to gym and exercise facilities. It also includes length of deployment and time on board, as well as the impact of separation from their home and community.

The nature of the role emerged as a significant influence on physical and psychological health. Aspects of the role included level of autonomy, task and skill variety, and workload and job satisfaction. In some cases, rank had implications for the nature of the role that impacted health.

Socialisation encompassed the nature of social interaction and communication on board, the potential impacts of social isolation, cross-cultural differences and awareness, as well as the transient nature of crews on ship. It also included the culture and openness of communication on ship, particularly with respect to hierarchy.

Leadership sets the tone on board ships, influencing the conditions in which work takes place, the level of social support and interaction, and the broader culture.

Attempting to comprehensively explain, evidence and detail how such a complex web of health-related factors leads to a variety of incidents at sea is a herculean task, and one not seen in any other industry. However, it has been possible to develop a conceptual framework, based on existing theory and evidence, of how health-related factors may ultimately impact on adverse incidents.

Potential sources of data were explored, and analysis was undertaken in other industries through the interviews with experts. One central conclusion is that across safety-critical industries, there is a desire to increase the focus on health-related factors and collecting and using health-related data would be of huge benefit. Of the data sources identified, whilst aspects of the content mapped well onto our five themes, none of them comprehensively covered all aspects. It is also true that for some of the routinely collected and potentially most viable data sources, concerns were raised over data quality and their perceived potential value.

Through the discussions and consultations, the authors realised that there are models of human behaviour that may explain *why* the five main themes emerged so strongly. One model that struck as having particular applicability and explanatory power is the SCARF model developed by David Rock.

Over the course of the research, lots of examples of practices or situations common to the seafaring experience were found to fit well into this framework.

A number of common interventions were discussed across all of the safety-critical industries included in the research. These included: employee assistance programmes and counselling helplines; telemedicine; training regarding the importance of good nutrition and physical exercise; and methods to improve crew/team socialisation. However, there were a range of interventions discussed in other industries that could be implemented into the maritime sector that focus more on some of the psychosocial factors that were identified as being important. These interventions include peer support mechanisms (highlighted in construction, the military and aviation), line management training and development (identified in the rail industry and military) and simulation exercises (identified in aviation).

Final insights

The results highlight a clear consistency of key themes and factors identified in the literature and through the expert interviews. Although some of these are more prominent then others, each on their own, and when interacting with others, can have an impact on the physical and psychological health of employees in safety critical industries. Focussing on high quality data collection to further understand their importance in the causal chain of unintended events is recommended, which will then provide further clarification and insight into what interventions to improve wellbeing will be most effective.

01 Introduction

1.1 Workplace wellbeing

There is an accumulation of evidence to suggest that a healthy workforce, compared to an unhealthy one, is more motivated, innovative, successful, engaged and resourceful[1], and that good employee health is important for businesses, the individual and society. Dame Carol Black[2] highlighted that if organisations focussed on improving employee health and wellbeing (both physical and mental health) that this could generate organisational cost savings. Workplace health and wellbeing has recently been propelled into the policy agenda with the publication of the Taylor Review[3] with the acknowledgement that providing 'good quality work' can have implications for employee health outcomes and overall productivity, and that improving workforce health should address issues such as:

- The physical work environment;
- Mental wellbeing at work;
- Fairness, justice, participation and trust;
- Senior leadership;
- Job design; and
- Line managers' role, leadership style and training.

The Taylor report noted that the nature and content of work and individual health and wellbeing are strongly related, and consequently a more proactive approach to workplace health and wellbeing needs to be undertaken to improve the quality of work in all occupations and settings. This notion of 'good work' is not necessarily new. Waddell and Burton[4] in their evidence review reported that work and wellbeing are closely related, and that work is generally very good for an individual's health and wellbeing, but the provisos being that the nature, quality and social context of the work needed to be taken into account and that jobs should be safe and accommodating.

1.2 The health and wellbeing of seafarers

It has often been acknowledged that seafaring is a hazardous occupation, as it is a physically and mentally demanding profession in one of the most dangerous work environments: the sea[5]. As a result of the dangers in this occupation, there is a higher than average risk of accidents and fatalities compared with other high safety critical and risky occupations and sectors. Aside from this risk of physical harm, more attention is now being paid to the psychosocial risks of having a career in the maritime industry, as a result of the reported prevalence of common mental health problems (e.g. depression and anxiety) and the elevated risk and incidence of suicide, giving greater cause for

[1] Vaughan-Jones H, Barham L (2010), Healthy work challenges and opportunities to 2030, The Work Foundation, London

[2] Black C (2008), Working for a healthier tomorrow. Review of the health of Britain's working age population, Department for Work and Pensions, London

[3] Taylor M (2017), Good Work: The Taylor Review of Modern Working Practices, RSA, London.

[4] Waddell G, Burton K (2006), Is Work Good for your Health and Wellbeing? TSO, London.

[5] Iverson, RTB (2012). The mental health of seafarers, *International Journal of Maritime Health, 63,* 78-89.

concern to employers in the sector. Even in industries where work demands can be more challenging and hazardous than average, the principles of 'good work' and improved health and wellbeing still apply (and may be even more important today), and efforts must be made to weave these into existing approaches to risk management and safety culture management – especially as the risks of not doing so could lead to both human and environmental tragedy.

Recent research[6] has identified worrying levels of psychiatric problems amongst seafarers.

For example:

- In a survey of more than 1,000 seafarers (17% were UK nationals), it was revealed that more than one-quarter had screened positive for signs of depression;
- 26% of seafarers reported feeling 'down, depressed or hopeless' on several days over the previous two weeks; and
- More than 20% reported feeling down, depressed or hopeless' every day.

The research also highlighted that there may still be a culture of stigma regarding the reporting of mental health and wellbeing as:

- Nearly half of the seafarers reporting symptoms of depression said they had not asked anyone for help; and
- Although one-third said they had spoken to family/friends, only 21% said they had spoken to another colleague on-board ship, despite sometimes spending months at a time on ship.

Research from the UK Chamber of Shipping[7] indicated that suicide rates among seafarers have more than tripled since 2014. In 2015 it was reported that suicide was the cause of death in 15.3% of identified mental health cases, an increase of 4.4% from 2014. In the same report figures from the International Maritime Organization were given, indicating that the rate of suicide for international seafarers is triple that of shore workers. This is despite the Maritime Labour Convention (2006)[8] aiming to promote opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and dignity. Within the convention document, there were a number of mentions with regards to the health, safety and wellbeing of seafarers, including:

- Every seafarer having the right to a safe and secure workplace that complies with safety standards;
- Every seafarer having a right to fair terms of employment;
- Every seafarer having the right to decent working and living conditions on board ship; and
- Every seafarer having the right to health protection, medical care, welfare measures and other forms of social protection.

[6] https://www.nautilusint.org/en/news-insight/telegraph/how-are-you-feeling/

[7] https://www.ukchamberofshipping.com/latest/breaking-taboo-seafarer-mental-health/

[8] https://www.ilo.org/wcmsp5/groups/public/@ed_norm/@normes/documents/normativeinstrument/wcms_090250.pdf

Many seafarers and industry bodies share the perspective that these measures have not materially changed life at sea, including (as the reported statistics suggest) the failure to promote and sustain the physical and mental health of seafarers. Amongst industry bodies suicide does remain a particular concern, as the extent of this human tragedy remains unclear as a result of incomplete data.

As the wellbeing of seafarers has a direct impact on their work, their experience at sea and safety performance, there remains an urgent need for action to positively improve wellbeing and performance. Some industry bodies and organisations are attaching a higher priority to ensuring an improved capacity for understanding, quantifying, predicting and mitigating the risks of mental illness and suicide in both their own workers and in sub-contractors, including the rolling out of interventions.

However, in many cases the ideas are fragmented and not aligned. This means that the value of any work being undertaken is not being optimised. Additionally, there still remains a lack of understanding regarding the factors that can have an influence on the health and wellbeing of seafarers, what interventions can be implemented to improve their health and wellbeing, and the overall implications that this can have on safety and operational performance.

Consequently, there is the view that:

- companies require further information and understanding of how to improve the health of their seafarers;
- companies are not fully aware of the links between poor health (physical or psychological) on both safety and operational performance; and
- whilst interventions to improve health and wellbeing exist and are being implemented, they are fragmented, not aligned and therefore not optimally used.

Whilst these concerns about the physical and mental wellbeing of employees continue, progression has occurred in the technical shipping space with the introduction of the HiLo project, which by demonstrating what weak signals can be precursors to major safety events, has enabled the industry to work together and improve and elevate safety performance across the board. The same attention should now be focussed on the human aspect of shipping. A review of the HiLo model could potentially provide a methodology by which factors that influence human behaviour could be analysed and may shift the health and human performance landscape of the global shipping industry.

Shell has had shipping operations key to the business throughout the company's history and currently technically and/or commercially operate 2000 vessels worldwide. Through their Partners in Safety programme they work with over 400 shipping companies to improve health and safety across their operations and they are taking this to the wider shipping industry in the promotion of the Together in Safety programme.

Shell recognises the importance of the seafarers' health and wellbeing has in safety performance and commissioned this report to gain a better understanding of the factors which are key to this. This report will serve as the basis to develop programmes internally and with their partners to improve the mental and physical wellbeing of their seafarers. It will also be a reference to inform the rest of the shipping industry to increase the awareness of these very important issues and to support continuous improvement.

02 Research aims and methodology

Previous research has indicated that the health, wellbeing and safety of seafarers is concerning, with high rates of anxiety and depression being recorded, and with evidence that this can have an impact on performance whilst on ship (leading to adverse incidents). More research needs to be undertaken to understand why this occurs and what could be done to improve seafaring psychological and physical health. Additionally, further research also needs to be undertaken to understand the multiple individual, job, organisational and ship factors that can influence both physical and mental-health on-board vessels which can also affect safety. The research gaps led to the development of this current research.

The focus of this research was primarily on understanding the health and wellbeing factors that could be used when trying to determine causes of adverse incidents in the seafaring industry. That said, the research team felt it was important not only to examine current research and practice within the industry, but also to reach out to and learn from the experience and knowledge gained in other safety-critical sectors such as construction, rail, aviation, nuclear and maritime industries. Whilst these sectors are different in many ways from seafaring, there are also similarities, and the authors sought to understand and identify thinking and practice which could have potential application to seafaring.

2.1 Purpose

The purpose of this research is to increase current understanding of the factors affecting health (psychological and physical) in the seafaring community, and to investigate if these factors might then be used to identify data and interventions that could unlock the potential of health and wellbeing to improve safety at sea.

2.2 Research questions

In order to fulfil the purpose of the research, four main research questions were developed to guide the focus of the data collection. These were:

- What factors influence the psychological and physical health in seafaring (and other safety-critical industries)?
- How, and in what ways, do/can psychological and physical health influence adverse incidents?
- What existing data could be collected on (factors related) to psychological and physical health that could have predictive value?
- What interventions are there in seafaring (and other safety-critical industries) that could be implemented that could have a positive impact on the psychological and physical health of seafarers?

2.3 Research methodology

The research questions were answered using two main methods:

- A rapid review of the literature, focussing on both academic and grey literature (relevant industry bodies, think tanks etc.)
- Interviews with subject matter experts from the seafaring and other safety critical industries.

Rapid evidence review

A rapid evidence review of the current literature was undertaken to establish what evidence already exists as to what the factors that have an impact on the physical and psychological health and wellbeing of seafarers (and workers in other safety critical industries) are, and how these can have an impact on employee performance and adverse incidents. The information gained from the evidence review helped to identify and weight the most commonly reported factors.

Search terms for the rapid evidence review included:

- Seafarers and wellbeing;
- Safety critical industries and wellbeing;
- Seafarers and mental health;
- Safety critical industries and mental health; and
- Human factors and wellbeing.

For academic literature, the research team had access to online databases and journals through Brighton University, and the initial search resulted in 680 papers. The search was limited to articles written in English within a ten-year scope. Two sifts of the research papers were undertaken:

- First, by journal article title; and
- Second, by reading the journal abstract.

As a result of this sift 50 of the 680 academic journal articles were selected for review. The articles were read by members of the project team, and a data extraction table was completed for each article (See Appendix for search terms and search strategy).

Grey literature refers to materials produced outside the traditional commercial or academic publishing and distribution channels, and includes materials produced by organisations, industry bodies, Governments etc. The grey literature was reviewed in this study to verify whether the factors identified in the academic literature were similar, or whether other issues also needed to be considered. Relevant literature was identified through data searches, as well as any reports identified through expert interviews.

In total 64 additional sources were identified and reviewed including industry reports, videos, podcasts and documents provided to us by the Shell team.

