Department for Transport

Understanding seafarer roster patterns and fatigue on vessels

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1. Glossary

During this project we use the following definitions:

Acute Fatigue - Acute fatigue is a temporary state of tiredness resulting from short-term exertion or sleep deprivation and can be alleviated with adequate rest and recovery.

Chain sampling - A non-probability sampling method that involves selecting participants based on referrals from initial participants. It relies on a network of connections where the researcher starts with a small number of individuals who meet the desired criteria and then asks them to refer or nominate other individuals who also meet the criteria.

Chain voyage - Chain voyaging refers to when seafarers undertake a series of consecutive voyage contracts in sequence, without rest periods between.

Circadian rhythm - Circadian rhythm refers to the internal biological clock that regulates various physiological and behavioural processes over a roughly 24-hour cycle.

Cumulative fatigue - Cumulative fatigue refers to a persistent and long-term condition that develops over time due to repeated or prolonged periods of insufficient rest or excessive exertion and requires more extensive recovery to alleviate.

Fatigue - Fatigue is a state of physical and/or mental exhaustion characterised by reduced performance, alertness, cognition, energy levels, and a sense of overwhelming tiredness. It arises from prolonged exertion, inadequate rest, illness, or stress. Different intensities of fatigue exist (see Acute Fatigue and Cumulative Fatigue).

Longitudinal data - Longitudinal data refers to a type of research or dataset that collects information from the same subjects over a long period of time to examine changes and trends over time.

Purposive sampling - A non-probability sampling technique used in research. It involves selecting specific individuals or cases for inclusion in a study based on the researcher's judgement or specific criteria relevant to the research objectives.

Roll-on/Roll-off (Ro-Ro)- Roll-on/Roll-off (Ro-Ro) vessels are cargo ships equipped with ramps or platforms that allow vehicles to be easily driven or rolled on and off the ship, facilitating efficient transport of wheeled vehicles. This may be under their own propulsion or by use of port-based tractor units.

Ro-Pax – Ro-Pax vessels (Roll-on/Roll-off Passenger vessels) are ships designed to carry both passengers and vehicles. They have specialised decks for vehicles, allowing them to be driven on and off the ship, while also providing facilities such as cabins, restaurants, and amenities for passenger comfort.

Roster - A roster pattern for shipping vessels refers to a structured schedule that determines the rotation, duties, and rest periods of crew members, e.g., 4 weeks on, 4 weeks off. It ensures adequate staffing, regulatory compliance, and crew fatigue management, while maintaining operational efficiency and the safety of the vessel and its crew during shipping operations.

Route intensity - Route intensity on vessels refers to the level of activity or demand experienced by a specific shipping route. It considers factors such as the frequency of vessel departures, cargo volume, passenger traffic, and overall operational activity along the route.

Shift - The pattern of hours worked across a given day's work, e.g., 12 hours on, 12 hours off.

2. Executive summary

Introduction and research objectives

The Department for Transport (DfT) commissioned the Behavioural Insights Team (BIT) and Transport Research Laboratory (TRL) in February 2023 to conduct a research project on seafarer roster and shift patterns on Ro-Ro and Ro-Pax vessels, focusing on the impact roster patterns have on seafarer fatigue. The project involved a literature review of 124 papers and qualitative research, specifically 8 interviews with industry stakeholders, and a roundtable with 8 industry stakeholders. This report provides details on the methodology, limitations, key findings, and recommendations for further research.

The four objectives of this research were to understand:

1. **The various types of seafarer roster and shift patterns and how they differ** by route and operators, and the consequential impacts of different roster patterns on seafarer fatigue and welfare.
2. **The quality and duration of rest available to, or experienced by, seafarers,** and the consequential impacts on seafarer fatigue and welfare.
3. **The factors that are taken into consideration when designing roster and shift patterns and why.**
4. **What measures, if any, are taken by ferry operators to manage seafarers' shorter-term "sleepiness", longer-term fatigue**, potentially reduced vigilance, and the effectiveness of these measures.

Methodology

Literature review methodology

A total of 124 papers were identified based on careful consideration of the search terms and databases used. After being evaluated based on inclusion criteria, 21 papers were reviewed in full. There were two caveats to the evidence. Firstly, there was a lack of recent research on seafarer fatigue specifically in relation to Ro-Ro and Ro-Pax vessels, as most studies published within the last three years (which were given priority based on the evidence review inclusion criteria) have focused on other types of vessels. Three years was chosen as the most appropriate period on which to focus the evidence search to account for any developments which have occurred as a result of the Covid-19 pandemic. Secondly, the recent literature primarily focussed on day-to-day shift patterns rather than week-by-week roster patterns.

Qualitative research methodology

We recruited participants using a combination of purposive sampling through a recruitment agency, outreach efforts by BIT, and chain sampling with DfT support. Participants were compensated for their time.[1] We selected participants based on their experience with and/or expertise in the maritime industry and screened them to ensure they had knowledge on seafarer work patterns and fatigue specifically on Ro-Ro and Ro-Pax vessels.

- **One-on-one interviews:** We conducted 8 interviews that lasted for one hour and took place online via Google Meets. Interviews were conducted with a sample that consisted of four ex-seafarers, three ferry operators, and one trade union representative.
- **Expert roundtable:** The roundtable session lasted for two hours and took place online via Zoom. The roundtable consisted of 8 expert stakeholders, including one current seafarer, two seafarer charities, three trade union representatives, one port chaplain, and one academic in the field of seafarer employment research.

During the qualitative research, we aimed to achieve a good spread of participants from different stakeholder groups, such as ex-seafarers, operators, charities, trade unions. However, we note that a limited input or engagement from ferry operators and from current seafarers is a limitation of this research.

Literature review findings

The literature review findings highlighted the following:

- **Fatigue is prevalent** amongst seafarers, linked to accident risk and negative effects on mental and physical health.
- **4 hours on, 8 hours off shift pattern was found to be the least fatiguing** compared to other shift patterns, including 6 hours on, 6 hours off and 12 hours on, 12 hours off, within the academic literature. Patterns specific to Ro-Ro and Ro-Pax vessels were identified within the qualitative research**.**
- **Environmental factors on board vessels were found to contribute to fatigue**, including noise, movement, vibrations, light, temperature, and air condition. However, addressing environmental factors is arguably less important than ensuring the timing and consistency of sleep and rest opportunities.
- **Addressing fatigue requires organisational changes**, policy interventions, and further research on specific vessel types and roster patterns. Better management of resourcing and workload responsibilities, for example by increasing crew numbers and implementing a three-watch system, could help to mitigate fatigue.

Qualitative research findings

[1] In line with Government Social Research guidance on ethical assurance for social and behavioural research. Retrieved from https://www.gov.uk/government/publications/ethical-assurance-guidance-for-social-research-in-government

Building on the literature review, interviews and roundtable discussions helped us to understand the different roster and shift patterns typical for Ro-Ro and Ro-Pax seafarers.

Roster patterns

Filling some gaps within the literature, our qualitative research revealed a variety of roster patterns used specifically on Ro-Ro and Ro-Pax vessels, which vary across operators. Overall, participants said that rosters and shifts tend to vary based on:

- **Route length and intensity**: shorter routes tend to be associated with shorter rosters, such as 1 week on, 1 week off or 2 weeks on, 2 weeks off, whereas longer routes were associated with longer rosters, such as 1 month on, 1 month off or 16 weeks on, 4 weeks off. This is because shorter routes are characterised by greater route intensity and more consistent work demands.
- **Nationality of the seafarer**: Seafarers and crew employed internationally tend to have longer roster patterns, such as 16 weeks on, 4 weeks off or 5 months on, 1 month off. This is due to logistical and economic benefits to employing crew on longer tours of duty if they have travelled further, as well as salary and compensation benefits for the crew.
- **In some cases, roster patterns differ between seafarer roles, however in the most part patterns were consistent across seafarer role and seniority,** across both long or short routes. These exceptions included kitchen staff that worked longer rosters of up to 5 months, and senior staff sometimes who worked overtime on their regular shift to make logistical and operational decisions.

Shift patterns

There are a variety of common shift patterns on Ro-Ro and Ro-Pax vessels, but according to participants most seafarers tend to work 12 hours per day. However, these 12 hours may be worked across two common shift patterns including:

- 12 hours on, 12 hours off
- 6 hours on, 6 hours off split shift.

There are other shift patterns in which seafarers are permitted to work shorter days, such as 4 hours on, 8 hours off.

Participants considered the 12 hours on, 12 hours off and 4 hours on, 8 hours off shift patterns to be more viable for fatigue management. This is because these shift patterns maintain the consistency of circadian patterns as employees can sleep at the same time each shift. These shift patterns also enable seafarers to have longer periods of continuous sleep, and more time off-shift overall. Participants assessed the 6 hours on, 6 hours off shift patterns as the most fatiguing. This is because this pattern does not allow for seafarers to have a longer period of continuous sleep.

Impact of shifts and rosters on fatigue

Participants told us that multiple features of shift and roster patterns could contribute to seafarer fatigue. This includes when seafarers work: longer tours of duty; night shifts and winter shifts; routes that were shorter and busier with a greater number of docking transfers; non-contracted hours on vessels; or worked continuously rather than taking time

off to rest between tours. Overall, we were told by roundtable participants that seafarers sometimes decide to work longer and more fatiguing roster and shift patterns to obtain more employment and income instead of prioritising rest.

Seafarer resting conditions

Participants revealed that resting and sleeping conditions vary across vessels, often depending on the age and model of the vessel and the facilities that existed on them, such as single or shared cabins. Moreover, related environmental factors impact rest quality, including vessel noise and vibrations, and weather conditions.

Shift and roster patterns design

Interviews highlighted that operators do acknowledge the impact of roster and shift patterns on seafarer fatigue when developing them, knowing that certain patterns can be fatiguing. However, there are a variety of other factors that also shape how operators design rosters and shifts that can conflict with fatigue management, including international regulation, business and operational limitation, union agreements, and local constraints, such as port access.

Current fatigue management on vessels

Interviews highlighted multiple different approaches that currently exist to help manage seafarer fatigue. These included operators:

- conducting primary fatigue research on vessels to understand levels of fatigue amongst crew and to explore the impact of shift length and intensity on fatigue.
- providing fatigue training to managers and senior leaders.
- making efforts to mitigate against disruption from noise and vibrations such as with vibration testing.
- providing managers and crew with educational information.
- offering mental health support to seafarers.

Conclusion

This research has identified various types of roster and shift patterns and how they differ by route. This includes shorter and more intense routes being associated with shorter rosters, longer and less intense routes being associated with longer rosters, and that most seafarers worked 12 hours a day across a variety of shift patterns.

Overall, this research showed that fatigue is a prevalent issue on Ro-Ro and Ro-Pax vessels and that roster and shift patterns have a key influence on the quality of rest and seafarer fatigue. However, a variety of other elements also influence fatigue including environmental factors and seafarers' motivations. Ultimately , fatigue risk management depends on engagement from multiple stakeholders across the Ro-Ro and Ro-Pax industry.

Nonetheless, there is a need for further research. Specifically, we recommend:

- further academic exploration of roster patterns and shift patterns on Ro-Ro/ Ro-Pax vessels, given that our literature review identified a lack of studies on the topic.

- exploration of the impact of roster patterns on fatigue for UK national and international seafarers.
- further studies identifying the level at which fatigue becomes an issue during a given shift or roster.
- further exploration of further operator perspectives.
- possible mitigation measures for reducing seafarer fatigue.

3. Introduction

The Behavioural Insights Team (BIT) and Transport Research Laboratory (TRL) were commissioned by the Department for Transport in February 2023 to undertake research to better understand the landscape of seafarer roster and shift patterns that exist, and the relationship that these have with seafarer fatigue and wellbeing, specifically on Ro-Ro and Ro-Pax vessels. The focus for this project was to understand and summarise the existing evidence from published literature, as well as to identify a range of perspectives on seafarer roster patterns, shift patterns and fatigue management from a wide variety of stakeholders across the maritime industry.

This report outlines our methodology, its limitations, our findings, and offers recommendations for further research.

4. Background and methodology

4.1 Background and research objectives

The aim was to explore differences in practices across industry, vessel size, routes, workloads, and sleeping conditions.

The four objectives of this research were to understand:

1. **The various types of seafarer roster and shift patterns and how they differ** by route and operators, and the consequential impacts of different roster patterns on seafarer fatigue and welfare.
2. **The quality and duration of rest available to, or experienced by, seafarers,** and the consequential impacts on seafarer fatigue and welfare.
3. **The factors that are taken into consideration when designing roster and shift patterns and why.**
4. **What measures, if any, are taken by ferry operators to manage seafarers' shorter-term "sleepiness", longer-term fatigue**, potentially reduced vigilance, and the effectiveness of these measures.

This research project involved several methods:

- a literature review of the current literature.
- 8 qualitative interviews with stakeholders across the maritime industry.
- an expert roundtable with 7 stakeholders in roster patterns and seafarer fatigue.

In this section, we outline our methodologies for each method.

4.2 Literature review methodology

A list of search terms (see Table 1) relevant to the project aims was generated and used to search for the literature. These search terms were applied across three online research databases: Google Scholar, ScienceDirect, and TRID.[2] 124 individual papers were identified from the search for literature. The sourced literature was compiled into a spreadsheet for review. The papers were then scored based on a set of the inclusion criteria which consisted of relevance, quality, and timeliness.

Table 1: Search terms

1st Level	(AND/OR) 2nd Level	(AND/OR) 3rd Level

[2] Transport Research International Documentation Database that covers a million records of references to books, technical reports, conference proceedings and journal articles within the field of transport research.

Seafarer Mariner Sailor Sea Cadet Naval Maritime Sea vessel Container ship/ boat/ vessel Passenger " " Tanker " " Shipping " " Trawler Ferry Ro-Ro Ro-Pax Ocean/ cruise liner Straits	Roster patterns/ times/ periods / lengths/ duration Schedule " " Shift " " Rest " " Sleep " " Watch " " Rota " " Duty " " Tour " " Leave " " Routes/ route intensity /route traffic Roles Responsibilities Tasks Workload Navigation Conditions Quarters	Fatigue Sleepiness Tiredness Drowsiness Exhaustion Alertness Circadian rhythm Well-being Welfare Health Stress Safety Risk Hazard Effectiveness Quality Solutions Disruption Management Regulation Operation

Of the 124 sourced articles, 21 were reviewed in full. These 21 papers were selected for review based on receiving the highest scores on the inclusion criteria. Most of the papers that were included were from within the past 10 years, except for one (Härmä et al., 2008) which was included because it was deemed to have particular relevance to seafarer fatigue and shift patterns. A summary of each of these papers is provided in Appendix 1, Table 2.

The literature review had two limitations. Firstly, there was limited recent research specifically on Ro-Ro and Ro-Pax vessels and seafarer fatigue, with evidence from the past three years (which was given priority over older literature) focusing on other types of vessels. As such, the literature review contains findings relating to seafarer fatigue in relation to other vessels, including shipping, tanker, fishing, and naval vessels. The evidence gaps on seafarer fatigue specifically on Ro-Ro and Ro-Pax vessels were addressed by the qualitative research methods. This was achieved through interviews and roundtable with stakeholders from across the Ro-Ro and Ro-Pax industry, ex-seafarers, trade unions, ferry operators, port chaplains, and academics specialising in seafarer employment.

The second limitation is that the literature focused on day-to-day shift patterns rather than week-by-week roster patterns. This means there was an evidence gap on what activities

seafarers did during their rest periods within a roster pattern and what impact roster patterns may have on fatigue. These evidence gaps were addressed by the qualitative research methods, through direct exploration of roster patterns on Ro-Ro and Ro-Pax vessels.

The reason for the focus on shift patterns in the literature may be due to the challenges faced with conducting robust longitudinal studies of roster patterns. This is because studies in the literature typically ran for several weeks, but an assessment of roster patterns would need to run for several months or years to increase the validity of the research. This would require more time and resources and may face challenges that are often associated with longitudinal studies, such as recruitment and retention of participants.

4.3 Qualitative research methodology

As part of the qualitative research, we conducted 8 semi-structured interviews, and a roundtable discussion with 8 attendees. The sample included: ferry operators, ex-seafarers, seafarer charities, trade unions, academics, and port chaplains. This sample was designed to explore perspectives from a broad range of stakeholders to help us understand the nature of seafarer roster patterns in the Ro-Ro and Ro-Pax context and mitigate some of the limitations of the evidence review.

The interview sample consisted of four ex-seafarers from Ro-Ro and Ro-Pax, three ferry operators, and one trade union. The interviews lasted for one hour and were conducted via Google Meets.

We developed the interview topic guides in line with the research objectives. The content included a semi-structured discussion of the current roster and shift patterns across different routes, the factors behind any variations, their impact on seafarer fatigue, and existing fatigue management on Ro-Ro and Ro-Pax vessels. The topic guides (see appendix 3) were reviewed, and quality assured by the Department for Transport.

The roundtable session involved a semi-structured discussion where all stakeholders were given the opportunity to contribute their perspective on roster patterns and seafarer fatigue.

The sample of 8 experts that attended the session included one current seafarer, two seafarer charities, three trade union representatives, one port chaplain, and one academic.

The two-hour long session entailed a semi-structured discussion which focused on:

- the most prevalent roster patterns,
- reasons why roster patterns varied.
- their impacts on seafarer fatigue.
- existing mitigation methods used by operators.

The discussion also included potential approaches to seafarer fatigue management, which was conducted via Slido.

4.4 Sampling and recruitment

Recruitment techniques

We used the following three channels to recruit interviewees and roundtable attendees, with considerable efforts being made to recruit harder-to-reach groups:

- **Purposive sampling (via Criteria Recruitment)**: A recruitment agency, Criteria, was subcontracted to purposively sample participants from across groups.
- **Purposive sampling (BIT)**: BIT also reached out to relevant contacts and organisations including charities, the Maritime Coastguard Agency, trade unions, and ex-seafarers.
- **Chain sampling (DfT)**: DfT supported BIT in chain sampling by sharing a research information sheet with relevant stakeholders.

Participants were screened to ensure that they were knowledgeable and comfortable speaking about:

- the causes of seafarer fatigue on Ro-Ro or Ro-Pax vessels.
- the specific impact of different roster/shift patterns on fatigue.
- how common different roster patterns might be across the industry for Ro-Ro or Ro-Pax vessels.
- potential solutions to manage seafarer fatigue on Ro-Ro or Ro-Pax vessels.

Participants were compensated for taking part in the interviews and roundtable which is common practice for Government Social Research projects.

4.5 Limitations of the qualitative research

We ask the reader to note some limitations of the qualitative research for this project.

Qualitative research does not aim to be fully representative

By design, this research project aimed to get insights from a wide variety of stakeholders from across the maritime industry, including operators, ex-seafarers, trade unions, seafarer charities, port chaplains and academics. Generally, the aim of qualitative research is to provide in-depth insights about the variety of perceptions, views, and behaviours of these stakeholders, rather than to quantify the relative impact of different themes. Therefore, we ask the reader to note that this research may not have captured a fully representative spectrum of views.

Operators

There were some challenges in recruiting ferry operators for the interviews. We attempted to engage with 10 operators, however, of these only three operators chose to participate. As such, we ask the reader to read this report with acknowledgement that there has not been the opportunity to include insights and input from all ferry operators.