Expert interviews

The research team also conducted 28 expert interviews. Experts were identified by the research team as individuals who had expert subject knowledge both within seafaring and other industries, and from a range of backgrounds, including (see Appendix for interviewee breakdown):

- Seafaring and mental health;
- Mental health and performance outcomes in other safety critical industries;
- Those internal and external to Shell who are experts in maritime health and safety;
- Psychologists;
- Academics;
- Human factors experts; and
- HR representatives.

Semi-structured telephone interviews were conducted with all experts. Each interview involved asking questions from a topic guide which were pre-determined. However the semi-structured approach allowed for further probing allowing the expert to provide further information or explanations on responses of particular interest or relevance to the study. The topic guide included questions on the following themes (see Appendix for topic guide):

- Their view on the main factors influencing the psychological and physical health and wellbeing of employees in safety critical industries;
- How, and in what way does psychological and physical health and wellbeing have an impact on performance and adverse incidents;
- What data is currently collected or could/should be collected that would be useful for predicting the psychological and physical health and wellbeing of employees to reduce the potential occurrence of adverse incidents; and
- Their knowledge on any practical interventions that are currently being implemented to improve the psychological and physical health and wellbeing of employees in safety critical industries.

The topic guide was piloted with two Shell Captains (no longer sailing) who had agreed to discuss their opinions and expertise with us. This ensured that the questions were clear, focussed on the right themes, and helped identify any gaps in the topic guide. For some experts, more focussed questions around their expertise were introduced, to gain the most from their knowledge.

Each interviewee was provided with a project brief explaining the purpose of the research, and the interviews were recorded with their consent. Interviews were transcribed verbatim and were analysed thematically by the research team. The software Atlas, xi was used in the data analysis to undertake the initial coding exercise, and to help the research team identify and label key quotes. After this initial stage, further analysis was undertaken using an iterative approach, reading, and re-reading the transcripts to identify common themes and ideas being represented. What became clear from the coding phase was that many factors were discussed, that could be captured through 5 main themes.

Additionally, one research project member undertook a ship visit to try and capture the 'lived-experience' of life on a ship, to view living and sleeping quarters, understand the work environment and to informally ask the crew who they had access to of their opinions of life and work on-board vessels. These findings were not part of the analysed research but consolidated a lot of what the experts reported in their interviews, and what was identified in the literature.

03 Results

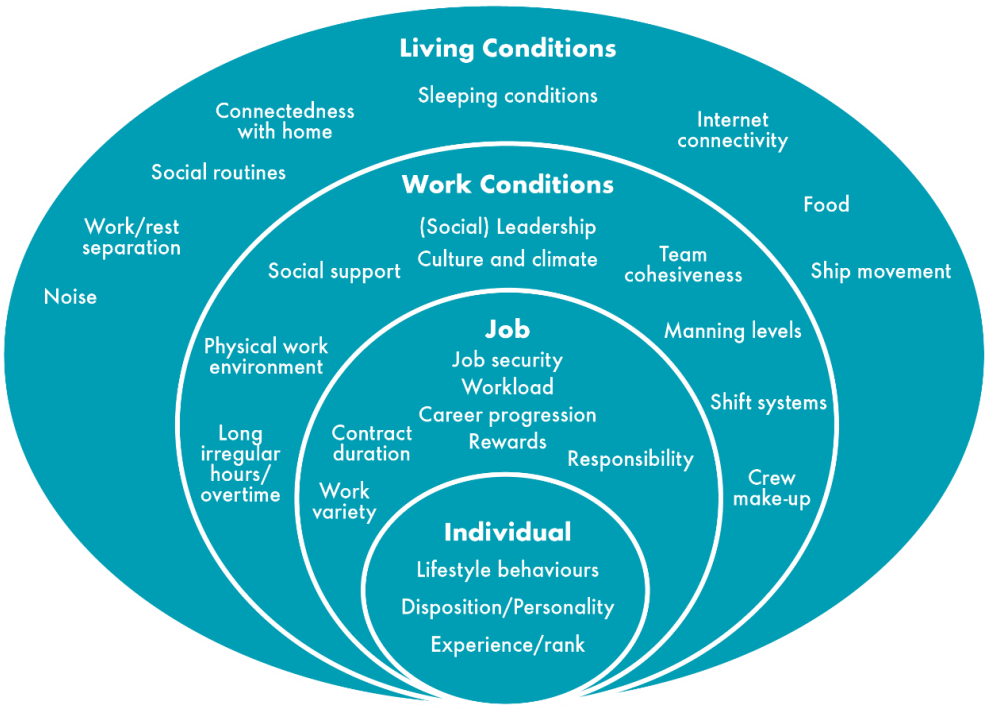
This section presents the findings of both the rapid evidence review and the expert interviews. What became clear when analysing the results from both research methods was the complexity of the causal pathways between factors that may have an impact on physical and psychological health and wellbeing and their outcomes in terms of individual wellbeing, job-related outcomes and adverse incidents. Throughout the research there was a focus both on the precursors of health and wellbeing amongst seafarers (and those working in other safety critical industries) and its impact in particular on adverse incidents and also human attitudes and behaviour that may have an impact on such incidents.

From the data, it clear was that the findings were complex, both in terms of the inter-relationships between variables and the fact that many variables were bi-directional. Additionally, many of the factors can be conceived of as an outcome or precursor, depending on the particular aims of any research or the viewpoint of the researcher. In short, there is not a single research study that could adequately trace all linkages and connections that lead to a multiplicity of adverse events. It is more the case that separate research studies explore different links which as a whole have created a compelling picture of how health and wellbeing is affected by life on a vessel and the potential impact that it has on adverse incidents. However, key themes have been identified and discussed below.

When health is referred to in the report this includes both physical and psychological health and wellbeing unless otherwise specified.

This complex web of factors has been represented in the diagram below (Figure 1). All the factors shown in the diagram have a degree of evidence to support their role in influencing health. The factors represented emerged both in the literature and the expert interviews.

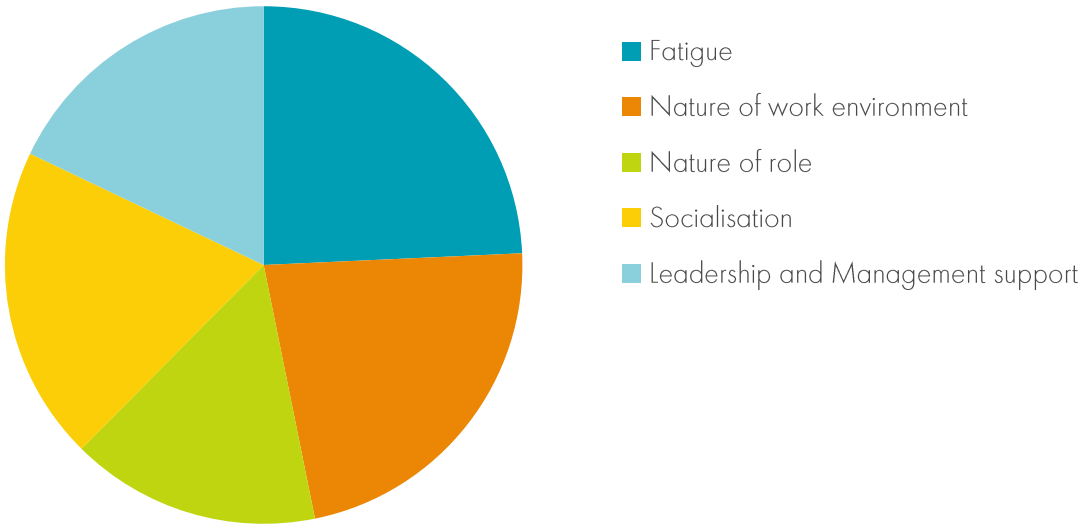
Figure 1: Factors that have an impact on health at sea



3.1 Rapid evidence review

Research from a wide range of sources, including academic and grey literature, and evidence from other safety critical industries was examined, and factors that had an impact on the wellbeing of seafarers and other safety critical industries were identified. There was also some evidence suggesting how these could have implications for employee outcomes and adverse incidents. However, it is important to note that the quality of evidence varied dependent on the source or the research methodology undertaken in the study. For example, some sources were evidence reviews, some expert opinions and others were clinical studies.

Throughout the evidence review the frequency with which certain factors were referenced in the literature was looked at to gain an indicative view of what factors were most commonly referenced. Whilst this is an interesting picture, it is not the whole picture as the strength of evidence varies across themes. The most commonly referenced psychological and physical health related factors were themed and represented in the pie chart below. A fuller description as to what each theme includes is discussed. A breakdown of the factors that are represented in each of the 5 themes can be found in Appendix 3.



Fatigue

Fatigue is a commonly cited theme in the literature as a factor that could have implications for the health and wellbeing of employees in safety critical industries, and as such could be part of the causal chain leading to an adverse event or injury. Additionally, in a number of studies, fatigue was also reported as an outcome of other factors (e.g. noise and heat on vessels). Fatigue was often discussed in relation to long-working hours, changes in working hours, the nature of shift work in safety critical industries and overtime which all contributed to increasing levels of fatigue being reported. Selected examples from the literature, where evidence is strongest highlighting fatigue as a key factor for employee wellbeing include:

- **Besikci et al.**, (2016) in a survey study of 31 seafarers working on a tanker ship reported that working at night negatively affected seafarer fatigue, and the Piper Fatigue Scale (PFS) measure used indicated that this raised the seafarers' perceptions of mental health symptoms. The study also found that working between the hours of 00:00-04:00 and 12:00-16:00 were associated with higher fatigue on the PFS measure than working other shifts.
- **Dohrman et al.**, (2017) in a systematic review of seafarer literature and fatigue reported that there were significant differences in the level of fatigue reported dependent on the time of watch, in that working at night was associated with greater fatigue. Fatigue also varied dependent on time into the shift, with higher fatigue reported at the end of the shift rather than the beginning. The type of watch systems also had an impact on fatigue, for example 6 hours on, 6 hours off was associated with higher fatigue when compared with 4 hours on, 8 hours off. Finally, seafarers who worked more than 13 hours a day had higher fatigue scores than those working fewer hours.
- **Fan et al.**, (2018) in a systematic review of the literature focussed on the rail industry reported that fatigue was associated with significant reductions in the amount of sleep that employees obtained before shifts and was also related to emotional and mental workloads. Drivers with longer work hours had higher fatigue scores, and those with work overload also reported increased fatigue. Fatigue developed more quickly during night shifts, and fatigue and sleepiness were also severe in morning shifts (not defined in the research). The report also provided evidence of the link between high levels of fatigue and cognitive disengagement from tasks leading to an increase in accident risks. Decision making and risk management abilities were challenged and impaired by fatigue.
- **Oldenburg et al.**, (2013) in a systematic review of maritime field studies about stress and strain in seafaring identified the differences in watch systems in relation to fatigue, highlighting studies indicating that fatigue was more pronounced in two-watch rather than three-watch systems and most obvious between 4-6am. The paper noted that fatigue was not dependent on seafarer age but could be associated with poor sleep quality and noise at night. Irregular working hours also had negative influences on sleep and fatigue.
- **Sliskovic et al.**, (2017) undertook a survey of Croatian seafarers to identify lifestyle factors that can relate to stress and health on-board vessels, reporting that there was higher sleep deprivation at sea than at home which had implications for reduced mental health and wellbeing, and that fatigue resulted from long working hours, which seafarers acknowledged often went unreported.

Nature of the work environment

A number of documents reviewed provided examples as to how the nature of the work environment and the conditions of work, especially for those in safety critical industries could have implications for the physical and mental health and wellbeing of employees, and potential consequences for safety incidents. Factors identified within this theme include: issues such as heat, noise, vibrations, ship movement, the quality of food, access to gym facilities etc. Also included within this theme is the length of deployment and time on board (as this increases the length of time that individuals are exposed to certain environments), and the related separation from home that some work in safety critical industries necessitates. Examples from the literature include:

- **Carmichael et al.**, (2016) explored the nature of health and wellbeing in the construction industry through qualitative interviews, finding that the physical nature of the work could result in musculoskeletal problems, and there is also a risk of exposure to harmful substances. The interviews discussed how having an unhealthy workforce could lead to a higher accident rate, with links between wellbeing and productivity also made.
- **Forsell et al.**, (2012) undertook a survey looking at the work environment and safety climate in the Swedish merchant fleet, reporting that exposure to noise at work was common for all workers, but was especially prevalent for those in the engine room. Ergonomic strain was also reported from the engine and service department employees. Hand/arm vibrations were reported, once again most commonly in the engine room and among ratings in comparison to officers. The risk of an accident was the second most commonly reported work problem (noise was the most common problem)
- **Hjarnoe et al.**, (2013) in a survey of Danish seafarers to identify lifestyle risk factors and behaviours reported that a majority of jobs were sedentary, only requiring minimal physical activity, and a high frequency of physical activity on boards was only reported by 1/3 of the respondents (this may be associated with access to facilities however). Seafarers reported a high risk of over-eating, with only 25% of those in the study reporting a normal BMI (others being overweight or obese). This led to risks of high blood pressure and other metabolic conditions that could have an impact on work behaviour and productivity.
- **Orosa et al.**, (2012) conducted a case study of safe working conditions in Spanish merchant vessels, finding that the work environment, in particular for those who work in the engine room (more noise, heat and vibrations) led to increased fatigue, and they were more likely to make errors and have accidents.
- **Patchiapanne et al.**, (2018) researched the level of job satisfaction and performance in a survey of Indian seafarers, finding that not only was the physical comfort of the work and rest space important for wellbeing, but social factors related to work were also important, especially separation from the family and not always being able to get home immediately post departure from vessels. It was concluded that the factors that inhibit this 'good work environment' could have an impact on work performance whilst on ship.

Nature of the role

Alongside the physical work environment, there is evidence to suggest that the nature of the role in terms of the level of task and skill variety, workload, job satisfaction, job security and work related burnout and the nature of the work itself has implications for the health and wellbeing of employees in safety critical industries. In some cases this is related to what rank an employee had. There are a number of examples in the literature reviewed that highlight this theme:

- **Chung et al.**, (2017) aimed to identify the role of burnout in seafarer health and wellbeing and its effect on safety. The results of the study reported that those who suffer from work-related burnout are more likely to be involved in incidents at sea, as well as those who suffer from higher levels of occupational stress, indicating that improving work related burnout is imperative to seafarer safety.

- **Mellbye et al.**, (2017) conducted a literature review and analysis on recent studies of depression and suicide in seafarers reporting that officers are the most stressed rank of seafarers as a result of the pressures that they face, their level of responsibility for the crew, the high number of working hours, time pressures and the permanently changing job demands that they face. Although the literature highlighted their work was more stressful, the study reported that 90% of suicides occurred among ratings and catering crew and so suicide risks are strongly related to seafarer rank (potentially related to highly changing job demands, stress and working hours).
- **Cantino et al.**, (2013) in research looking at the interactions between cognitions, emotions and safety culture in the context of learning from errors in the Italian Air Force found that learning from mistakes could be hampered when there was routine and habit (which could lead to reduced motivation or complacency), and this reduced situational awareness could lead to a potential 'cognitive switch-off'. The element of having a routine (associated with mindless processing) could prevent adaptive responses and impair learning.
- **Sliskovic et al.**, (2015) studied the level and sources of job satisfaction and dissatisfaction in Croatian seafarers on cargo vessels using an online survey, finding that respondents were moderately satisfied with their jobs (3.35 on a 5 point scale), with many seafarers noting that the nature and the dynamic of their job as a source of satisfaction (they are doing work that they are educated for, enjoy, is interesting and challenging), and they were satisfied with their level of pay. Common sources of dissatisfaction were related to the nature of the living and working conditions, and separation from home.
- **Yeun et al.**, (2018) used a survey of seafarers from Singapore to research the implications of job satisfaction and its effect on job performance. The results indicated that rewards, job stress, dispositional affect (e.g. locus of control, low burnout) and job characteristics (e.g. skill variety, task variety, autonomy etc.) had direct effects on job performance as measured by seafarers absenteeism, quality of work, productivity and intention to stay with the company. Job related stress was the leading cause of dissatisfaction.

Socialisation of crew

The social element of work is seen to have important implications for the health and wellbeing of employees in safety critical industries. Elements of socialisation that are included in this theme are: levels of team cohesion, the number and composition of teams and nationalities, social isolation and whether there are strong levels of communication between employees. Examples of evidence from these themes include:

- **Carotenuto et al.**, (2012) in a secondary analysis of literature discussing psychological stress in seafarers reported that seafaring is associated with mental, physical and psychosocial stressors, and the main factors contributing to this included loneliness of the crew reported on board, multi-national crews that resulted in poor communication, and limited recreational activity associated with a reduced ability to socialise with other crew members. It was suggested that interventions to reduce loneliness on board should be implemented.

- **Carmichael et al.**, (2016) when discussing the health and wellbeing in the construction industry reported that as a result of having a masculine character, stress and mental wellbeing may be more prevalent as males are less likely to admit to suffering or asking for help, and this issue of 'stigma' is still prevalent. This unwillingness to discuss such issues within teams can lead to worsening of issues (which may be work, or not work related), may lead to the worsening of mental health and further accidents whilst at work. As such, the mental health and wellbeing can become poorly understood. Additionally, the culture of subcontracting, changing teams and having transient employment means that it can become harder to monitor the wellbeing of staff, and can lead to barriers to socialisation and feelings of isolation.
- **Kim et al.**, (2018) in a survey study focussing on seafarers' quality of life reported that when there was a positive organisational culture this had a positive impact on organisational support and employee self-efficacy. Also reported was a significant relationship between self-efficacy on work related quality of life. The negative relationship between organisational support and fatigue was statistically significant, thus the authors concluded that organisational support should be the first intervention point in relieving fatigue and improving self-efficacy to have a positive impact on the quality of work.
- **Mellbye et al.**, (2017) conducted a literature review and analysis on recent studies of depression and suicide in seafarers and found that exposure to isolated working conditions is associated with a high rate of suicide for seafarers, as social isolation is associated with fewer opportunities for communication and experiences of loneliness (87% of all suicides happened on large deep-sea ships). With multi-national crews, cultural distance between seafarers is a major determinant of stress and led to communication failures and difficulties in building relationships on board. The report also found that there is a relationship between the period of cultural adjustment and the experience of mental pressure.
- **Oldenburg et al.**, (2010) in their article aiming to present the current and most important hazards in seafaring based on maritime expert opinions reported that relationships with those on board could lead to stress and psychosomatic disorders. Crew size and communication can lead to changes in workload. It was discussed that seafarers are among the most isolated demographic working group, and if they do have a health or wellbeing problem, they are also reluctant to seek help. Social isolation was reported to potentially lead to depression and despair and could be a cause of suicide. Multi-national crews were viewed as a stressor, and the resultant communication problems can lead to both work incidents and increased isolation.

Leadership and management support

There is also evidence to suggest that the role of leadership and management support to employees in safety critical industries can influence their physical and psychosocial wellbeing and their quality of life at work. In some cases, this could be related to the hierarchical nature of the work (especially in maritime). Other pieces of research report that leadership positions can result in more stress and reduced wellbeing. Examples of leadership and management support and the implications for wellbeing are:

- **Forsell et al.**, (2012) in a survey looking at the work environment and safety climate in the Swedish merchant fleet reported that 25% of the survey respondents (crew members) felt exposed to offensive actions or harassment and the most common culprit behind these actions were work leaders. This led to employees showing a reduction in their wellbeing.
- **Loggerenberg et al.**, (2017) when developing an employee wellbeing framework to facilitate a safety culture within a nuclear plant, reported that the workplace can be the main source of stress, and a factor in how engaged employees are with their work, which has implications for productivity. The report highlights the roles of leadership and management in ensuring that employee wellbeing remains positive and creating a 'safe environment' and work culture. This is achieved by supporting employees, ensuring their voice is heard, fair work conditions and reward. This will have an impact on efficient production and service efficacy.
- **Oldenburg et al.**, (2013) in their cross-sectional study assessing the risk of burnout in seafarers found that those in leadership positions were subject to greater amounts of pressure as a result of their high level of responsibility for the crew, the ship and their permanently changing job demands, which can lead to stress for other employees. The authors concluded that to improve wellbeing and reduce burnout there is a need to improve leadership communication and leadership skills and diminish leaders' stress.
- **Patchiapanne et al.**, (2018) in a survey of Indian seafarers identifying factors affecting job satisfaction and performance reported that management conflict and management style had an impact on employee satisfaction. Developing a 'good work environment' with appropriate managerial support was viewed as important to improve a seafarers' job satisfaction, to improve their work performance.
- **Yeun et al.**, (2018) in a survey of seafarers from Singapore researching the implications of job satisfaction and its effect on job performance reported that the management hierarchy have a responsibility to help seafarers cope with stress and improve their wellbeing, by building and creating a supportive working and living environment, and aim to motivate and retain seafarers to improve productivity.

3.2 Expert interviews

Interviews were undertaken with a range of experts both within the maritime industry and in other safety critical industries. The thematic data analysis was undertaken using an iterative approach (multiple members of the research team reading and re-reading the transcripts, refining and checking themes to ensure consistency and rigour). The aim of this was understand the complexity and the richness of the data captured. It became clear that this was a timely piece of research, for a number of reasons: that it sat alongside current policy discussions about the health and wellbeing of the workplace and discussing good work practices, but also as a result the knowledge of recent statistics into maritime health and the safety implications this can have indicating more needs to be done. For example:

"We've always had a government remit to look after health and safety at sea... by developing the wellbeing side, rather just looking after the basic health and safety aspects, you're looking at seafaring much more holistically, and hopefully end up with a global workforce who will be fitter, healthier... if they are mentally and physically well, their operational daily performance will be better... and hopefully we won't have so many accidents or near misses..."

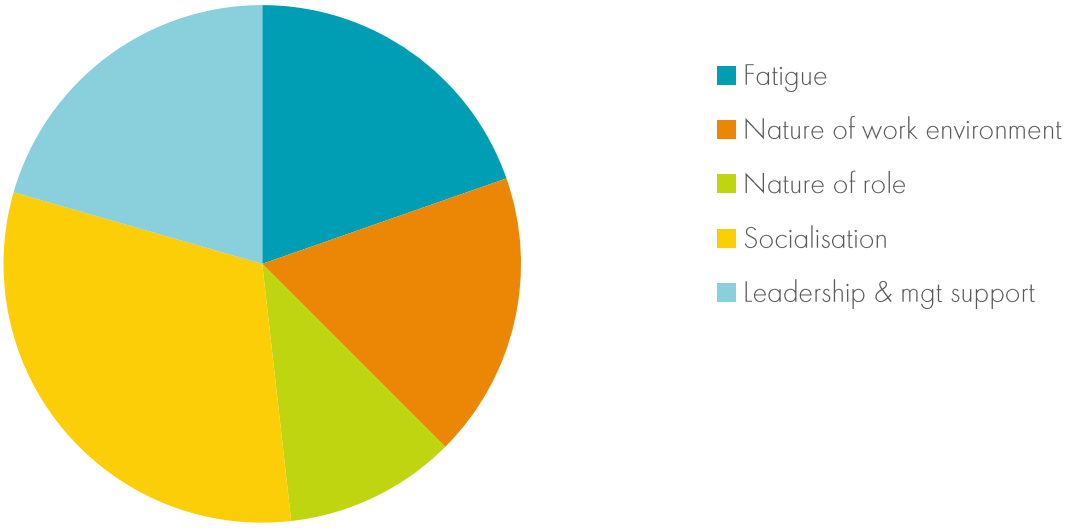
Maritime Expert

Additionally, there was recognition within the interviews, that there was often an interaction between factors (e.g. physical environment, mental health and physical health) which means focussing on mental health is now becoming increasingly important:

"We talk about mental health and making them aware of it, discussing signs and symptoms... but there is also the issue of physical health and this is still a burning issue among seafarers today"

(Deepti Mankar, Psychologist, Sailors Society)

When undertaking the analysis, a number of key themes were identified, which crossed over quite neatly with the results from the rapid evidence review. These most commonly reported factors discussed are highlighted below, followed by a more in-depth discussion of the findings. Within each theme, as with the literature reviews, a number of factors were relevant. A breakdown of these factors can be viewed in the appendix.



Fatigue

Fatigue is frequently discussed as one of the main factors that can have an impact on the health and wellbeing of seafarers and other employees in safety critical industries, which consequently lead to concerns about the safety of working practices and the risks of accidents if individuals are working in a state of fatigue.

"...regardless of how resilient someone is, if they are suffering from stress and fatigue, that will impact on decision-making and focus... there is that element of safety and security with fatigue... with length of shifts and if you have a lot to do in a short space of time."

Ed Corbett, Head of Human Factors and Organisational Performance, The Health & Safety Laboratory

One of the main factors that lead to fatigue for seafarers is shift-work, and always having to have people undertake certain tasks to ensure safe practices. However, with the nature of the working conditions, individuals may need to work beyond their shifts, or change their working patterns, resulting in disturbed rest-patterns:

"Fatigue is probably one of the greatest problems, we've got people working at all hours of the clock. You've got the watch keepers who would be, depending on what kind of ships they're on, working at night-time to sleep at day. You have people in other roles who will have to suddenly be working at night for maybe two, three hours. And then still being called at by people at shore who work normal hours the next day."