Current seafarers

There was limited input from current seafarers. We deliberately minimised contact with current seafarers for multiple reasons. Firstly, we minimised contact due to ethical concerns around the risk of interviewing current seafarers without certainty that we could have the necessary and robust safeguarding measures in place within the short timeframe of this project. Secondly, we minimised contact due to some validity concerns around the risk that current seafarers may not self-report accurately during interviews because of perceived pressures to speak favourably about their employers. Therefore, we ask the reader to acknowledge that we have limited insights into the current lived experiences of seafarers.

5. Findings

5.1 Findings from the literature review

It was evident from across the reviewed literature that fatigue is a persistent and concerning issue within the seafaring industry due to its association with accident risk (Grech, 2016) and its detrimental effect on mental (Nittari et al., 2022) and physical health (Jepsen et al., 2015). This was particularly concerning for more senior crewmembers who appear more vulnerable to greater levels of stress, anxiety, and fatigue brought on by the greater responsibility of their job roles (Oldenburg & Jensen, 2019). However, this was also relevant to seafarers with monitoring responsibilities. This was due to the combination of low stimulation and prolonged vigilance associated with this type of work, which can lead to fatigue (Andrei et al., 2020).

Two shift patterns appeared particularly common in the maritime industry
These were a 4 hours on, 8 hours off shift pattern and a 6 hours on, 6 hours off shift pattern. Though other patterns, such as 8 hours on, 8 hours off, (Short et al., 2015), and work schedules, such as day and night shifts (Riethmeister et al., 2018), have been identified within this review, the 4 hours on, 8 hours off and 6 hours on, 6 hours off shift patterns were the ones most commonly presented in the evidence. This suggests that these appear to be the leading shift patterns across the seafaring industries covered within the literature review.

The 4-on/8-off shift patterns may allow for greater rest and reduce risk of fatigue
Comparably, the6 hours on, 6 hours off and 8 hours on, 8 hours off shift patterns have consistently been found to be associated with greater levels of fatigue (Azimi Yancheshmeh et al., 2020; Härmä et al., 2008; Mansyur, 2021; Short et al., 2015; Van Leeuwen et al., 2013). This can be attributed to having a greater rest period compared to working period.

A larger workforce can allow for more rest time and reduced workload
The literature suggested that fatigue could be mitigated by having more crew members, which can allow for better sharing of workload and responsibility, and reduced working hours (Jepsen et al., 2015; WMU, 2022). Larger crews can also allow for a three-watch system which has been demonstrated to improve sleep outcomes over two-watch systems (Van Leeuwen et al., 2022). Increasing crew numbers could provide improvements in generating a ‘culture of care’ in the seafaring industry, although this would come at a financial cost to organisations to employ the extra staff. However, if the true costs of

fatigued employees to operators were calculated, then the increased cost of employing additional workers might be more viable.

Quality of sleep can be impacted by a variety of environmental factors
Although not as important as the length and timing of sleep periods (Jay et al., 2015), there is a need to ensure sleeping conditions are suitable to allow quality sleep. Factors that impact sleeping conditions included noise, movement, vibrations, light, temperature, quality of air, and air conditioning (Abrahamsen et al., 2022; Cui et al., 2022; Jepsen et al., 2015; Schmied et al., 2020). Providing tools such as noise-cancelling headphones, air conditioning, window shades or eye masks may present a solution that is more affordable and easier to implement than organisational changes such as increasing crew numbers and reworking shift schedules.

There is a culture of accepting and tolerating fatigue in the seafaring industry
Long working hours, extended periods of time at sea away from family, and little rest time were accepted as common practices within the industry as part of the job (Grech, 2016). Strategies such as promoting social and physical activities, including sports and games played while at sea, could help in mitigating the physical and mental toll that this culture generates from being away from family and friends for long periods of time (Nittari et al., 2022).

However, the benefits of these efforts may be limited (Schmied et al., 2020; Slade, 2022), as this would not resolve the wider need for overarching organisational change in the industry. This may be achieved through policy changes and awareness campaigns designed to target the beliefs around tolerating fatigue, such as the AMSA (2020) fatigue management guidelines. Maintaining accurate records of seafarers' work and rest hours may also encourage seafarers to be compliant with policies around working hours (WMU, 2022).

The evidence discussed here covered a range of different vessels and locations. No evidence emerged which provided direct comparisons of fatigue between different vessel types, although some evidence discussed here has managed to highlight how fatigue differs between European and Chinese shipping companies (Zhao et al., 2020). Future research may wish to investigate how these factors apply across different vessel types and routes. Nonetheless, this evidence review suggests that fatigue is an issue across the maritime industry irrespective of vessel type.

5.2 Findings from the qualitative research

Aiming to build on the existing literature base, we generated qualitative insights from face-to-face interviews and an expert roundtable exploring roster patterns and shift patterns on Ro-Ro and Ro-Pax vessels and their impact on seafarer fatigue. We then analysed our emerging findings using a thematic analysis approach. In this section, we discuss our findings across the themes.

Understanding seafarer roster patterns

Filling key knowledge gaps that exist within the literature, interviews and roundtable discussions helped us to understand the different roster and shift patterns typical for Ro-Ro and Ro-Pax seafarers specifically, and how these may relate to seafarer fatigue.

Evidence from qualitative interviews and the expert roundtable highlights a wide variety of different roster and shift patterns, with the major variation attributed to different operators. However, there were some general trends about roster length, outlined below.

Length of the route (short vs. long) and route intensity (high vs. low)

Building on the academic literature, we found that shorter routes tend to be associated with shorter rosters, such as 1 week on, 1 week off or 2 weeks on, 2 weeks off, whereas longer routes are associated with longer rosters, such as 1 month on, 1 month off or 16 weeks on, 4 weeks off. This is because shorter routes are characterised by greater and prolonged route intensity and work demands: the Short Strait (Dover – Calais) was described by an operator as a *"24/7 never ending operation"*. There is a perception that seafarers grow fatigued more quickly during shorter, more intense routes - it was explained by one operator that for shorter routes they need to make sure that crew are "*fresh and aware*", so they operate shorter rosters. The role of the route length and intensity is well illustrated by the following quote from an operator interview:

"*[Roster design is] largely about the route for us, [and] how much intense activity [crew members] have during their time on board. There is no comparison to the Dover Straits: it never stops, there is never a period off. Whereas on the longer crossings, you have times where all the passengers are in bed .... Therefore, there is some calmness [on board]. Now, we can have less people and stagger shifts…. It is easier when it's a longer crossing*."

Operator

Overall, the interviews and roundtable enabled us to build key understanding about rosters specifically within the Ro-Ro/Ro-Pax industry that had not been documented in the literature, and it is important to consider the length and intensity of a route when developing roster patterns for fatigue management.

Nationality of the seafarer

Building further on the academic literature, we found that seafarers and crew that are employed internationally tend to work longer roster patterns, such as 16 weeks on, 4 weeks off or 5 months on, 1 month off, depending on the operator. Interviews highlighted a variety of explanations for this, outlined below.

Firstly, there is an economic efficiency for operators to employ international seafarers for longer tours of duty, because of the business cost of flights and transfers for crew. One trade union representative explained that "*if [the operators are] flying someone from the other side of the world, and [the operators] have to pay for that flight back",* then the

international transfer process needs to be economically profitable for the operator. As a result, operators operate longer rosters for international seafarer.

Secondly, there is an additional logistical benefit to employing crew on longer tours of duty if they have travelled further. This is because, if seafarers have longer tours of duty, they require fewer long-distance transfers between their home and the vessel, which reduces the accumulation of fatigue and hassle from constant long-distance travel. When discussing roster length for international seafarers, an operator interview participant stated that international seafarers *"need to be away for longer periods of time for it to make sense"*.

Thirdly, interviews suggest that many international seafarers themselves prefer longer roster patterns and tours of duty. One operator suggested that international seafarers often asked for longer rosters, such as 3 months on, 3 months off, because it meant that they would get longer at home with family during time off.

Moreover, participants indicated that international seafarers were opting for longer rosters to increase their income, potentially at the expense of elevated levels of fatigue. Multiple participants across the interviews and roundtable corroborated this. During the roundtable discussion, one trade union representative said that "*most seafarers are making the decision to stay on board for a long roster for a decent salary*" and another trade union participant from a seafarers' charity emphasised that it "*is an economic decision for the seafarer because they can earn whatever they earn here [in the UK], [which is] more than what they earn in the Philippines… they are making career choices, they are making financial choices*".

However, the roundtable discussion also emphasised that international seafarers may be agreeing to longer roster patterns because there is pressure for them to comply to ensure future employment. During roundtable discussions, one academic expert said that international seafarers may be "*unlikely to complain [about longer rosters] and say 'I'm tired and this is too long for me' because then they won't get invited back."* Further research should be undertaken to explore the nature of this pressure and to understand the lived experience of international seafarers as they make the trade-off between more fatiguing rosters and higher salaries.

The interviews and roundtable discussion built on the existing literature by providing context that is specific to the Ro-Ro and Ro-Pax industries. Overall, these findings emphasise how important it is to consider how fatigue management can be tailored to the needs of international seafarers.

In some cases, roster patterns differed between seafarer roles. However, in the most part patterns were consistent across seafarer roles and seniority, for both long and short routes.

Adding to the existing literature, insights from interviews and the roundtable highlighted that roster and shift patterns on Ro-Ro and Ro-Pax vessels tend to be broadly the same across different roles. This was the case for short and long routes. However, there were some exceptions highlighted across the interviews and roundtable. Namely, some kitchen staff have longer rosters on vessels of up to 5 months and often more senior staff have to work overtime on their regular shift to make logistic and operational decisions and complete managerial admin.