Jens Ottosen, Maritime Operations Specialist, Shell

Shift patterns are a factor to take into consideration when discussing fatigue, with the 4 hours on, 8 hours off pattern often preferred as it provides 'adequate rest time' for seafarers. However, 'rest time' does not always result in sleep, both as a result of additional work duties (overtime), and the choices individuals make about what they do in their hours off work. For example, after a shift a technical handover and other administrative procedures still need to be completed, the size of the crew has an impact on extra work and the length of working hours, and then there are individual differences in how employees could 'relax', and whether they then wish contact family, or maintain their fitness:

"I would be on rest but you physically couldn't sleep; you'd been so busy and active that it would take you a couple of hours to actually wind down, because you'd been so involved with operations. And the relaxation mechanisms you would have to learn and develop yourself... but a rest period doesn't necessarily mean sleep, especially with the internet... they're trying to communicate (with home), and therefore not having that sleep period which is very very important."

James Brown, Fleet Efficiency Coordinator, Shell

This interviewee also highlights that the possibility for relaxation in official 'rest time' is also dependent on rank in the system and how much accountability a person has on-board. In their opinion the higher the level of accountability, the greater the level of concern you have regarding the vessels performance and analysing the 'what if's' of potential courses of action. Importantly, and critically in terms of safety this 'extra work' can go unreported, and would still be considered as rest time:

"So as a Master when I was sailing, it was constant. You'd be up in the night an awful lot because you've potentially got teams, somebody you're not sure of, so you pop to the bridge every couple of hours just to check that they're being compliant..."

James Brown, Fleet Efficiency Coordinator, Shell

Tracking sleep and finding improved ways of accurately reporting the level of sleep and rest hours was mentioned, as it was highlighted that everyone has a responsibility to report how many hours they have worked and rested. If it became apparent that there is a culture of over-working on-board ship then this should be highlighted and an intervention (e.g. extra resources) could be applied. However, there were concerns about the nature and the quality of the data that is currently collected, with little indication as to how this reporting could be improved:

> *"So everybody records how many hours they've worked. And if they go into red, we get an alarm here...then we'll know and then we can intervene. Where there's always a doubt of course, is the quality of data in. So, if they're not putting in where they were over-working, then the system doesn't work. And we try to make sure they do... we don't have a physical monitor on them, and we don't have the old factory workshop click in with a time clock... so it's generally on trust and your input."*

John Evans, Global Maritime Security Manager, Manager of Maritime Emergency Response, DPA, Shell

Fatigue and the serious consequence of fatigue was also discussed with aviation experts. How flying hours are monitored in heavily regulated in the industry as a result of the serious consequences that can occur if pilots fly when fatigued. Pilots can only fly for a certain number of hours consecutively and must have rest hours in-between flying hours. Additionally, when flying across time-zones, breaks and extra compensatory time is given to allow for acclimatisation. In some organisations scheduling is electronically monitored and so managers are automatically made aware when pilots are flying too many hours and are consequently at risk of fatigue.

> *"It's known that fatigue is highly important because people who are fatigued perform badly, so there are things that can be enacted... things like crew time limitations, flight duty limits, ensuring suitable crew sizes...but importantly pilots in our organisation are allowed to say, and know to say that they are too tired to fly"*

Michael Harrigan, Consultant Occupational Physician, British Airways Health Services

The level of sleep and the consequent implications for fatigue become important when considering the implications for operational safety and performance. Respondents often spoke about fatigue resulting in reduced mental health and wellbeing and stress:

> *"So, if you sleep less, it will affect your mood... I mean, fatigue and sleep problems are in psychiatry the number one starter of bad things."*

Derek de Beurs, Senior Researcher, Dutch Institute for Healthcare Research, NIVEL

However, the effects of fatigue for safety and performance were stressed in experts from all safety critical industries. Fatigue was often associated with reduced concentration, forgetfulness, processing of information, performance, being more prone to distractions and tiredness which can lead to higher risks of an accident or incidents.

"It's when you work nights and then swap to days, which gives workers about four hours rest, and as a result they're always zombies on the rig. And I go 'hang on a minute, if this is complex machinery, why are you doing this?' And with fatigue comes stress, which compounds the situation and as a result they're not really able to operate very well... so fatigue is a really big piece... that is a big impact on the way you operate."

Robin Adlam, Managing Director, Touchstone Leadership Consulting, Ex RAF Pilot

Ways in which this could be better managed were also offered including ensuring that crew levels are sensible meaning that the potential for overtime and long-working hours are reduced, early training in maritime careers highlighting the imperative need for rest and sleep (including uninterrupted sleep to allow for full recuperation), including the links to risks if this does not occur.

Nature of the work environment

The nature of the physical environment where employees work in safety critical industries was often mentioned as a factor that can have implications for the health and wellbeing of employees.

"It's a unique way of working with a unique culture and challenges and ways of dealing with things... what works in some places, won't work in others, it's unique and no two humans are alike and will respond to things differently"

Martin Coyd, Head of Health and Safety for Construction, MACE ltd.

This is especially the case for seafarers, who unlike office workers, are unable to create a distinction between their work and home-life. It was argued that some seafarers may have more resilience to cope with this however this could still affect both physical and mental wellbeing:

"It is like being in prison. You are isolated for four months maybe... on board they have internet, so they are connected with home, but it's completely different than going home every single night. So they need a high level of resilience to do this, you couldn't just ask anybody off the street to go away to sea for three or four months... there's no break from the work environment. So it's really tough"

Dave Cudbertson, Fleet Group Manager, Shell

As a result, interviewees discussed aspects of the environment that can lead to poor wellbeing, which when considered as part of a causal chain, could have implications for outcomes such as fatigue and performance. For example, heat and noise were often mentioned, heat was often noted in relation to where individuals worked (those in the engine room were often affected more by the heat, through the very nature of their work), but noise was something thought to have implications for all staff on vessels, there being a constant level of 'white noise', but then other disrupting sounds that could wake those who may be trying to rest after a shift:

"There are also the impacts of noise, ships can be noisy. Even the quietest of ships have ventilation handling that you would not have in your own home, they are a noisy place... It is not

just the constant noise level; it can also be the change of noise. You know, doors opening or equipment starting…"

John Treeves, Technical and Operational Excellence Manager Shipping & Maritime, Shell

Interviewees also mentioned how the availability of a good and healthy diet and access to gym facilities is an important measure for physical health, but could if neglected, have implications for mental health. One interviewee associated a 'happy ship' with one that had 'good food', concluding that having good food choice is an easy way to keep morale high on board. Access to recreational spaces on board to engender a more collegiate environment was also recommended as a way the work environment could be enhanced to improve wellbeing. Some experts spoke of interventions they knew of to improve diet on board to reduce the level of over-weight and obese employees (e.g. education and training for chefs about healthy cooking, and education for crew members about making healthy food choices); that as a result of having multinational crews who enjoy different food choices and have a higher propensity for certain metabolic conditions (e.g. diabetes, high blood pressure):

"We make sure that our catering officers have information available to be able to cater and give healthier menus. Because at the end of the day you have a menu with a choice of meals…"

John Evans, Global Maritime Security Manager, Manager of Maritime Emergency Response, DPA, Shell

As the nature of seafaring meant that having a workplace that is mobile, and can operate in a variety of weathers, and is essentially their 'home' meant that if there was a change in plan or trip duration, the uncertainty that this created was a source of distress and disappointment for crew members, as they had psychologically prepared themselves for getting off the ship. Associated with this was the separation from families, and anything that extended this could also cause stress. This was also noted in a number of other safety critical industries:

"The longer the deployment, the bigger the impact this can have on family relations and mental health… there are positives and negatives for communication with family. Being in contact can ease the difficulty of being away from home, but if you are told of problems at home that you cannot do anything about this causes frustration and stress"

Nicola Fear, Professor of Epidemiology, Director of King's Centre for Military Health Research, King's College London

As will be discussed later, although internet communication on-board vessels have improved, the knowledge of what is occurring at home (and what crew members could be missing out on) was a source of stress also. The implications this could have for mental wellbeing was discussed, in terms of both reduced motivation for tasks, and the effect of stress and uncertainty on sleep:

"One of the biggest things for me was the uncertainty about when you are getting off the ship… I didn't mind when I was going to sea and I knew that I was going to be doing a long trip… you would set your mind and say 'ok, I have four months and then I am going home'. However, if you kept getting delayed and delayed…that's when it gets really difficult… you focussed intensely about getting off, and the 'what if' scenarios would deviate…"

James Brown, Fleet Efficiency Coordinator, Shell

Nature of the role

Alongside the physical environment being a factor for mental and physical wellbeing, the nature of the role in terms of task variety, the level of employee engagement and job satisfaction it provided for employees was also an issue that came under consideration, and evidence was collected indicating that this could have effects for mental wellbeing and potential safety and risk outcomes. Interviewees noted that although the physical environment is different, it did not mean that employers should neglect work or role related factors that have an impact on stress:

> *"It comes back to the six HSE factors for stress, demand, control, relationships, role design, support and so on... you need some high level overview of how people are rating some of these elements... these could be sources of stress."*
>
> **Ed Corbett, Head of Human Factors and Organisational Performance, The Health & Safety Laboratory**

The level of task variety and job demands for crew members was discussed. Once again, how taxing a role is, seemed to be dependent on both what stage of the trip the vessel was in (for example mooring and leaving ports when the risks of accidents were greater resulted in more activity and need for attention, in comparison to when the vessel were at sea for long periods of time), and what rank you are. The implications of the level of task and skill variety were mentioned in relation to both mental wellbeing and safety:

> *"If you're alone on the bridge, not having anyone to talk to... if it's late in the middle of the night and no one else is on the bridge then it could be quite lonely and quite boring as well."*
>
> **Roger Harris, Executive Director, International Seafarer's Welfare & Assistance Network**

This issue of 'task under-load' was also discussed in other safety critical industries, so is not just restricted to seafarers. For example, in the rail industry it was said that:

> *"The roles can be incredibly repetitive and boring... and I think that cognitive underload can really be a bit of a risk factor for poor mental health as well"*
>
> **Michelle O'Sullivan, Mental Wellbeing Specialist, RSSB**

A comparison was also made within aviation:

> *"I think managing distractions is a very big issue. I would think if you're out at sea for a long period of time, you could get bored. And the same thing about flying; even if it's a three-hour flight or a 15-hour flight... once you get up to 35,000 feet, the other pilots engaged and you're just watching the world fly underneath you. It's easy to become complacent; it's easy to become distracted."*
>
> **Michael Harrigan, Consultant Occupational Physician, British Airways Health Services**

For others working on vessels, their roles were perceived to be continuously changing or evolving and there was a dynamic environment where something could always be done (an opinion predominantly voiced by ex-Captains, who would have more authority and responsibility as part of their role). Ship-life was described as one where there were always work to be done – including ship maintenance, training, and when on shorter voyages entering and leaving ports more frequently, reducing the opportunity for boredom.

Employee engagement and how motivated an individual is towards their role was a topic discussed by a number of interviewees, as there is evidence from other sectors that employee engagement can have an impact on performance[9].

> *"When employees are given a purpose then their basic needs are met...we also know that work can hinder our health and wellbeing... having a job design that's just not compatible with the person's knowledge or skills that they can bring to the role."*
>
> **Ingrid Ozols, Managing Director, Mental Health at Work**

Many different aspects of employee engagement were mentioned including being valued, the ability to use all your skills, having the opportunity to make decisions, and feeling like you have voice in your role. Implications for employee practice in safety critical industries were made:

> *"If you're feeling like you're valued by the organisation, if you're feeling like your job matters, you're going to take more care of it. And we know that when your brain is under stress, your attention and your ability to function decreases. So it is creating that environment where people feel safe to express their views; where they feel valued; where they feel they've got freedom and autonomy and trusted to make their own decisions..."*
>
> **Emily Hutchinson, Occupational Psychologist, EJH Consulting**

Staff surveys were discussed by interviewees as ways through which information about employee motivation, job satisfaction and employee engagement can be collected. Some companies do undertake staff satisfaction/engagement surveys, but this is not universally the case. Barriers to implementation include relative short tenure of crews on board, and changes in crew mix meaning that results may not be indicative, and chances for interventions reduced. There is a Seafarers Happiness Index could potentially be more widely applied. Other industries do undertake 'pulse surveys'[10] which can indicate where engagement and other work-related measures may be low, and changes in work practices can then be made to improve performance.

[9] https://www.kingsfund.org.uk/sites/default/files/employee-engagement-nhs-performance-west-dawson-leadership-review2012-paper.pdf

[10] https://www.hsj.co.uk/leadership/the-new-way-for-trusts-to-improve-staff-engagement/5070283.article

Socialisation

A theme that was often mentioned was one of social interaction, social relationships and the level of communication among staff. This was seen as especially important in safety critical industries where openness for communication so that safety critical messages could be easily delivered (both up and down the line of authority), and views exchanged in a 'safe culture' could occur (whether this be complaints of just an exchange of ideas about work practice). A number of interviewees noted that in seafaring this could become more difficult, as crew members often had role specific duties and could work in isolation, and consequently finding ways for improved interaction and ensuring that there was a positive mood on board became critical:

> *"One thing you have to look at especially is how the mood is on board the vessel? How are the crew interacting with each other? On the ship you may be the only one having that particular role, and you're often working very isolated. So you don't have any colleagues as such and no natural group you are part of, you need to connect across to other areas of the ship."*
>
> **Jens Ottosen, Maritime Operations Specialist, Shell**

This was in comparison to some other safety critical industries, especially in the military, where a sense of a 'shared mission' is important for social cohesion:

> *"Where social cohesion exists in a unit, the bonds are good between personnel. Military personnel do not operate in isolation, and they rely on each other and work as part of a team. They have this shared mission, a shared risk."*
>
> **Neil Greenberg, Professor of Defence Mental Health, King's College London**

One feature of the seafaring community was the mix of nationalities that can be found on-board, and how this can change dependent on which tour you were on, and how long a tour-length could be. This meant that not only do employees not know who they would be working with, but there is uncertainty as to whether they would be the only member of their nationality on board. Interviewees spoke of a need for cross-cultural awareness and training that could help to understand different cultures and backgrounds that could help form the camaraderie necessary on board. Associated with this was how different nationalities approached hierarchy and authority on board – with some more willing to challenge authority if they had noticed a mistake or malpractice being made. This is obviously important to recognise in terms of understanding procedure and minimising the impact of errors and accidents on-board. The lack of communication or limited understanding between nationalities can also have an impact on safety if delays in communication or miscommunication occur. However, sometimes this can be difficult, and the impact on wellbeing (especially stress) was noted:

> *"When there is a mix of culture, communication becomes a bigger problem, and some cultures mix very easily with other nationalities, whereas some may not. So sometimes you can be there, and it is fine, and sometimes there can be racism on board. That also causes stress among seafarers..."*
>
> **Deepti Mankar, Psychologist, Sailors Society**

Ways in which crews could mix and socialise were mentioned. Discussions revolved around the role of alcohol, as some companies have 'dry' ships, whereas other allow moderated alcohol consumption. The provision of alcohol in safety critical industries was a point of considerable debate in the interviews, and in the maritime industry companies deal with the issue differently. The associated risks of operating complex machinery and processes whilst under the influence of alcohol was often provided as the reason for dry vessels, however others warned against the 'unintended consequences' of the bans in terms of social cohesion.

> *"...there's no doubt that alcohol in moderation is a pro-social agent... it helps people socialise... in our studies of military personnel we found that the units that had better cohesion, that got on better were likely to drink more... the positive side of alcohol is that people are likely to be honest... but in terms of blanket bans, I think you need some careful consideration about the impact of that."*
>
> **Neil Greenberg, Professor of Defence Mental Health, King's College London**

Mealtimes were also seen as opportunities for social interaction, consequently the role of good food and nutrition is not only important for physical wellbeing, but for improving socialisation. Other interventions included vessels undertaking specific events such as BBQs, quizzes and games nights.

However, changes in technology on-board vessels also have an impact on social communications. The introduction of the internet was often described as a 'double-edged sword', as it allowed for all important connection with an individual's family (although this was a cause of stress, especially if there was negative news from home), but it meant that crew often spent time in their cabins interacting externally, instead of developing internal communication:

> *"If you end up with people on a ship spending most of their time off in their cabins interacting externally rather than sitting in a recreational space interacting locally... you need the right balance between the two. Whether you're connected with someone else virtually with what's going on at home, at the end of the day you need to get on with the people around you and generate that collegiate teamwork environment for the ship to function effectively and safely".*
>
> **Bob Sanguinetti, CEO, UK Chamber of Shipping**

Other interventions to improve socialisation on board included developing peer support networks. If individuals feel isolated, there is a high correlation with mental health issues and depression, thus the association with wellbeing does need to be considered. Interviewees highlighted that an open and safe peer network may encourage open conversations about wellbeing, through which signposting to professional support such as employee assistance programmes could be mad:

> *"The power of peer support helps this as well. Having a group of champions who are willing to say 'look, we've been through this, we've actually been vulnerable."*
>
> **Ingrid Ozols, Managing Director, Mental Health at Work**

Tools to develop employee resilience were also discussed such as Shell's Resilience Programme, and mindfulness have also been encouraged. For vessels with small crews, it was suggested that having a mental health champion could be useful, especially if there is an open culture and an understanding of the importance of employee wellbeing. However, the difficulty here is related to the number of champions that need to be trained due to the nature of crew changes:

> *"On a trip with a small crew, you might train a mentor up or someone in suicide first aid or mental health first aid, which I think would be good. But then if that person is only on board six months and the crew changes, I think you have to train a lot of people up to do that. It's not impossible, but with the nature of the industry you don't have the same crew on ship, it keeps changing."*
>
> **Roger Harris, Executive Director, International Seafarer's Welfare & Assistance Network**

Leadership and management support

Achieving an appropriate on-board culture and ensuring appropriate procedures were undertaken on vessels were duties often associated with Captains and others with managerial responsibilities, which led to the role of leaders being discussed in relation to employee wellbeing. Throughout the interviews, leadership was seen to be important for issues such as appropriate communication, ensuring the effective equipment was kept up to date and that there was a safe working environment (including making sure that personal protective equipment was being used) and that staff were correctly following processes and procedures.

As a result, having the right leadership was seen as 'critical'. However, the seafaring culture was perceived to be hierarchical which could be viewed as a barrier to creating a culture of safety and building a robust team. It became clear that leadership needed to encompass both roles: developing teamwork and maintaining safety:

> *"I think it's critical, the right sort of leadership... but you need two types of leadership: you need that team leadership, but you also need hierarchical leadership when something goes wrong and someone to make the decisions... you can have someone who can work with and interact with the team and manage emergencies effectively, I do believe that you can change between the two and get the best out of the team."*
>
> **Dave Cudbertson, Fleet Group Manager, Shell**

Although some were critical about the hierarchy and the impediments that this could have for developing safety cultures, others deemed that this hierarchy was necessary – but how it is enacted was important. For example 'active leadership' or 'social leadership' were phrases that were often used, indicating that leaders should meet and interact with their crew, spend time listening to crew concerns and opinions, and show that staff and the roles that they undertake are valued. Thus, as well as managing the 'functional' aspects of crew leadership, the Captain must also understand that staff welfare and wellbeing and providing a safe work environment is also part of their role. Having a hierarchy should not impede this:

"Having a hierarchy is important... employees may consider that their view on how to do something – and of course their view is important – should be given the same weight as that of someone with relevant experience, who's been there for a long time. Certainly, on board a ship, a safety critical environment – having a hierarchy is really important for knowing in an incident who it is who should be leading a particular task... but the way they lead needs to be respectful of people's mental health."

Neil Greenberg, Professor of Defence Mental Health, King's College London

The role of leadership was also discussed in the aviation industry, which has similarities to the maritime industry in that those in command have a large role and responsibility for the safety of the crew, and as such a distinct culture can develop. If the Captain does not listen to other members of the crew, resulting in poor communication then the risks of incidents can increase. In the aviation industry 'Crew Resource Management' has been implemented to ensure that members of the crew are receptive to each other, no matter where they are in the hierarchy.

"You can get a distinct culture of gradiancy; you might have a very senior Captain who doesn't listen to the junior First Officer who is sitting alongside them... there have been a number of accidents that have occurred because of this issue"

Michael Harrigan, Consultant Occupational Physician, British Airways Health Services

How leaders are developed and what training they could need was a topic that emerged throughout the interviews. As in many industries, seafarers move up the ranks into managerial positions as a result of their technical skills (how well they are performing in their current role and meeting key performance targets), and not on the basis of their management skills. However, in safety critical industries, where leaders are tasked with supervising safety critical tasks, it was thought that a promotion criterion should be how leaders relate to colleagues who may be having troubling times or experiencing stress. If this did occur, this would provide a more holistic approach to leadership. If moving up the hierarchy remains on technical ability, then it was suggested that wellbeing training for leaders and managers is necessary for effective leadership:

In a lot of industries people progress based on their technical skill base rather than their soft skills, the caring compassion side. This comes back to good leadership again... being able to recognise when someone is struggling and being able to help... and having some conversations about these difficulties... this is an area that could be upskilled... so leaders feel more able to broach the topic and have the conversation.

Ed Corbett, Head of Human Factors and Organisational Performance, The Health & Safety Laboratory

Training for managers in soft-skills was discussed frequently in the military sector, where the importance of supervisory performance was strongly highlighted:

> *"We've carried out loads of studies looking at the perception of a team and a team leader's ability to manage, and how they relate to each other... we offer peer support training in these situations, and we get really good feedback for this... managers need as part of their promotion some of this supervisory training to have the skills they need"*
>
> **Neil Greenberg, Professor of Defence Mental Health, King's College London**

If this training occurred, then it would enhance the leader's ability to understand where stressors are, and then try to address them as best they can. Some organisations have already recognised the importance of leadership and the impact that this can have on staff wellbeing, and are developing training for leaders to support this more 'human element' aspect to their role:

> *"We're doing a piece of work in leadership learning, around supporting leaders to understand the human elements of leadership, what kind of information, support, techniques and strategies they would need to enable them to be a leader who really is able to think about the performance of their people in a human sense, including how could they support this, and create this environment of care."*
>
> **Teri Lillington, Programme Manager Health HP and Care, Shell**

3.4 Role of the individual

The themes identified in both the rapid evidence review and the expert interviews do clearly influence the health of employees in safety critical industries, which can have knock-on effects on safety and risk behaviours. However, the role of the individual was also discussed by a number of experts in interviews as important in how they perceive situations and cope with what they are faced with. For example, in terms of fatigue and physical exercise it was highlighted that individuals have the ability to decide whether they have had enough sleep or rest, whether they use the gym facilities, and what they choose to eat on board ship (which, as explored in the interviews all have an impact on both physical and mental wellbeing). Alongside this, individuals have different levels of what experts termed 'resilience' or how they coped with pressure and stress (which could be common in safety critical industries). In this case, how individuals react and respond to certain situations (and in some case influence them) could have an impact on their behavioural and job-related performance and consequently on the occurrence of adverse incidents.

> *"If you carry out a root cause analysis of an incident looking at who was doing what, their training, their skill base; you also should be looking at what the level of psychosocial stresses that people involved in that task were subject to at the time, what was the likelihood or possibility that that person may have been suffering either temporary but understandable distress or may have been psychiatrically unwell. An analysis of the psychosocial stressors affecting the*

key people is vital in any human factors analysis. Making the assumption that everyone involved in an incident is mentally well and consequently functioning well is highly likely not to be true."

Neil Greenberg, Professor of Defence Mental Health, King's College London

The role of the individual was also discussed in terms of investigations into adverse incidents and the causal pathway, questioning the factors that resulted in an incident; for example, if an individual was appropriately trained for a role, or did they act in a non-compliant manner wilfully? However, as the evidence has indicated, there are a range of complex interactions that can lead to an incident, and so trying to collect data or understand the relative importance of each factor can be difficult:

"Humans are humans, it is not the machine that makes the error, it is human factors that result in the error. That is generalist but if you pull back any incident far enough, there will be a person involved somewhere. People make decisions and sometimes they make bad decisions. The influences on why they make those bad decisions, there's a multitude of them. And within that multitude will be mental wellbeing, but it doesn't mean that's the only factor."

John Treeves, Technical and Operational Excellence Manager Shipping & Maritime, Shell

3.5 Health and adverse incidents

Throughout both the rapid evidence review and the expert interviews examples were provided where the impact of these factors on both mental and physical health and wellbeing, could along the causal chain of interacting factors lead to adverse incidents. There are various models in the Human Factors literature on accident/incident causation, there is no single 'correct' model[11]. The Swiss Cheese or latent failure model was developed by James Reason in 1990[12]. In that context poor mental health and the factors influencing health and wellbeing, can be seen as a latent failure in the system. An incident is caused when latent failures "line up". Control theory (Rasmussen, 1997)[13] posits that accidents happen when component failures, external disruptions or interactions between components of the system (such as people or machines) are not adequately handled. It is the complex interactions between components that result in incidents. Poor mental health often results in greater variability of human performance, and interactions that exceed control boundaries thus resulting in an incident. Resilience engineering represents another way of thinking about incidents and "error". Accidents do not represent a breakdown or malfunction of normal system functions, but adaptions necessary to cope with real world complexity. In that sense, poor mental health reduces the cognitive buffer and flexibility that

[11] See David Woods, "Behind Human Error", 2nd edition, Ashgate.