There are a variety of common shift patterns on Ro-Ro and Ro-Pax vessels, but most seafarers work 12 hours per day

Once again, the qualitative research built on the existing literature by providing context that is specific to the Ro-Ro and Ro-Pax industries around shift patterns. Overall, we found that across the variety of roster patterns outlined above, participants suggested that most seafarers work up to 12 hours per day. At the roundtable, one trade union representative estimated that *"probably 80-85% will be doing a 12-hour day"*. This did not seem to vary across roster length - a trade union representative emphasised that "*everyone works 12 hour shifts regardless of how long the tour goes on for - 1 week, 2 months".*

However, these 12 hours can be worked across a variety of common shift patterns including: 12 hours on, 12 hours off; and 6 hours on, 6 hours off split shift. There were some shift patterns which enabled shorter working days, such as 4 hours on, 8 hours off.

The interviews and roundtable indicated that certain roster and shift patterns are more fatiguing than others but that there is a variation in preference between seafarers. This is explored below.

12 hours on, 12 hours off and 4 hours on, 8 hours off were considered more viable shift patterns for fatigue management

Participants viewed the 12 hours on, 12 hours off and the 4 hours on, 8 hours off patterns as the best shift pattern. One ex-seafarer said that *"12 hours on, 12 hours off were, in [my] opinion, the best operational days, because you [can] do things in a block".*

There are a variety of other potential interpretations of these findings, such as that it entails more time off-shift, enables longer periods of continuous sleep, and maintains the consistency of circadian patterns as employees can sleep at the same time each shift. For example, the 4-8-4-8 shift pattern fits into a 24 hour cycle. Additionally, the 12 hours on, 12 hours off patterns could potentially lead to a better circadian rhythm (12-12, with one longer sleep per 24 hour cycle).

Overall, this suggests that shift patterns that enable longer periods of rest and, in particular, those that can allow for at least 8 continuous hours of sleep in the off period, are better for managing seafarer fatigue.

6 hours on, 6 hours off shifts were considered the most fatiguing

Corroborating with much of the evidence in the literature, the interviews and roundtable discussions emphasised that the 6 hours on, 6 hours off shift patterns were consistently associated with greater levels of fatigue.

Findings from the interviews suggested that this was because employees' sleep was disrupted by these shift patterns. One ex-seafarer said that *"the killer is 6 hours on, 6 hours off, you don't get 8 hours sleep you're always chasing it*". A representative from a seafarers' charity expressed that *"on 6 hours on, 6 hours off pattern, a worryingly large number of seafarers fall asleep on shift",* and that "*6 hours on, 6 hours off is utterly destructive and not sustainable. I'm amazed we're even still talking about it - it's impossible to survive for more than a couple of days*".

Overall, this highlights the potential harm that 6 hours on, 6 hours off shift patterns have on seafarer fatigue.

Multiple features of shift and roster patterns that can contribute to seafarer fatigue

The interviews and roundtable discussion add to the existing literature by providing context about the impact of shift and roster patterns on fatigue that is specific to Ro-Ro and Ro-Pax seafarers. Multiple features of shifts and rosters impact fatigue, including:

6. **Longer tours of duty:** Participants suggested that across all route intensities, longer rosters are more tiring. This is because longer tours of duty require constant exertion and effort for longer periods of time, having a cumulative impact on fatigue.

7. **Night shifts and winter shifts:** Participants reported that night shifts were more fatiguing because it takes time to adjust sleep rhythms and patterns back from being awake during the daytime after the shift. Therefore, switching between night and day rosters regularly is fatiguing for seafarers. One ex-seafarer said that "*if you are doing nights, you at least lose a day, maybe day and a half, before you can adjust back. It gets a little difficult to get back onto the day patterns*". Equally, participants mentioned that winter shifts can be more fatiguing because the lack of sunlight reduces morale on board vessels and harsh weather conditions disrupt voyages, which make it more difficult to sleep on vessels due to increased movement of the vessel and the greater need for foghorns.

8. **Route intensity and number of transfers:** Participants reported that routes with greater intensity were more fatiguing. This was summarised by one operator who noted that "*[a] longer service is… a little bit more relaxed... [it is] not quite as intense as the Dover-Calais crossing"*, and by an ex-seafarer who said that "*the more*

journeys [in one shift] the more fatiguing". At the roundtable, attendees further emphasised that route intensity can be further exacerbated by harsh weather conditions, one current seafarer said that *"an important factor [for fatigue] is route intensity. The in and out [of the port], it is constant and quickly becomes fatiguing. But if you've got bad weather too and you've got foghorns going… the routes that you are working on can definitely impact fatigue or tiredness".*

9. **Non-contracted hours:** Furthermore, it was suggested that seafarers sometimes work non-contracted hours on vessels, whether that is helping colleagues with tasks during their breaks or associated with additional tasks at the end of a tour of duty. For example, one academic specialised in seafarer operations emphasised that there is "*a lot of 'lashing' done while the ship is at port [that is] non-contracted*",[3] which contributes to fatigue. Moreover, more senior crew members often have to work non-contracted hours to complete administrative and managerial tasks.

10. **Shift pattern and start points:** The pattern of the shift can impact seafarer fatigue when it compromises sleep duration and time. As a result, the start time of a shift is a factor that impacts how fatiguing a shift is, because it can interrupt circadian rhythms. One interviewee said that *"which [time] shift you happen to be on also impacts [how fatiguing] that shift is. If you're on the 00:00 - 4:00 am, then that is going to turn your sleep on its head".*

Overall, the interviews and roundtable identified a variety of features that contribute to how fatiguing a roster is for seafarers on Ro-Ro and Ro-Pax vessels. Often, many of these factors occur simultaneously and so have an additive impact on seafarers' fatigue, and have a cumulative impact on fatigue over longer rosters. Ultimately, this makes it challenging to identify which of these factors have a greater impact on fatigue, calling for further research that explores the relative impact of these factors.

Interview participants revealed variation in preference for roster and shift patterns

There was an appreciation that seafarers have a variety of different perceptions around the impact of roster patterns on fatigue: a participant representing a trade union said that *"I think every seafarer has a different view"*.

Some participants suggested that some seafarers do not need as much rest and recuperation as others following a roster and feel ready to work again before their next roster begins. One ex-seafarer, when talking about their weeks onshore between rosters, stated that *"the problem [is], for the next 4-6 weeks [that] you are off the ship… after the first 7-10 days you were bored and wanted to go back to work"*. Another ex-seafarer said

[3] 'Lashing' is the process of fixing containers or other cargo to a vessel or dockside.

that they benefited from extended periods of time off by travelling: *"when you have a one week off [it] is brilliant! If you are on your own, you can fly away for 6 days*".

However, it is possible that the above statements are influenced by the general perception that fatigue is a part of the job when working on Ro-Ro and Ro-Pax vessels. Other seafarers have highlighted the importance of roster and shift patterns for fatigue. When talking about shift and roster patterns for the Dover-Calais Short Strait, one ex-seafarer said that it is "*more sustainable*" to work any roster if the shift pattern allows you to "*get your 8 hours off*" to sleep.

Overall, it is key to note there is variation in lived experience of fatigue and roster patterns between different seafarers on Ro-Ro and Ro-Pax vessels.

Seafarers sometimes move between operators immediately when tours end, working continuously rather than taking time off to rest

Adding to the insights from the literature review, discussions at the roundtable highlighted that seafarers may also be fatigued because they are chaining voyage contracts together in sequence and taking no (or very little) time off to rest and recuperate. During the roundtable, an academic emphasised that "*we often have no idea how long [seafarers have] got off, they might take another short contract [after a roster]. It's not the case that people 'can't work' during their rest period - they might do 5 months on, then plan to have 1 month off, but just don't",* and another explained that *"you might go from operator A, then have 2 days off, then go to operator B, etc".*

Overall, chaining voyages together will contribute to seafarer fatigue if crew do not rest between rosters.

Workers can be motivated to work more fatiguing roster and shift patterns to gain a higher salary

Adding insight on top of the literature review, the interviews and roundtable discussion revealed that seafarers *"can be motivated to work beyond what's safe",* and that seafarers often selected more fatiguing roster and shift patterns in exchange for higher wages. Roster and shift patterns that better manage fatigue with shorter tours of duty and daily working hours can reduce the payment that crew get. Not all seafarers liked to prioritise rest and fatigue, and one operator participant emphasised that "*some workers have complained",* if their working hours and wages are compromised in favour of fatigue management.

Overall, this suggests that seafarers face competing priorities between increasing their income and prioritising rest. It could be suggested that these competing priorities are particularly acute for lower paid seafarers, who would be more incentivised by higher salaries. It is important to undertake further research to explore the lived experience of seafarers as they make this trade-off.

Understanding seafarer resting conditions:

Through interviews and roundtable discussions, we also explored the typical seafarer resting conditions on Ro-Ro and Ro-Pax vessels, which can help address fatigue by offering the opportunity to recuperate and recharge. Many of the insights drawn from the interviews and roundtable around sleeping conditions and recuperation reveal themes that did not emerge from the literature review, while others corroborate findings in the literature. Below we highlight some of the main themes.

Sleeping conditions vary between different vessels

There is variation in the quality of resting and sleeping conditions across vessels, often depending on its age and model.

For example, interviews with ex-seafarers and operators suggest that most vessels offer single cabins whilst some offer shared quarters. One representative from an operator said that "*the vast majority of our colleagues have single berth cabins".* Single berth cabins are better suited to manage rest and fatigue because sharing quarters with other crew members can increase fatigue because sleep is disrupted by others moving around the cabin. One trade-union participant noted that seafarers were sometimes "*sharing 4 to a cabin…loud, noisy berths, engine running constantly*".

Moreover, interviews revealed that there are facilities within sleeping cabins that help a seafarer to relax and feel at home, which is positive for managing seafarer fatigue. One ex-seafarer said that *"for me, my cabin was like my second home, I had my own kettle…! I had my own TV and everything"*, and an operator explained that "*crew wifi is a higher priority than passenger wifi."*

Overall, it is important to consider the environment in which seafarers sleep when developing approaches to managing seafarer fatigue.