[12] Reason J. Human error. New York: Cambridge University Press; 1990

[13] Rasmussen J, (1997), Risk management in a dynamic society 'a modelling problem', Safety Science, 27 (2-3), 183-213.

people have to cope with unanticipated events and complexity in their work, thus making accidents more likely to occur.

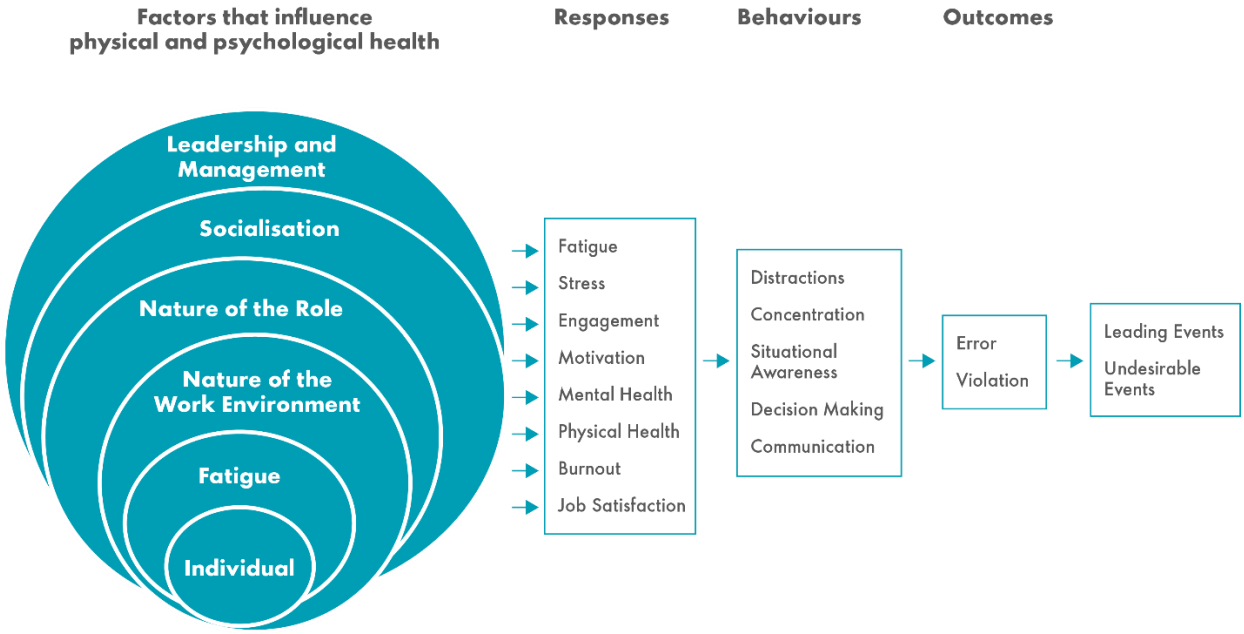
In 'Evaluation of Human Work' (Wilson and Corlett, 2005)[14], a model is presented that shows how the external environment and organisation drives constraints, goals and other factors that have an influence on the nature of the tasks that people perform. It also highlights the two-way link between wellbeing and performance, and other factors such as how the design of displays, controls, communication, and so forth can affect primary inputs and outputs of people at work.

Attempting to comprehensively explain, evidence and detail how such a complex web of factors that can have implications for physical and psychological health and how this leads to a variety of incidents at sea is a herculean task, and one not seen completed in any other industry. However, it has been possible to develop a conceptual framework, based on the research evidence from these findings, of how health-related factors may ultimately have an impact on adverse incidents. The authors have presented this conceptual framework diagrammatically below (Figure 2).

This conceptual framework, based on the evidence collated during this project, illustrates how the factors that influence physical and psychological health, could lead to human responses (for example how stressed, engaged, fatigued they are). These responses can then lead to a range of behavioural outcomes, for example the decisions someone chooses to make, how an individual respond to the distractions, or how an employee communicates to others. These responses could then lead to errors or violations, which result in the leading or undesirable events. This framework draws on academic theoretical models as discussed above but requires further data to verify the links inferred from the current research.

[14] Wilson, JR, Corlett, N (2005), Evaluation of Human Work, 3rd Edition, Taylor and Francis: Florida

Figure 2: How the factors that influence physical and psychological health could have an impact on adverse incidents



3.6 Sources of data

One of the aims of the research was to investigate what human factor data is already being collected or could be collected that could be used as a predictive value to help reduce the level of unintended events or accidents on-board. During the course of the research (both the evidence review and expert interviews) a number of data sources were identified that could provide information that would map onto health-related factors.

A number of data collection tools were identified in the rapid evidence review. The most notable included:

- The Seafarers Happiness Index[15], an index that was designed to monitor and benchmark seafarer satisfaction levels by asking 10 main questions on: contact with family, access to shore leave, food, salary, ability to keep fit on board, training, crew interaction, workload and quality of welfare facilities ashore. Although this could provide a barometer regarding employee satisfaction of life at sea, important issues identified through the evidence have not been included, for example perception of the safety culture, communication, leadership and management and work-related factors.
- The International Seafarers Welfare Assistance Network (ISWAN)[16] produces reports on seafarer wellbeing based on the call logs from those who have contacted their advice line. Calls are categorised according to four main themes, each which has a number of sub-categories: Living conditions (diet, fatigue, physical abuse, fighting, physical environment, drinking water);

[15] https://www.missiontoseafarers.org/seafarershappiness

[16] https://www.seafarerswelfare.org/

Psychological health (discrimination, anxiety/stress, depression/loneliness, mental illness); Physical illness and injury and Humanitarian issues. Although this provides some data of issues occurring at sea, the initial problem seafarers call about may be masking a range of underlying issues that are not discussed, and once again a range of work-related factors important aspects of the psychosocial environment are not considered.

- The Maritime and Coastguard Agency[17] used CHIRP near miss reports between 2003-2015 and identified the 'deadly dozen' – the 12 most frequent people related factors that led to the near miss. These 12 factors are: situational awareness; alerting; communication; complacency; culture; local practices; teamwork; capability; pressure; distractions; fatigue and whether somebody was fit for duty. Although these factors include aspects of the psychosocial work culture that match the current research findings, other potentially important issues such as leadership and management and job satisfaction/employee engagement are not specifically captured, and the way in which the calls or reports are categorised is unclear, and may need further exploration.

[17] https://www.chirpmaritime.org/

The table opposite provides a commentary on these, and other data sources that were often cited in the evidence review and interviews:

Data source	Data elements	Commentary
Seafarers Happiness Index	Ten main questions covering satisfaction with: contact with family; shore leave; food; salary; ability to keep fit on board; training; crew interaction; workload; quality of welfare facilities ashore.	A useful barometer of satisfaction with life at sea. Important issues identified through the evidence base are not covered, e.g. leadership, safety culture, crew communication etc.
ISWAN Advice Line Logs (The International Seafarers Welfare Assistance Network)	Calls to the advice line are categorised into four areas: living conditions; psychological health; physical illness and injury; humanitarian issues.	Useful data on most common issues arising through life at sea. Further exploration is needed of how calls are categorised. Important work-related factors impacting health are not covered, e.g. leadership, level of autonomy in role, etc.
The Deadly Dozen (The Maritime and Coastguard Agency)	Based on near miss reports between 2003-2015.	Ways that near miss reports have been categorised would require further exploration. Data are necessarily derived from incidents where things have gone wrong, rather than a focus on data related to positive factors that support health and wellbeing.
Employee (engagement) surveys	These tend to cover aspects of leadership, culture, sense of control and a whole range of work-related factors important for health.	Whilst potentially useful, such surveys are either not carried out with seafaring staff and/or not carried out routinely in seafaring organisations.
Ship personnel/ operational data	Includes data on: work/rest hours; delays in replacement of personnel; unplanned extensions of duties; manning levels; diversions/ changes of planned route.	Useful elements that map onto some (sub-) elements of the five themes. Quality of data in some cases is considered to be sub-optimal, e.g. work/rest hours.

One key conclusion is that across safety-critical industries, there is a desire to increase the focus on psychological and physical health factors and collecting and using data related to the main factors (and underlying themes) identified would be of huge benefit. That said, it seemed that this was unrealised potential, with scant evidence of the collection and use of high-quality health-related data.

Of the data sources identified, whilst aspects of the content mapped well onto our five themes, none of them comprehensively covered all aspects. It is also true that for some of the routinely collected and potentially most viable data sources, concerns were raised over data quality and their perceived potential value (the collection of work and rest hours was often cited as an example). It would be worth considering a more detailed piece of work to explore which pieces of data map onto the five themes identified here and could be most widely collected and offer the greatest potential for achieving a sufficient quality-level of data.

Experts that were interviewed also reported a range of data sources that are currently collected on vessels that could be useful evidence measures (however, these were often caveated within the understanding that the quality of the data should be taken into account). Human factor data was thought to be a helpful inclusion when looking into unintended events as that could provide a more holistic account of the situations leading up to events. However, once again the quality of the data would be needed to be taken into account as 'too much information provides the same problem as bad data', so the emphasis from many experts was to be able to extract sufficient data of good quality.

Data points mentioned throughout the interviews included:

- Data on hours worked and hours of rest
- Medical data, how many people reported themselves as sick or saw the medical officer on board
- Sickness absence
- Number and rank of crew on board (including age profile)
- Number of accidents and incidents
- Commercial and physical performance of the ship
- Unplanned extension of duties
- Time at sea
- Time in ports

However, other data points especially in relation to human factors were suggested as potential important pieces of information to collect that could have predictive value. These included:

- Internet connectivity, and periods of internet downtime
- Level of social interaction on board (e.g. frequency of team events)
- Number of calls made to whistle-blowers, or designated person ashore
- Use of correct protective equipment
- Temperature, heat and noise on vessels

- Food wastage
- Maintenance/repairs reports

Some interviewees when discussing what human factor information would be helpful discussed the type of questions they would ask if conducting a root cause analysis of accidents or near misses on-board – and many of the sources were related to the psychosocial work environment:

- How many hours have they worked when the event happened?
- How many hours of sleep have they had?
- What pressures were they experiencing to get the task completed?
- Who were these pressures from?
- Did they have the right level of support?
- Were there any other distractions?
- What were the working conditions like?
- Did you have too much work to be doing?

3.7 Why did the five themes emerge most strongly?

Throughout the research it was recognised that there are a number of models of human behaviour that can explain *why* the five main themes emerged so strongly. One model that struck as having particular applicability and explanatory power in this research is the SCARF[18] model developed by David Rock. The model is developed around three central ideas:

- The brain treats many social threats and rewards with the same intensity as physical threats and rewards;
- The capacity to make decisions, solve problems, and collaborate with others is generally reduced by a threat response and increased under a reward response; and
- The threat response is more intense and more common and often needs to be carefully minimized in social interactions.

The model is made up of five domains:

1. Status – our (perceived) relative importance to others
2. Certainty – our ability to predict the future
3. Autonomy – our sense of control over events
4. Relatedness – how safe we feel with others
5. Fairness – how fair we perceive the exchanges between people to be

[18] http://web.archive.org/web/20100705024057/http://www.your-brain-at-work.com:80/files/NLJ_SCARFUS.pdf

These five domains have been shown in many studies to activate the same reward circuitry that physical rewards activate, and the same threat circuitry that physical threats activate. Understanding these domains can help individuals and leaders navigate the social world of work. Practices and policies can then be developed that reduce perceptions of threat and increase perceptions of reward.

Over the course of our research, the authors came across lots of examples of practices or situations common to the seafaring experience that fitted well into this framework. For example:

- 'status', corresponds neatly with the theme 'leadership and management support' including the elements of management hierarchy, crew status and the level of supervisory support;
- 'certainty' corresponds with elements of fatigue (i.e. irregular work hours, overtime) and also the nature of the work environment such as length of deployment;
- 'autonomy' can relate to the nature of the role including sense of control of task variety, skill variety, work monotony and job design;
- 'relatedness' links to socialisation and factors such as co-worker support, team cohesion, multi-national crews and the safety culture on board; and
- 'fairness' can relate to issues of fatigue and nature of the role in terms of long working hours, level of overtime, level of job security and job demands.