The quality of sleep can be impacted by a variety of environmental factors

Academic studies showed that these factors included noise, movement, vibrations, light, temperature, and air conditioning (Abrahamsen et al., 2022; Cui et al., 2022; Jepsen et al., 2015; Schmied et al., 2020). Poor conditions in addition to some shift patterns can lead to compromised sleep (Jay et al., 2015).

These findings were supported by discussions during the interviews. One ex-seafarer said that *"the only downside of living on board is if there is really bad weather and the engine is rather loud. If it is extremely rough, you might be woken up, which could potentially affect your sleep,"* and another noted that *"[the disturbance] doesn't settle down - [if it was a] rough week, rough weather, engines running all the time… it is difficult to sleep".*

It is key to consider disruptive environmental factors that shape sleep and rest when developing approaches to manage seafarer fatigue.

There is mixed evidence on how easy it is to relax during off-shift time

Building on the academic literature, the interviews revealed mixed experiences for seafarers in terms of how easy it is to wind down and relax during time off-shift. Some participants felt that vessel conditions enable them to relax whilst off shift on vessels. One individual noted that there are good options for food and leisure facilities such as a gym, a sauna, a tennis table, television, and books.

However, other participants felt that it can be difficult to relax even when they were off shift: one ex-seafarer felt that "*you haven't got time to relax [even when you are off shift], you are always in a standby position"* in case an emergency occurred. Additionally, it was reported that it is sometimes difficult to fully relax since participants felt lonely on ships. One ex-seafarer felt that: *"on the ship, if you're working Dover-Calais, there's no real socialising. People come out of their place of work, eat, watch tv, read a book, sleep, wake up, shower. No real human interaction at all"*.

Equally, there is some qualitative evidence that seafarers on Ro-Ro and Ro-Pax vessels do not get much time to rest at all - roundtable attendees commented that: *"rest hours in the vast majority of cases is a work of fiction"* and that *"if you mention 'rest hours' on a ship to someone you will get a knowing smirk".*

Overall, it is important to recognise that enabling seafarers to relax on vessels when off-shift, such as through entertainment or socialising, will help to manage fatigue.

It can be a challenge to recuperate from fatiguing work

Recovering from fatigue through rest and recuperation is not a linear process. It was identified that taking a month off to rest will not mitigate the impact of months of high intensity work (without breaks) that follow it. One trade union representative said that *"it's often implied that longer rest periods can make up for longer tours. Not true, you can't 'bank' sleep".*

Moreover, as mentioned above, it can be particularly difficult to recuperate after working night shifts. When talking about this, one ex-seafarer said: *"you're like a zombie when you come home. If you're off the ship on a Wednesday, Wednesday is a travel day, when you get home you are sleeping, Thursday, Friday you are recovering and by Saturday you finally become a human being."*

Overall, it is important to acknowledge the real impact of fatigue on seafarers and consider that longer roster patterns and shift hours that disrupt sleep will cause fatigue irrespective of the amount of rest a seafarer has had before a tour of duty.

Understanding how roster patterns are designed:

During the qualitative interview and roundtable process, we also aimed to get an understanding of the factors that are considered when designing a roster or shift pattern. These insights add to the existing literature by providing context that is specific to Ro-Ro

and Ro-Pax seafarers. Below we summarise a variety of factors that each shape how roster and shift patterns are designed.

Fatigue management is one of multiple factors that shape roster and shift pattern design

Interviews with operators and ex-seafarers highlighted that operators do acknowledge seafarer fatigue when developing rosters. Often, fatigue is considered because it compromises vessel safety.

However, there are a variety of other factors that shape how rosters and shifts are designed, including international regulation, business and operational limitation, union agreements, and local constraints (e.g. port access), which are discussed below. Moreover, many of the efforts that operators make to manage seafarer fatigue occur outside of rostering, e.g. by provision of training or facilities.

Internationally defined standards for safe working conditions shape roster and shift design

Adding further insight to existing literature, multiple interview participants (operators, ex-seafarers, and trade union participants) agreed that operators do abide by international standards and laws regarding crew health and safety when designing rosters and shifts. When discussing whether managers of ships would often allow seafarers to work longer hours, an ex-seafarer said that *"[operators] were trying to be quite strict about it".* Insights from operator representatives also emphasise strong efforts to align roster patterns with international standards, one operator said that it is *"not tricky to balance – we are not trying to jump through any loopholes".* Overall, it seems that operators make efforts to meet international fatigue standards.

However, when talking about roster and shift patterns, one participant who worked at a trade union said that employers *"adhere to international minimum [standards] only"* but suggested that they should be aiming for more.

Operational constraints for operators shape roster and shift design

Interviews and roundtable discussions identified a variety of operational demands that also shape the final design of a roster, which are not discussed in the academic literature. For example, crew rotation feasibility (as shift and roster patterns must adjust to allow for crew rotation at port). These themes are summarised below.

- **Commercial and business constraints for operators:** Equally, shift and roster patterns are designed to meet operators' commercial and business needs. These exist at the shift level (e.g. designing shifts around customer demands for certain journey times) and at the level of the roster (e.g. by minimising time for handover and rotation on specific trade routes).

- **Local constraints on routes:** For example, port requirements vary on a local level and different ports face tidal constraints, each shaping ferry schedules. One operator said: "*we've got some tidal ports as well... So, if you don't match the tide you're stuck outside, which can then have an impact on [the crews'] hours of rest".* This shows that rosters and shifts on each route may therefore vary based on a series of local factors.

Overall, it is important to acknowledge that operational factors also shape the design of rosters and shifts and may be prioritised above fatigue management.

Input from seafarers and union negotiations shape roster and shift design

Qualitative interviews conducted suggest that, if an employee is struggling with fatigue, they can speak to managers who can be flexible in allowing seafarers to take longer breaks if a shift is not too busy, which can help to reduce fatigue.

Moreover, through their union liaison officers, some seafarers get the opportunity to negotiate with employers about their roster and shift patterns. In these negotiations it is possible for seafarers to prioritise seafarer fatigue and feed that into discussions about roster and shift patterns.

However, one trade union employee suggested that *"there is a lot of resistance from employers because they see it [shift management] as a cost-effect"* (i.e., the trade-off between the cost of managing fatigue through rosters, and the effect that this has on employees and business). This indicates that input from seafarers on roster and shift design may not be too strong.

Together, it is key to accept the variety of factors that shape the design of roster and shift patterns, which can sometimes conflict with fatigue management.

Understanding approaches to managing seafarer fatigue:

As part of this project, we also explored the different approaches that currently exist to help manage seafarer fatigue, which was present in the existing literature. Below, we highlight some themes that came from discussions during the interviews and roundtable session with Ro-Ro and Ro-Pax stakeholders.

Operators are making efforts to engage with fatigue management on vessels

Some themes included:

- **Conducting fatigue research**: Interviews with operators revealed that they are conducting investigations of their own into seafarer and crew fatigue: *"One of the things I am looking up this year is to carry out fatigue research, so that we have got some evidence to point to".*

Operators undertake this research with the aim of understanding levels of fatigue amongst crew on their vessels, looking forward to solutions to improve fatigue management.

It is important to note that measuring fatigue during studies can be challenging. For example, during interviews we found that seafarers may not feel confident enough to complain about their working conditions, so relying on self-report fatigue from seafarers may be a challenge. This is an important factor when developing approaches to measure fatigue.

- **Fatigue training for managers:** Operators also explained their efforts to provide fatigue training to managers and senior leaders. One operator explained that for managers "*there is a specific fatigue training for resources, recognising the signs of stress",* and for crew too there are "*awareness sessions with the staff themselves*". Such training programs are positive for promoting fatigue awareness on vessels and form a foundation for promoting fatigue management practices from crew.

- **Noise and vibration management:** Operators also suggested that they are making efforts to mitigate against disruption from noise and vibrations. One operator said: *"We do noise testing, we do vibration testing, and we have noise cancelling headphones for the crew if needed".* Ultimately, operators need to measure and understand the environmental factors that disrupt the rest and sleep of their crew to develop the best solution to overcome them.

- **Educational information**: Additionally, operators provide managers and crew with educational information relating to fatigue. One operator said: *"we send out health and wellbeing information on a two-monthly basis".*

- **Offering mental health support:** Moreover, operators provide support to seafarers that relates to fatigue. One operator explained that *"we do a lot of training on mental health first aid, provide a counselling system that is open 24/7 for a chat or legal/debt advice".* Whilst not directly related to fatigue, there could be an opportunity to discuss burnout and exhaustion through these resources too.

Adding to the existing literature, our qualitative research shows that operators are making some efforts to engage with fatigue management on Ro-Ro and Ro-Pax vessels. However, given the prevalence of fatigue on vessels evidenced through this research, it is important to continue these efforts and develop new ways to ensure that seafarers get adequate sleep and rest during their tours of duty.

6. Conclusions

The aim of this project was to explore different roster and shift patterns on Ro-Ro and Ro-Pax vessels and to better understand their impact on seafarer fatigue. Through reviewing the available literature and undertaking qualitative research with a range of stakeholders in the maritime industry, we provide an initial exploration of this evolving landscape. Building on previous research, this review adds contemporary insights about the spectrum of roster and shift patterns that currently exist across different Ro-Ro and Ro-Pax vessels, routes and provides some emerging insights into the effect they have on seafarer fatigue.

The main overarching themes are summarised:

- **There is a large variation in roster patterns** across the industry, ranging from ‘1 week on, 1 week off’ to ‘16 weeks on, 4 weeks off’.

- **Route length and intensity shapes roster length:** Within the sample group for this research, roster patterns tend to vary based on the route length and intensity, with shorter, more intense routes being associated with shorter rosters and longer, less intense routes being associated with longer rosters. These patterns exist because the seafarers that work shorter, more intense tours of duty get a lower quality of rest whilst on tour, so need to recuperate from fatigue sooner.