However, there were a number of factors related to the work environment that as the research has identified can also have an impact on employee behaviour and performance outcomes that do not necessarily fit into the SCARF model as it has currently been developed, but are also important to consider (e.g. nutrition, level of noise, vibrations, on-board facilities etc.). Thus, for safety critical industries a 'SCARF+' model may be useful to develop when looking at outcomes. Additionally, there is also a need to understand the role of the individual and the choices that they make that can have an impact on their health and behaviours.

The SCARF model is also helpful as it can help the with the identification of relevant data sources that would be useful to collect for helping to understand the human factor elements in unintended incidents, and what interventions are important to consider to reduce the weak signals and improve employee health.

3.8 Interventions

A number of potential interventions to help improve the mental and physical wellbeing of employees in safety critical industries were identified throughout our interviews, which if implemented could lead to reductions in unintended events.

Common interventions discussed across all the safety-critical industries included in the research are:

- Employee Assistance Programmes (EAPs) that employees could contact when they had a problem that they would like to speak to somebody external about. However, common issues with EAPs include their under-use as a result of not being promoted among employees, stigma related to their use, and issues

related to confidentiality of the service. However, interview experts reported that their accessibility and the range of advice they can provide to employees make them a worthwhile investment.

- Telemedicine: the opportunity to consult experts online or over the phone regarding mental and physical symptoms. This was seen as very important, especially as in the maritime industry mental health screening is not undertaken. Mental health screening was frequently discussed as a potential intervention; however, experts in both maritime and other safety-critical industries reported that as a result of the stigma that still exists regarding reporting mental health, screenings would be ineffective. However, what is helpful is when other medical advice is being sought is for professionals to highlight what mental health provision is available.
- Training pre-boarding vessels on topics such as the importance of good nutrition, physical exercise, and the importance of socialisation when on board. The provision in the maritime industry (in some organisations) of nutritional information for chefs in vessels was reported in interviews as being positive in understanding what a healthy diet is.
- Mental health champions: these are individuals who are trained to recognise symptoms of mental health and wellbeing in fellow team peers, and act as signposts to appropriate support. This will also help to prevent stigma regarding mental health in the workplace and encourage open discussions. Although some experts questioned their use in the maritime sector, due to the rotating nature of crews, and the number of champions that will consequently need to be trained.

However, there are also a range of interventions to aid the health of the workforce identified in other safety-critical industries that could be applied in the maritime sector:

- Peer support and mentoring. Successful examples of peer support programmes were highlighted in the construction industry (Mates in Construction) and the military (TRIM). Mates in Construction is an initiative where individuals are trained to spot the signs of poor wellbeing, and signposting peers to relevant sources of information or support. TRIM in the military highlights the role of improving peer support systems, enabling positive social exchange between the team and to increase help seeking behaviour. Interviewees in the aviation industry also highlighted a drive internationally to introduce a Pilot Assistant Network, where a team of experienced pilots of varying seniorities who have been trained to be peers can be called upon anytime by a pilot in need, who may have been involved in a near miss or an incident of some kind. Initial feedback from aviation organisations who have already implemented this suggest that it is a popular initiative which has had a number of referrals and picking up on pilots with potential mental health issues and signposting them to appropriate support.
- Line management/leadership training: line managers and leaders not only need to be proficient in their work tasks, but it is also important that they have emotional intelligence and understand the importance of social leadership. In this way, line management training is important, but line managers should also be trained to be able to signpost their direct reports to appropriate wellbeing support. It is also important for HR to ensure that those promoted into line management and leadership decisions have the appropriate skills to undertake the role. The RSSB has been working alongside IES to develop mental health training programmes, identifying the both the best topics and the best methods to teach line managers to improve training in their understanding of health and wellbeing. In the aviation industry Crew Resource Management training is undertaken to understand the importance of being receptive to the rest of the crew when making decisions.

- The aviation industry is using the development of simulator technology and how realistic they are becoming for pilots and other crew members to undertake simulator training in aircrafts. In this way various safety incident conditions can be simulated, and crews can run through the processes that need to be undertaken including issues related to teamwork, communication and job roles, as well as any physical or technical adjustments that need to be made. As such behaviours can be directly observed, reviewed and corrected.
- Improving awareness of employee wellbeing and work-related wellbeing by undertaking staff surveys of all employees who work in safety critical industries. Although in some industries it is recognised that there is a changing workforce, with common team fluidity, however in the NHS 'Pulse surveys' are undertaken in an attempt to recognise where 'weak points' are, and to intervene to improve any negative repercussions of poor wellbeing or work satisfaction.
- For some interview experts in both maritime and other industries (especially military and aviation) much of what is being undertaken is a 'reactionary' approach to improving mental or/and physical health and wellbeing, whereas a number of interviewees suggested that safety critical industries should develop a health and wellbeing strategy, so that wellbeing is considered in any organisational decision and could thus develop a more preventative approach.

04 Final insights

Working in safety critical industries can lead to challenges in the provision of 'good work' and consequently lead to negative implications for the health and wellbeing of employees in these industries. One example of a hazardous occupation is seafaring, with data suggesting that there is a higher than average risk of accidents and fatalities when working in this industry, in comparison to other safety critical occupations. Recent research has also indicated that there are high levels of psychiatric problems among seafarers providing further evidence that shipping companies should no longer neglect the health and wellbeing of their crews.

There is a vast amount of evidence on the factors that can have an impact on the psychological and physical health of seafarers, and how this can have implications for performance and safety at sea. Results from both the rapid evidence review and the analysis of expert interviews uncovered five main factors that could have an influence on the psychological and physical health and wellbeing for employees in safety critical industries. These are:

- **Fatigue:** commonly cited, and could occur as a result of different shift patterns, from working long hours (maybe having to overwork) and as a result of insufficient rest (either through individual choice, or external circumstances such as the level of heat and noise in their surroundings);
- The **nature of the physical work environment:** for seafarers in particular the factors include the limited distinction between their home and work environment, and the nature of the environment was noisy, food and nutrition was limited to what was available on board, access to physical exercise could be restricted, the uncertainty of the work, and the possibility for (unplanned) extensions on trips;
- The **nature of the role:** especially in relation to task and skill variety, employee engagement and how motivated employees are to their role. If employees think they are not being valued in their roles or feel unsatisfied this can have a negative effect for psychological wellbeing (however, this may be related to particular roles or positions that employees have);
- **Socialisation:** the role of positive communication on board, the impact of having multi-national crews, the need to avoid feelings of isolation team cohesion, positive communication channels, and the development of a safety culture; and
- The role of **leadership and management:** including the hierarchical nature of crews, leadership and supervisory support, approachability, the effectiveness of line management and supervisory conflicts.

It is important to note that these factors not only have an impact on health individually, but there are connections between them. For example:

- Leadership and management is closely connected with the social culture on board and developing clear lines of communication between staff;
- The nature of work, and the roles crew members have can also lead to isolation during shifts and thus this emphasises the importance of developing social measures to reduce isolation during rest times; and
- Fatigue can be an issue in itself or can occur as an outcome of both how individuals respond to their work environment and the work that they do.

This only serves to highlight the complexity of understanding the multitude of factors (and their interactions) that can have an impact on the mental and physical health and wellbeing of employees in safety critical industries, and the difficulties in attempting to determine which factors are most important. In addition to this, it is important not to rule out the role of the individual, the decisions they make and their individual resilience and self-efficacy in certain situations. How individuals respond to their environment (both social and physical) will determine how they act at work and also their health and wellbeing.

One explanatory model that may explain why these five themes emerged most strongly is the SCARF model. The SCARF model identifies status, certainty, autonomy, relatedness and fairness as key dimensions in our perceptions of threat and reward and which ultimately determine our ability to collaborate, make decisions and solve problems. SCARF may be a useful framework for thinking about how to improve the work environment, and the sorts of data that might be particularly useful to collect in order to improve safety. However, it may be useful to consider the role of the individual and how this can influence the original five themes identified.

There was also evidence regarding how these identified themes can create increased risks for accidents or near misses. For example:

- Fatigued individuals may have reduced concentration, be more prone to distractions, have reduced reaction times or reduced attention to notice when something has gone wrong, or when a mistake has been made, which further down the causal chain can lead to an unintended event;
- Evidence both from the literature and interviews suggested that when roles became ambiguous as a result of uncertainty (both in terms of length of deployment or mechanical issues on job), the increase in workload and ambiguity could have an impact on job satisfaction which then has an impact on an individual's stress and fatigue;
- The consequence for behaviours such as reduced motivation, reduced communication and concentration are all factors that raise the possibility of errors occurring; and
- The results indicated that not only is the physical environment important to acknowledge, but the psychosocial work factors are important to understand. A conceptual framework, based on existing theory and evidence, of how health-related factors may ultimately impact on adverse incidents has been developed to attempt to explain the complex web of health-related factors that lead to a variety of incidents.

Across safety critical industries, it is clear that there is a desire to increase the focus on factors that can have an impact on physical and mental health and that collecting and using health-related data will be a huge benefit. However, this currently is an unrealised potential, and there is scant evidence of the collection and use of high-quality health-related data. Of the data sources that were identified, none of them comprehensively covered the main five themes identified throughout the research. Also, for the most routinely collected and potentially most viable data sources, concerns were raised over the data quality and their perceived value.

A number of common interventions were discussed across all of the safety-critical industries included in the research. These included: employee assistance programmes and counselling helplines; telemedicine; training regarding the importance of good nutrition and physical exercise; and methods to improve crew/team socialisation. However, there were a range of interventions discussed in other industries that could be implemented into the maritime sector that focus more on some of the psychosocial factors that were identified as being important. These interventions include peer support mechanisms (highlighted in construction, the military and aviation), line management training and development (identified in the rail industry and military) and simulation exercises (identified in aviation).

The results highlight a clear consistency of key themes and factors identified in the literature and through the expert interviews. Although some of these are more prominent than others, each on their own, and when interacting with others can have an impact on the physical and psychological health of employees in safety critical industries and are thus worthy of consideration.

Appendix 1: Rapid evidence review search criteria

Rapid evidence review search terms

- Topic-specific journals: HR/wellbeing/psychological and organisational journals:
  - Journal of Occupational and Organizational Psychology;
  - Journal of Occupational Health Psychology;
  - Organizational Behaviour;
  - Journal of Occupational Medicine; and
  - Health, Risk & Society.
- Industry-specific journals:
  - International Maritime Health; and
  - Maritime Policy & Management.
- Grey literature:
  - Shell and other industry publications – aviation, nuclear, medicine, health; think tanks;
  - industry bodies; and
  - trade unions.

Also searched Databases including OneSearch, Scopus, PsychInfo etc

Criteria:

- In last 10 years
- In English language

Table A1.1: Search terms applied to academic databases

Primary	Secondary
Seafarers and wellbeing	Engagement; motivation; accidents; wellness; performance; human behaviour; resilience; training; health; suicide; job satisfaction; productivity; sickness; absence; culture; fatigue; leadership; mental health.
Human Factor and wellbeing	
Safety Critical Industries and wellbeing	

Appendix 2: Discussion guide

1. Introduction

Thank you for agreeing to participate in this research.

Interview record

Researcher name:
Date:
Interviewee number:

Introduction

Thank you for agreeing to participate in an interview about the physical and mental health, wellbeing and performance of workers in safety-critical working environments. We are interested in your experiences and thoughts on what you think about physical and mental health issues and risks in seafaring or other safety-critical industries. In addition, we would like to talk about any examples of good practice you know of which have been taken to predict or mitigate poor physical and mental health and wellbeing at work and its consequences.

We hope to cover four main topics within the course of our discussion. These are:

- What influences psychological and physical health and wellbeing in shipping and other safety-critical industries?
- What and how does psychological and physical health and wellbeing impact on undesirable events in shipping and safety-critical industries?
- What currently available and potential data sources might be used to help predict and ultimately mitigate undesirable events?
- What practices or interventions are useful in improving psychological and physical health, and ultimately mitigate reduce the incidence of undesirable events?

The findings from our interviews will be used by IES and Shell for research purposes, and to improve safety and wellbeing both for Shell and the larger maritime industry. The interviews will be recorded, with your consent, transcribed and submitted to thematic analysis by our research team. The recordings will be held within the IES research team, stored securely and deleted at the end of the project. In accordance with General Data Protection Regulation (GDPR) any personal data and data from interviews will be kept securely by the Institute for Employment Studies (IES). We will seek your permission to use specific quotes from the interview and we agree to share the final report with you.

No-one outside of the IES research team and Shell Project team will listen to the recordings or see notes or transcripts. Are you happy for me to record the interview today?

The evaluation is important in understanding what works in being able to predict and mitigate risk in the physical and mental health and wellbeing of workers in safety-critical industries. Please note there will not be any questions about your own physical and mental health and wellbeing. The interview will take approximately one hour.

Have you seen the briefing sheet and are you happy to go ahead with the discussion?

2. Background

- Check interviewee's name, job title and their role remit.
- Could you please describe your organisation/work? And the nature of your role/work or expertise in relation to seafaring/your safety-critical industry/academic work?
- How does that fit in the context of your organisation's main activities?

3. Safety-critical industry wellbeing

- In your view, what are the main factors influencing the psychological and physical health and wellbeing of employees in your industry?
  - Probe for both positive and negative influences; and
  - Probe for issues such as leadership, culture, relationships with fellow workers, feelings of psychological safety, communication with/separation from family and friends, physical demands of job, fatigue, length of working day/voyage, distance from home country, time onshore, anything else etc.)
- In your view, of the factors you have identified, which factors would you prioritise in enhancing psychological and physical health and wellbeing?
- What practices or interventions might be valuable in improving the psychological and physical health and wellbeing of employees in your industry?
  - Probe for discrete interventions as well as wider changes such as changes in ways of working, leadership and culture, encouraging crew to socialise, better access to support services, more supportive culture etc.
  - Probe for any examples.

4. Impact of mental and physical wellbeing on worker performance and safety

- In your view, how and in what ways does employees' psychological and physical health and wellbeing impact their performance and safety at work?
  - Probe for impact on areas such as decision-making, errors, motivation etc.
  - Probe for any examples that they are aware of.
- How, and in what ways, does psychological and physical health and wellbeing impact on the occurrence of undesirable events (both human incidents such as suicide and operational incidents such as fire/explosions or vessel collisions)?

  - Probe for any examples they know of and feel able to share.
- How, and in what ways, might improve psychological and physical health and wellbeing reduce the incidence of undesirable events?
  - Probe for any examples they may have and feel able to share.

Shell Manager – is there anything else you would like to ask?

5. Using human factors and wellbeing data to predict (safety) performance

- What data do you think is or could be most useful for predicting psychological and physical health and wellbeing of employees in your industry?
  - Probe for data sources including operational data such as time at sea, time in port etc; data about the work environment including working hours, staff turnover, crew makeup, training, unplanned extension of duties as well as availability of exercise facilities, Internet etc; personal data such as age, BMI etc; HR data such as performance and engagement of employees.
  - Probe for any examples of where data is being used to predict psychological and physical wellbeing.
- How is, or might, this data or other human factors data be used to predict undesirable events?
  - Probe for any examples of where they know this is happening.
- Are you aware of any work being undertaken in your industry or other safety-critical industries to model the influence of human factors (including measures of and precursors to psychological and physical health) on safety performance?

6. Interventions to improve wellbeing and safety performance

- Thinking widely, what interventions or practices do you think can support psychological and physical wellbeing of employees in your industry, and which may ultimately impact on safety performance?
  - Probe for things such as: improving leadership and management style; interventions to improve the culture of reporting near misses and improved psychological safety; removing barriers to accessing help for mental and physical health issues; better support for mental and physical health issues; better risk assessment procedures; better processes for embedding the learning from errors and near misses; better incorporation of human factors in analysis of critical incidents; awareness raising around the importance of physical and psychological wellbeing; better workplace adjustments for those with health problems/returning to work; improved policies and procedures for supporting employees with physical and psychological health issues etc.

Shell Manager – is there anything else you would like to ask?

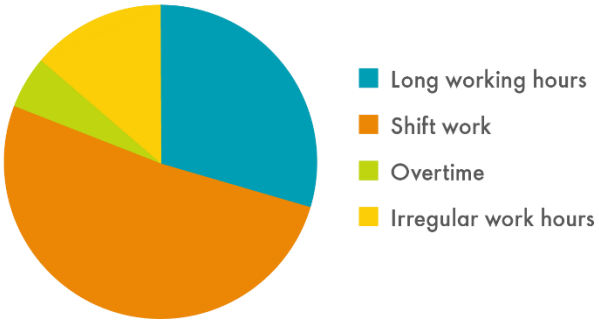
Is there anything you would like to add or think we should know?

Thank you and close.

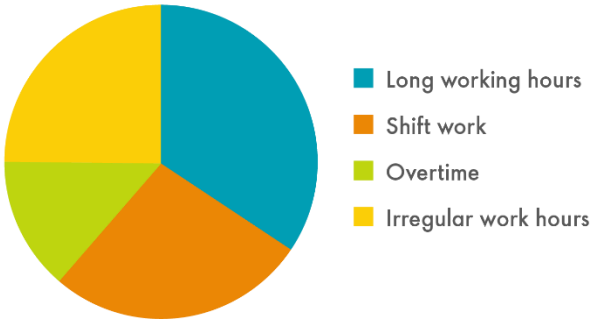
Appendix 3: Identified themes

Graphical representations of the five main factors identified from the literature and the interviews and the factors that comprise them.

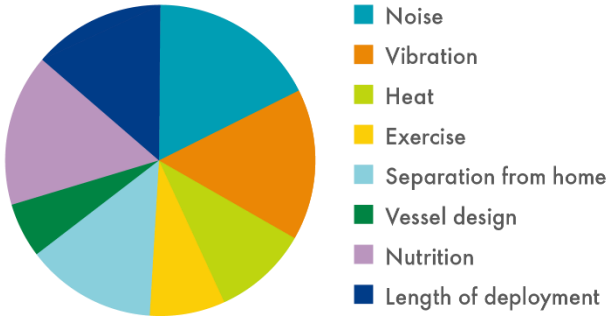
Fatigue Factors – Literature



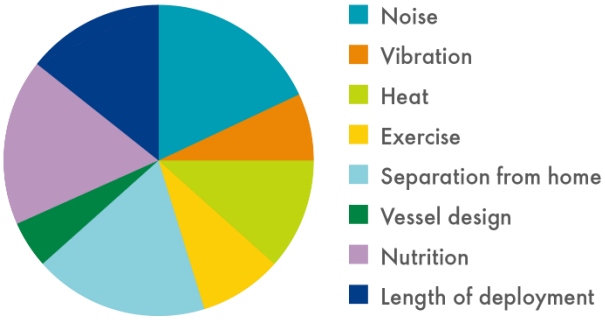
Fatigue Factors – Interviews



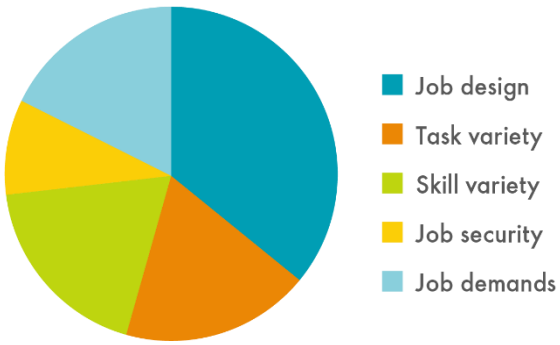
Nature of Work Environment – Literature



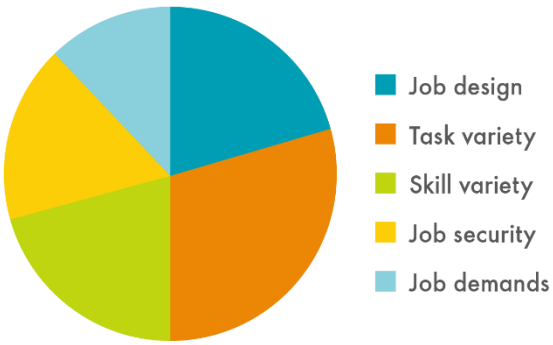
Nature of Work Environment – Interviews



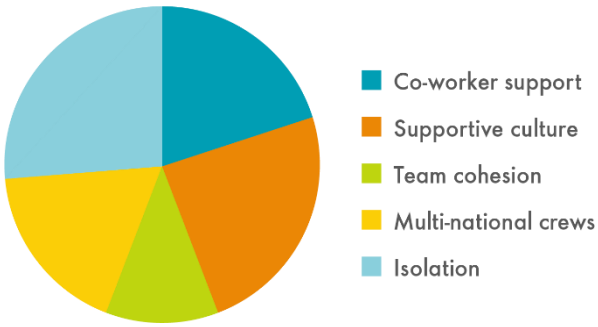
Nature of Role – Literature



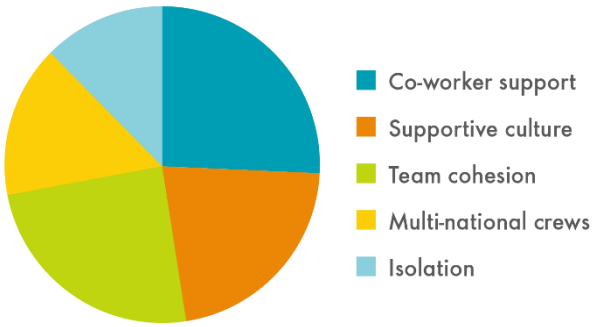
Nature of Role – Interviews



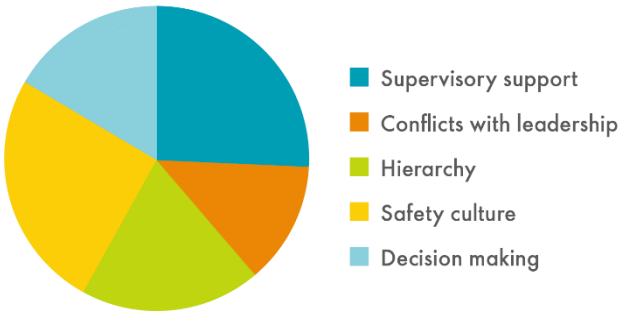
Socialisation – Literature



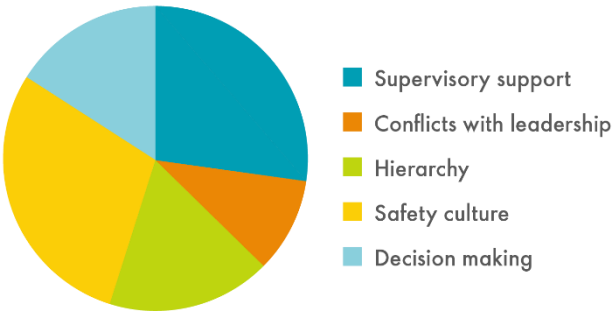
Socialisation – Interviews



Leadership and Management – Literature



Leadership and Management – Interviews



05 About the authors

Zofia Bajorek, PhD, MSc, BA

Research Fellow

Zofia is a research fellow at IES, and works in projects that fit in the programme of work on health at work and HR. Prior to joining IES, Zofia was the lead researcher in HR and Management at the Work Foundation, where she worked on a number of projects related to a range of workforce issues, including a systematic review for workplace policy and management practices to improve the health of employees, understanding the role of employee engagement for the NHS workforce and patient outcomes and contributing to a number of health and wellbeing at work policy papers, Zofia completed a PhD in management studies at King's College London, focussing on the management of temporary staff in accident and emergency departments and the impact this can have on patient safety and service quality. Zofia has recently co-authored a book discussing the future the workforce and the workplace.

Dan Lucy, MSc, BSc

Deputy Director, Employer Research and Consultancy

Dan leads IES' research and consultancy work for employers and plays a key role in its programme of work on health at work. Prior to re-joining IES, Dan led the research team at Roffey Park Institute, a management education institute established post-WWII with the aim of helping veterans rehabilitate back into the workplace. He has previously led assignments for the Health and Safety Executive, Department of Health, Ministry of Health in Singapore as well as a range of private sector organisations. One notable assignment was that of exploring the role of leadership in health and safety at work, in particular looking at its role in supporting high levels of health and safety performance on the London Olympic Park. Dan is a Principal Practitioner of the Association of Business Psychologists.

Stephen Bevan, BSc, PGCE

Director, Employer Research and Consultancy

Stephen is director of employer research and consultancy at IES with responsibility for developing innovative new projects and programmes with IES partners and other collaborators. He has conducted research and consultancy on high-performance work practices, employee reward strategy, performance management, staff engagement, retention and 'good work'. He has a special interest in workforce health and wellbeing, having led a number of national and international projects focussing on workforce health and the impact of chronic illness on productivity and social inclusion. Stephen is an adviser to a number of UK government departments and has advised employers and policymakers in Europe, Asia-Pacific, Australasia and North America. He is a Board Member of the European HR Director's Circle and a member of the Britain's Healthiest Company expert advisory group. Stephen has appeared in HR Magazine's list of Most Influential HR Thinker for the past ten years. He has also been an honorary professor at Lancaster University Management School since 2010.