- **Seafarers employed internationally work longer rosters**, depending on the operator. This is due to economic and logistical benefits for operators to employ crew on longer tours of duty if they have travelled further and because international seafarers may be opting for longer rosters to increase their income.

- **Most seafarers work 12 hours a day across a variety of shift patterns** (e.g. 12 hours on, 12 hours off; 6 hours on, 6 hours off), although some shifts enable shorter working days (e.g. 4 hours on, 8 hours off).

- **Seafarers find ‘12 hours on, 12 hours off’ and ‘4 hours on, 8 hours off’ shift patterns less fatiguing.** This is because these patterns enable longer periods of continuous sleep and a consistent circadian rhythm (i.e. up to 8 hours of sleep at the same time each day). For these reasons, the shift pattern of 6 hours on, 6 hours off is considered damaging to fatigue.

- **Multiple features of shift and roster patterns contribute to seafarer fatigue.** For example, longer tours of duty routes with greater intensity are more fatiguing because they require exertion for longer or more intense periods of time. Plus, night shifts are more fatiguing because it takes time to adjust sleep rhythms and patterns back being awake during the daytime after the shift. Lastly, some shifts are more fatiguing if seafarers work non-contracted hours on vessels, such as by helping colleagues with tasks during their breaks or at the end of a tour of duty.

- **Seafarers sometimes chain voyage contracts together, impacting fatigue**. Chaining voyage contracts together in sequence means some seafarers are taking no or very little time off between to rest and recuperate between rosters.

- **Seafarers can be motivated to work a more fatiguing roster and shift to gain a higher salary.** Seafarers face competing priorities between increasing their income and prioritising rest, and it is important to undertake further research to explore the impact of this on the wellbeing and safety of seafarers.

- **The quality of seafarers sleep and rest depends on a variety of factors**. This includes the conditions of their sleeping quarters, the facilities available to them during the period of rest, and multiple environmental factors (such as noise and vibrations from the vessel, and disruption due to harsh weather conditions).

- **Roster and shift patterns are designed with fatigue management in mind, but other competing factors also shape the design.** Operators do consider fatigue when developing rosters and shifts and adhere to international legislative requirements during planning. However, there are multiple other competing factors that shape roster and shift design, including operational constraints, commercial and business constraints, and local constraints, such as port access.

- **Operators make efforts to engage with fatigue management on vessels.** This includes conducting research into fatigue amongst their crew, providing training and education about fatigue for seafarers of all roles, engaging with noise and vibration management, and offering mental health support. However, further efforts could be made to reduce fatigue through roster and shift patterns.

Overall, this research has explored the various types of roster patterns used by operators, the quality of rest experienced by seafarers and how this impacts their fatigue, and what fatigue management measures are used by operators. The research found that fatigue is a prevalent issue on Ro-Ro and Ro-Pax vessels. Roster and shift patterns have a key influence in seafarer fatigue. However, a variety other elements shape fatigue too, including environmental factors and seafarers' motivations. In the next section we lay out some recommended avenues for further research.

6.1 Evidence gaps and further research questions

Multiple research gaps have emerged from the literature and qualitative research. These represent distinct gaps which we could not directly address within the collected evidence or qualitative insights and are detailed below.

Further evidence relating to Ro-Ro/Ro-Pax vessels specifically

This current research project aims to explore the landscape of rosters and fatigue on Ro-Ro and Ro-Pax ferries. The reviewed academic literature covered a range of different

vessels, including shipping vessels, oil tankers, fishing vessels, and naval vessels. Our own qualitative research focussed on Ro-Ro and Ro-Pax vessels and thus to some extent fills this evidence gap.

However, it is recommended for future research to build on our current efforts to research fatigue and the effect of different roster patterns among Ro-Ro and Ro-Pax vessels specifically.

Further research relating to roster patterns alongside shift patterns

This current research project aimed to explore the range of roster patterns that exist (i.e., weeks/months on/off).

However, the majority of the reviewed academic literature focussed on shift patterns (e.g. hours on/off). It is therefore recommended for future research to more systematically map the spectrum of roster patterns that exist, and to better understand what seafarers do when finishing a tour. For example, an operator is unlikely to know if a member of staff starting a tour has come from an extended period of rest or has recently finished a tour with another operator. Yet this could be quite consequential on the seafarer's starting condition of cumulative fatigue.

The literature review and qualitative research approach alone was not sufficient to gather comprehensive data on shift and roster patterns. We emphasise that quantitative approaches to gathering data on this topic, such as through mandatory reporting, could further illuminate the spectrum of real roster and shift lengths.

Exploring fatigue and rostering with current and international seafarers

The scope of this research piece had been set out to limit the seafarer sample to ex-seafarers rather than current seafarers; insights about the current seafarer roster patterns were derived from interviews with operators, trade unions, charities, port chaplains, and academics. In recent years, the make-up of seafarers employed around the world has been shifting. As such, future research should expressly aim to explore the experiences of current seafarers on an international scale.

Identify the level during a shift or roster at which fatigue becomes a problem for seafarers

There is further scope to identify fatigue tipping points within given seafarer rosters and shift patterns. We recommend a quantitative approach here, to ascertain as accurately as possible the moment during rosters at which seafarers begin to feel fatigued. This could entail monitoring seafarer fatigue on vessels through self-report surveys, or modelling fatigue via existing fatigue models to understand when fatigue becomes unsafe.

Further research into the impact of fatigue on seafarers' ability to adhere to muster lists

Muster lists (duties and responsibilities for seafarers to undertake during crisis moments, e.g., rough weather, machinery malfunction) are critical for the safety of Ro-Ro and Ro-Pax vessels. Further research should be undertaken to explore the impact of fatigue on seafarers' ability to adhere and execute muster lists.

Further explore operators perspectives

There were challenges in recruiting many operators for this research project, and therefore given the small sample of operators we interviewed, the findings in this report do not account for the full range of perspectives that operators may have about rostering and seafarer fatigue. Therefore, future work should aim to gather further data about operators' perspectives on rostering and fatigue management.

Identification of further mitigation measures

Current measures to reduce seafarer fatigue are largely focussed on avoiding poor practices (e.g., not working excessive hours). Any efforts to identify further measures to promote seafarer wellbeing and minimise the risk of fatigue beyond merely avoiding poor practice would be beneficial. Example research studies may include exploring a cost-effective way of providing quality soundproofing of sleeping quarters or identifying optimal crew numbers to manage both workload and rest-time safely.

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8. Appendix

Appendix 1: Summary of the literature review

Table 2: Summary of the reviewed literature, which were selected on the basis of scoring highest on the inclusion criteria

Author (year)	Title	Summary
Abrahamsen, Weihe, Debes, & Van Leeuwen (2022)	Sleep, sleepiness, and fatigue on board Faroese fishing vessels	157 Faroese fishers completed sleep and sleepiness diaries while wrist-worn devices objectively measured individual sleep and activity (4133 sleeps were recorded over the study period). A reaction time test was used to measure sleepiness at the start and end of shifts. Data on ship movements and noise were also collected. **Fishers on longliner vessels were found to get the most sleep per day**; more than those on netting vessels, which in turn had more than those on trawlers. Ship noise during the day while awake appeared to improve sleep efficiency (i.e., the amount of sleep) by having a tiring effect on the fishers, while **noise during resting hours decreased sleep efficiency**. Ship movement showed a U-shaped trend with **too little and too much movement both having negative impacts on sleepiness and fatigue**.

An, Gao, Liu, & Liu, (2022)	Empirical study on the relationship between vacation schedule and seafarers' fatigue in Chinese seafarer population	165 seafarers of various ranks (cadets, support, operations, management) from large bulk carriers and container ships in China completed a questionnaire measuring work stress, fatigue, and vacation time. **Senior crew members found to experience greater fatigue than more junior members**, likely due to the increased responsibilities. **Insufficient vacation time and excessive working hours are strongly linked to fatigue**.
Andrei, Griffin, Grech, & Neal (2020)	How demands and resources impact chronic fatigue in the maritime industry. The mediating effect of acute fatigue, sleep quality and recovery	199 seafarers (including officers and crew) working on bulk carrier ships completed a survey examining work demands, fatigue, and sleep issues. **Monitoring demands found to have a strong association with fatigue**, more so than feelings of time pressure, likely due to low stimulation and boredom. Both **job autonomy and social support appear to have potential fatigue-mitigating effects**.
Azimi Yancheshmeh, Mousavizadegan, Amini, Smith, & Kazemi (2020)	Poor sleep quality, long working hours and fatigue in coastal areas: a dangerous combination of silent risk factors for deck officers on oil tankers	70 oil tanker deck officers working 4 hours on, 8 hours off shifts completed measures of attention, sleepiness, and sleep quality. Results showed that **officers with 4 hours on, 8 hours off shifts in a real-world setting had greater fatigue than those on 6 hours on, 6 hours off shifts in simulator studies** (e.g. HORIZON) – suggesting that simulated studies of seafarer fatigue do not capture the true extent of fatigue experienced in reality. **Poor sleep quality, high workload, and long working hours were also identified as the most critical factors which impair performance**. It should be noted that this study used a subjective measure

		of sleep quality (self-completion questionnaire) which has lower precision than an objective measure.
Cui, Liu, Wang, Yang, Fan & Shu (2022)	The impact of marine engine noise exposure on seafarer fatigue: A China case	800 cadets (19-21 year old males) worked on the “Yukun”, a training ship that integrates teaching and research tasks, for 28 days – 14 at sea and 14 at port. Engine noise was measured in the ship’s dormitories and cadets completed a survey of sleep quality and mood throughout the study period. **Time in bed and total sleep time increased as engine noise level increased** as seafarers want to sleep longer to relieve the anxiety and irritability caused by engine noise. In addition, **higher numbers of engine noise events caused sleep onset latency to increase (i.e. it took longer to get to sleep) and sleep quality to drop**. Due to the young age range of the all-male sample, it is unclear whether these issues are exacerbated further by age and gender.

Grech (2016)	Fatigue risk management: A maritime framework	Study reviewed evidence on seafarer fatigue and analysed case studies of real-world accidents in the shipping industry where fatigue was a contributory factor. This work highlighted the poor culture in this industry wherein **tolerating fatigue is an expected and accepted part of the job**. This work ultimately proposed a risk-based approach for the management of fatigue; this approach has since been adopted by the Australian Maritime Safety Authority in their 2020 guidance document '*Fatigue Guidelines: Managing and Reducing the Risk of Fatigue at Sea*' (see references).
Härmä, Partinen, Repo, Sorsa, & Sidone (2008)	Effects of 6 hours on, 6 hours off and 4 hours on, 8 hours off watch systems on sleepiness among bridge officers	185 bridge officers completed a questionnaire on sleep, work hours, and safety. This included the Skogby Excessive Daytime Sleepiness index (SEDS). 78 worked two 4 hour watches (4 hours on, 8 hours off) per day; 48 worked two 6 hour watches per day (6 hours on, 6 hours off). In addition, 92 completed a 7-day sleep diary while at sea. Findings suggest that the **6 hours on, 6 hours off watch pattern was associated with greater sleepiness, particularly during early morning hours** compared to other watch patterns. Study recommends all merchant vessels have a watch system of master plus two bridge officers to improve safety, as well as encourages 4 hours on, 8 hours off watch system which allows for at least one 8-hour period of continuous rest.

Jay, Aisbett, Sprajcer, & Ferguson (2015)	Sleeping at work: Not all about location, location, location	Study conducted a review of evidence on factors contributing to sleep outcomes, including timing of rest periods, duration of breaks, sleeping environment (noise, movement, light, vibration), circadian phase, and familiarity with sleep location. All factors were deemed important in contributing to quality sleep and reducing fatigue; however, **the sleeping environment was deemed less critical than the timing and duration of sleep periods**.
Jepsen, Zhao, & Van Leeuwen (2015)	Seafarer fatigue: a review of risk factors, consequences for seafarers' health and safety and options for mitigation	Broad evidence reviews on seafarer fatigue with attention given to fatigue risk factors, short- and long-term consequences for health and safety, and fatigue mitigation measures. **Work stress, shift work, and physical workload were found to be critical risk factors related to fatigue**. **Long-term fatigue can result in metabolic, cardiovascular, and gastrointestinal disorders among other health issues**. **Larger crews can reduce workload and working hours, thus helping to mitigate fatigue**. **On-board sleeping conditions should be protected from noise and vibration, properly air-conditioned, with an option to shield off daylight to promote good quality sleep**.

Mansyur (2021)	Long working hours, poor sleep quality, and work-family conflict: determinant factors of fatigue among Indonesian tugboat crew members	127 tugboat crew members from ships with a minimum 7-day voyage in Indonesia recorded work/rest time during their voyage. Questionnaires also used to collect relevant demographics, sleep data, and stress related to work-family conflict. Study only considered those on 4 hours on, 8 hours off and 6 hours on, 6 hours off work schedules. As stated in the study title, **long working hours (>72h/week), sleep quality, and work-family conflict were strongly associated with fatigue**. Other personal and occupational factors (e.g., age, seafaring experience) were found to not be significantly associated with fatigue.
Nittari, Gibelli, Bailo, Sirignano, & Ricci (2022)	Factors affecting mental health of seafarers on board merchant ships: A systematic review	A systematic review of evidence to identify the main causes of mood disorders and their long-term effects on health among seafarers working on merchant ships. **The main causes of mood disorders among seafarers were identified as: social isolation, distance from families, fatigue, stress, and long working hours**. The effects of the Covid-19 pandemic were also identified as exacerbating problems such as isolation. The serious problems surrounding seafarer mental health appear to persist due to the culture within the industry. Strategies such as **promoting group activities and physical activities (e.g. sports) are encouraged to help in counteracting the onset of mental illness**.

Oldenburg & Jensen (2019)	Stress and strain among seafarers related to the occupational groups	323 seafarers on 22 container ships completed a questionnaire – recording working time, leisure time, and sleeping time – and were biometrically surveyed via an armband monitor over a period of 3 days. Participants were categorised based on their job role: nautical officers, deck ratings, and engine room personnel. **Nautical officers were found to have the shortest sleep episodes, greater sleep deficits, and experience the most mental stress**. **Work-related energy expenditure was highest among deck ratings**, followed by engine room personnel and then nautical officers. Study recommends creating a tailor-made on-board health promotion programme, shortening the duration of stay on vessels, and better scheduling to reduce the number of port calls required for cargo handling.
Riethmeister, Bültmann, De Boer, Gordijn, & Brouwer (2018)	Examining courses of sleep quality and sleepiness in full 2 weeks on/2 weeks off offshore day shift rotations	Bi-daily sleep diaries used by 42 offshore workers across a four-week period: one week of pre-offshore leave, two weeks of offshore work, one week of post-offshore leave. Sleeping accommodations of participants were assessed and scored with the recommended ranges. Findings showed that **offshore day-shift workers experienced sleep and sleepiness problems during shift rotations**, similar to night- and swing-shift workers. However, it is noted that the challenges of readapting to day life is more pronounced among night-shift workers and sleep efficiency appears better among those working dayshift. The study fails to account for any

		accumulated fatigue prior to the start of the study.
Schmied, Harrison, Dell'Acqua, Perez, Glickman, & Hurtado (2020)	A Qualitative Examination of Factors That Influence Sleep Among Shipboard Sailors	22 interviews conducted with naval service members assigned to sea duty. Interviews focused on assessing the experiences of sleeping in shipboard environments to understand the barriers to sleep and strategies employed by service members to improve sleep and combat fatigue. **Stress, rotating schedules, and environmental factors (e.g., noise, light) found to be barriers to sleep**. Mitigation strategies (e.g., noise-cancelling headphones) not always viable due to job responsibilities. Study recommends improving education around fatigue management practices among naval service members. It should be noted that the method involved a mix of telephone, in-person one-to-one, and group interviews, which may have impacted on the consistency of themes drawn out by the analysis.

Short, Agostini, Lushington, & Dorrian (2015)	A systematic review of the sleep, sleepiness, and performance implications of limited wake shift work schedules	Evidence review which aimed to identify the optimal shift to promote sleep, alertness, and performance. LWSW are work/rest patterns where work time is ≤8 hours and there is >1 rest period per day for ≥2 consecutive days. **4-on/8-off roster associated with better quality sleep and reduced sleepiness** compared to 6 hours on, 6 hours off and 8 hours on, 8 hours off rosters. Study highlights research needs that compare different rosters and the consequences on performance.
Slade (2022)	Seafarer health: Research to date and current practices	Evidence review and series of four roundtable discussions with shipping companies, trade unions, and regulatory bodies. Various stressors were identified from the literature found to be affecting the overall seafarer population. These were categorised as: 1) work environment, 2) organisational, 3) cultural, 4) physical, and 5) psychosocial. Elements relating to fatigue and working patterns fell across these categories. **Interventions intended to mitigate these stressors have been limited by barriers** such as how these have been implemented and embraced among target groups. Study highlights the importance of introducing a ‘culture of care’ in the seafaring industry.

Van Leeuwen, Kircher, Dahlgren, Lützhöft, Barnett, Kecklund, & Åkerstedt (2013)	Sleep, sleepiness, and neurobehavioral performance while on watch in a simulated 4 hours on/8 hours off maritime watch system	30 bridge officers participated in a simulator trial of a one-week voyage in the North Sea and English Channel to understand sleepiness patterns and effects during 4 hours on, 8 hours off watch system. Three watch teams (00-04, 04-08, 08-12) rated their sleepiness every hour and completed a psychomotor vigilance test at the start and end of every watch. Findings showed that **within 4 hours on, 8 hours off shift schedule sleepiness peaked during the night and early morning watches**, while sleepiness was at its lowest during afternoon and evening watches**.** This is comparable to sleepiness experienced on 6 hours on, 6 hours off shift schedules. Of note, **1/3 of participants fell asleep on watch**.
Van Leeuwen, Pekcan, Barnett, & Kecklund (2022)	Mathematical modelling of sleep and sleepiness under various watch keeping schedules in the maritime industry	Study applied a mathematical model of rest/alertness to compare different maritime watch schedules. The model was applied on a 2-week period of watch-keeping. **Three-watch systems (i.e., having three watch keepers/teams share a 24-hour period) were found to be the best overall in terms of reduced sleepiness and opportunity to obtain sleep**, ahead of two-watch systems. The model used did not account for specific details (e.g., vessel type, workload, environmental factors) so findings may not be closely accurate to reality; however, the highlighted finding is broad enough to still be valuable.

World Maritime University (2022)	A culture of adjustment: evaluating the implementation of the current maritime regulatory framework on rest and work hours (EVREST)	Conducted a series of interviews (71), focus groups (2), and case studies involving seafarers, shipping companies, port control officers, and maritime organisations. Study aimed to gain an understanding of seafarers' compliance with the current maritime regulatory framework on rest and work hours, including barriers to effective implementation and its effectiveness at preventing fatigue. **Insufficient manning levels found to facilitate non-compliance with rest hours requirements**. Recommendations include ensuring accurate record-keeping among seafarers on work/rest hours, while relevant organisations review policies around managing seafarer work/rest hours.
Youn & Lee (2020)	Seafarers' physical activity and sleep patterns: results from Asia-Pacific Sea routes	51 senior apprentices on South Korean training ships (Mokpo National Maritime University) volunteered to have data collected across three sea voyages. Physical activity and sleep were compared between: moored vs, on- vs off-navigation duty, and day vs night navigation duty. **Physical activity levels and sleep quality of seafarers in Asian maritime settings were found to be considerably lower than recommended levels**. Sleep quality also found to be worse while at sea compared to moored, and **physical activity and sleep quality was found to be worse among those on night-watch duties**.

Zhao, Wadsworth, Jepsen, & Van Leeuwen (2020)	Comparison of perceived fatigue levels of seafarers and management approaches in fatigue mitigation: Case studies from two Chinese and two European shipping companies	880 seafarers, half from European shipping companies and half from Chinese companies, completed questionnaires on work, rest, fatigue, and travel to and from the vessel. 98 interviews were also conducted with seafarers and managers across two European and two Chinese shipping companies. Compliance with international regulations on work/rest hours and on-board living conditions varied. **Seafarers among Chinese shipping companies were found to suffer from greater fatigue than those in European companies**. Factors which contributed to fatigue in both groups, including job security, work demands, and environmental factors, were similar across both regions.

Appendix 2: Inclusion/exclusion criteria

Table 3: Inclusion scoring criteria used for the evidence review

	Score = 1	Score = 2	Score = 3
Relevance	Not relevant to the objectives of the review	Some indirect relevance to the objectives of the review	Directly relevant to the objectives of the review
Quality	Non-scientific article (e.g., online source, newspaper, or magazine article)	Non-peer reviewed scientific article	Peer-reviewed scientific article (e.g., journal paper or conference procedure)
Timeliness	Published more than 15 years ago (2007 and earlier)	Published between 4-15 years ago (2008-2019)	Published in the last 3 years (2020-2023)

These criteria allow for only the most relevant and quality literature to be included in the evidence review, meaning only the most robust and appropriate findings will be drawn. The Covid-19 pandemic is likely to have had an impact on seafarers and fatigue (see the impact of covid-19 section in this article: Wellbeing in the workplace: a focus on seafarers - What Works Wellbeing and the 2020 Seafarers Happiness Index reports). As such, the scoring criterion timeliness was designed to consider the impact that the pandemic may have had on the industry, with the highest-scoring most likely to reflect present-day experiences.

Appendix 3: Topic Guide for the one-to-one interviews.

Section 1. Introduction

Introduce yourself

Explain the aim of the discussion:

- BIT is a social- research organisation.
- We are working with the Department for Transport (DfT) to explore ferry seafarer work patterns and fatigue.

This interview:

- 1 hour long
- We want to speak to UK based maritime organisations (including operators, unions, charities, trade bodies, ex-seafarers and industry experts) about their experiences and perceptions of the impact of roster patterns and management approaches in seafarer fatigue and well being.
- We are also hoping to gather some data and insights about the typical roster patterns that different shift-workers have on Ro-Ro and Ro-Pax ferries.
- There are no right or wrong answers, we just want to understand the world from your point of view.

Confidentiality: Findings and quotes might be used in a published report, but it will be completely anonymous - we will not name you, or use any information that could identify any individuals.

Anonymity and privacy:

- We won't use your name anywhere in any reports.
- If you feel uncomfortable answering a question we can just skip it.
- If you want to stop the interview altogether at any point, just let me know. You don't have to give a reason.
- If afterwards you decide you want to withdraw your answers, just get in touch with me and I will remove your answers from our research.

Do you have any questions?

Are you happy for me to record the interview? We'll use the recording to make a transcript of our discussion to help us analyse our findings.

- **To start off, can you tell me a bit about your role?**
- **What other roles have you worked on ferries in your life that could also inform you responses today?**

Section 2. Understanding the typology of roster patterns

First, we'd like to learn more about the different types of roster patterns on Ro-Ro and Ro-Pax ferries. You may refer know this as rotation. We are interested in the

working hours and hours and days of rest and how many weeks are 'on' / worked continuously and how many weeks are 'off'.

Note: We appreciate that there may be a number of different working patterns in place, depending on operator, contract, role, seniority and local agreements. For simplicity, please provide details of the most commonly used rosters and which roles they would apply to.

Basic questions

1. Please can you describe the most common **work pattern(s) or base roster** worked by Ro-Ro and Ro-Pax seafarers?

2. In your experience, what are the shortest and longest rosters currently used? What would be a couple of typical case studies / scenarios? [note: this could give us a range / a couple of scenarios for the model]
    a. What makes it the best or worst?

3. **How would these typical patterns differ,** in function of seniority / type of role, type of vessel or other factors? Can you share some examples?
    a. *Prompts: low-cost ferriers / agency workers; junior vs senior staff, shorter vs longer routes (particularly short straits (Dover-Calais), specific operators, British/European seafarers vs international seafarers etc.*

Detailed questions: *Skip questions as needed in case of lack of detailed knowledge.*

4. On a typical 'tour of duty', **how many days/weeks are workers at sea** /off?
    a. *Prompt: e.g. 2 weeks on/ 2 weeks off for senior staff; 18 weeks on / 6 weeks off for junior staff*
    b. *When it comes to 'off' periods, are these spent at shore or off-shore (on vessel or off)?*
        i. *If it is ashore, do you tend to do so in France or in the UK? How long does it take to get home during off rosters?*

5. How many **hours** do seafarers typically work **per week**? How many **consecutive** days?

6. What **shift systems / watch patterns** are typically in operation?
    a. *Prompt: e.g. 6 on / 6 off; 4 on / 8 off; 8 on / 8 off*

7. How much **rest time** do seafarers typically get?
    a. *Prompt: e.g. 10 hours daily rest (divided into 2 periods, 1 of which has to be 6 hours); 16 hour interval between 6 hour rest; 70 hours rest in a 7 day rolling period*
    b. *And is rest time undisrupted? Or are workers called upon to help out during down time?*

8. How would the above **differ in function of** seniority / type of role, type of vessel or other factors? Can you share some examples?
    a. How does this differ based on the length of the route (Short Strait routes vs. a 3-day)?

For operators' roster managers/union representatives/ex-seafarers:

- *Would you be able and willing to provide an example roster sheet for different types of roles and vessels?*
- *In your experience, how reliable / truthful are the official rosters? Why/not?*

Section 3. Design of roster patterns

We have a couple of questions now about how rosters for seafarers are designed [skip if the person doesn't have the insight needed].

9. How do ferry operators **make decisions about roster patterns**?
    a. What factors do they consider? *Prompts: E.g. legal requirements, union demands, financial factors / competitive pressures, habits, other…*
        i. *Is seafarer wellbeing or welfare factored in?*
    b. How much is seafarer fatigue is considered when roster patterns are designed?
        i. How does this differ by rank?
        ii. How does this differ by nationality?
    c. Who makes roster decisions on a given vessel (e.g. roster master)?
    d. How are rosters recorded? To whom are these accessible?
    e. How easy or hard is it to change roster patterns? How frequently are they reviewed? Based on what information?

10. What **role do seafarers play** in this decision-making?
    - Can they influence / select their roster? What factors do they take into account when deciding what to choose / accept?
    - How does this differ for different types of roles / seniority, etc.?
    - Do seafarers have a preference for more or less intensive shift patterns at sea / on leave? Does it vary, e.g. depending where they're from?
        i. Do you have evidence that the seafarers prefer longer roster patterns?
        ii. Does this differ by route?
    - How do organisations engage with employees about working conditions if they ARE NOT part of a union?

Section 4. Seafarer fatigue

Now we'd like to move on to discussing seafarers' resting and sleeping conditions, their levels of fatigue and the link with roster patterns.

11. What are **the typical resting and sleeping conditions** on Ro-Ro and Ro-Pax ferries?
    a. *Prompt: number of people in the cabin, size of the cabin, noise, motion, and light levels*
    b. *Prompt: differences by type of role, seniority, type of vessel, route and season (e.g. sea conditions) operator, etc.?*

12. How do the staff typically **spend their non-working hours** ?
    a. *Prompt: differences by type of role, seniority, type of vessel, operator, etc.?*

13. How **prevalent do you think fatigue** is for seafarers? What are the most common causes?
    a. *Prompt: Roster pattern, Timing of the rest period; Excessive light; Room sharing; Noise from operations; irregular sleeping hours; Weather; Crossing duration/frequency, etc.*

14. In your experience, what roster patterns are more likely to cause fatigue? Why?

    a. *Prompt: differences by type of role, seniority, type of vessel, operator, etc.?*

15. What are some of the **most common adverse consequences of fatigue** for seafarers?
    a. *Prompt: differences by type of role, seniority, type of vessel, operator, etc.?*
    b. *Physical health? Mental health? Crew morale? Relationships? Errors in work?*

Section 5. Mitigation measures for seafarer fatigue

Finally, we'd like to talk a bit more about what <u>is</u>, and what <u>could be</u>, done to help prevent and mitigate seafarer fatigue in Ro-Ro and Ro-Pax ferries.

16. To what extent is the ferry **management aware** of the seafarer fatigue issue?
    a. What do managers do to manage fatigue?
    b. How motivated are they to put measures in place to manage seafarer fatigue?

17. What **standard practices** - proactive and reactive, systematic and short-term - exist on ferries **to manage seafarer fatigue**, to your knowledge?
    a. *Prompt: e.g. change of roster patterns, Fatigue Management plans, fewer people in cabins, noise cancelling devices, more crew*
    b. What, if anything, prevents operators / seafarers from implementing these?
    c. *Prompt: differences by type of role, seniority, type of vessel, operator, etc.?*

18. What evidence, if any, exists, on the **effectiveness** of these types of measures? How is it measured?

19. What **other solutions** could be promising?
    a. *Prompt: e.g. coming from the government, unions or and other major stakeholders; solutions adopted by individual seafarers*

Section 6. Closing

Thank you for taking part in our research today.

Once we've completed all of our interviews we'll be taking a closer look at our findings which we'll then summarise in a report for DfT that will be published later in the year. All of your responses will be anonymised so no one will be able to identify you from our report.

Do you have any questions? In case you have any questions in the future, feel free to contact us at [interviewer email].