

> TNO report for
NOGPA

Implications from a change in tour and leave from 2-2 to 3-3



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Implications from a change in tour and leave length from 2-2 to 3-3

Report for NOGEPA
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1 Introduction

The Dutch working time legislation limits the amount of shifts in offshore mining to 14 shifts in 28 days. This leads to the current practice of '2 weeks on/2 weeks off' (2-2 system). In recent years, the offshore oil industry has gone through major economic, structural and technological changes leading to reduced manning of rigs and ships, increased automation, increased workload and decreased job security. This indicates that regulations may need to be updated.

Worldwide, a variety of different schedules is being used. The work and rest schedules are mainly dependent on the travel time of employees, the travel opportunities, weather conditions and regional and national regulations. The most common rotation worldwide is 28 days offshore and 28 days onshore, but rotations of 7-14-35-49 days and longer are also known. In the North Sea various schedules are being used. The most commonly used schedules are:

- › Dutch continental shelf → 14 days offshore/14 days onshore;
- › Danish, German and UK continental shelf → 21 days offshore/21 days onshore;
- › Norwegian continental shelf → 14 days offshore/28 days onshore.

NOGEPA¹ wants to make a request to the Ministry of Social Affairs and Employment to allow a '3 weeks on/3 weeks off' system, thus providing a broader playing field for individual companies. In the current system of '2 weeks on/2 weeks off' travel time takes up a large part of the resting time, since workers come from many different countries. In a '3 weeks on/3 weeks off' system less time will be spent traveling. Furthermore, less helicopter traveling reduces traveling related risks. Also, less handovers and shift changes will be needed, which implies an improvement of efficiency and quality. In addition, training that takes place onshore could be organised more efficiently. In order to make such a request, more knowledge is necessary about the consequences of this system (3 weeks work at a drilling/production platform and 3 weeks leave). The unions have asked for an independent research into the health and safety consequences and - if a new system would be implemented - into the conditions in which this new system could be implemented in a healthy and safe way, such as the optimal working time schedules while working offshore or other risk management measures.

NOGEPA has invited TNO to provide an objective and well-founded report into the health, safety and well-being consequences of the different systems for the offshore employees² and to advise on the conditions for implementing a 3-3 system. This report describes the results of this research.

1.1 Research questions

The central research questions are the following:

- › What would be the health, safety and well-being implications for the offshore employees of an extension of the offshore working time from 2 weeks to 3 weeks?

¹ Nederlandse Olie en Gas Exploratie en Productie Associatie.

² All offshore employees who work on oil and gas drilling and production rigs in the North Sea area.

- › What are the conditions for implementing this extension in a healthy and safe way?

The main objectives are:

- › Insight into the (dis)advantages of a 3 weeks on/3 weeks off system in comparison to a 2 weeks on/2 weeks off system with scientific knowledge from the (international) literature;
- › Insight into the preferences and practices with regard to the working time schedules and health, safety and well-being aspects of employees and employers in the member organisations of NOGEPA, IADC³ and IRO⁴.

1.2 General assumptions

This report was written based on the following assumptions:

- › The 12-12 rotation scheme is given as a fact and is not questioned;
- › An extension of the tour length from 2 to 3 weeks is accompanied by an equal extension of leave length. In short: from a 2-2 to a 3-3 system;
- › The reader has knowledge of laws and regulations with respect to work in offshore mining (see also Appendix 1).

Our conclusions will be based on the assumption that rigs will have at least 25 workers. With this minimum amount, workers should be able to support one another during the time offshore.

³ International Association of Drilling Contractors.

⁴ The Association of Dutch Suppliers in the Oil and Gas Industry.

2 Method

We started our research with (Part I: July-August 2014):

- › an orientation on the sector;
- › a literature review;
- › expert consultation.

Since the results of these activities didn't give an unambiguous answer to the research questions, we have (Part II: December 2014 - June 2015):

- › investigated workers' appreciation on different topics in relation to an extended tour duration,
- › investigated employers' intentions to change the current tour and shift system if allowed by new regulations,
- › interviewed experts (HSE & Q officers and physicians) on health and safety measures, health related complaints in relation to offshore work and expert views on the effects of tour duration,
- › conducted a study on available Health and Safety data to investigate the correlation between tour duration and health- and safety related issues.

2.1 Part I: Orientation in the sector

- › Visit to a drilling platform, observation of the work and interviews with employees and managers.
- › Study of working time rules and regulations in the sector.
- › Study of available information on the current situation on the basis of documents provided by NOGEPA and IADC⁵ (rotation scheme, consequences for safety and health, etc.).

2.2 Part I: Literature review

Review on the international scientific literature about shift work in offshore, rotation schemes, consequences for safety and health, and comparisons of rosters.

The sources for scientific literature:

- › TNO's own research on the topic;
- › A search on our web database for scientific literature; and
- › A request for research in offshore among the members of the Working Time Society (Scientific Committee on Shiftwork and Working Time of the International Commission on Occupational Health) (e.g. Canada, England, United States, Australia and Norway);
- › We have performed a literature (English and Dutch) search up from the year 2000 on the following topics:
 - Health and safety, work life balance in relation to offshore;
 - Rotation schedules offshore;
 - Offshore working time consequences;

⁵ International Association of Drilling Contractors.

- Shift work, night shift, night work, rotation scheme in combination with offshore, off-shoring;
- Gas platform, oil rigs.

Since research on this particular topic is rare, we did not limit our search with respect to a time frame. This means that some older studies do not necessarily reflect the improvements in labour conditions that have taken place on the rigs in the past ten years.⁶ For our literature review we have limited our scope to workers that spend the entire 2 or 3 weeks on a drilling platform.

2.3 Part I: Expert consultation

We have consulted the following four experts currently involved in offshore research:

- › Dr. Kathy Parkes, researcher at Oxford University, author of many articles on psychosocial workload in offshore environments, including systematic reviews. Most research was funded by the UK health and safety executive;
- › Vanessa Riethmeister, researcher at Shell/NAM and University of Groningen conducting PhD research in the field of healthy ageing;
- › Suzanne Merkus, PhD Fellow at EMGO+ Institute and IRIS (International Research Institute of Stavanger), conducting PhD research within Occupational Health: stress research, work-family balance, recovery and re-adaptation from shift work;
- › Prof. Dr. Friedhelm Nachreiner, researcher at GAWO (Germany). Conducted a feasibility study on a possible evaluation of the new German working hours regulation for the offshore sector.

2.4 Part II: Surveys

We have conducted a survey among employees and a survey among employers.

In figure 2.1 we show the model we have used to conduct the employee and employer surveys (see table 2.1 for further specifications). Our assumptions for this model are the following: the main assumption is the correlation between the tour systems (2-2 and 3-3) and employees' sleep quality, fatigue, need for recovery, health, well-being, satisfaction and safety. That is also our main research question. There are, however, other variables that will influence this correlation. The shift systems within the tour system i.e. 7 days/7 nights, 14 nights, 21 days, etc., may also influence employees' health and well-being.

The attitude towards the 3-3 tour system may vary due to the system that is currently being used, and due to the former experience with different tour systems (work history). The work history may in turn influence the coping strategies employees have developed to deal with the work offshore, for instance strategies to improve their sleep quality and alertness during work. These coping strategies may influence the relationship between the tour system and the outcome variables (green); employees may have developed effective ways to deal with the difficulties offshore.

Demographics (age and gender) may influence the relationship between the tour system and the outcome variables as well. This also holds for the social and domestic situation. For instance, employees who have a family to take care of may have more problems being away from home 3 instead of 2 weeks. Employees who live a long distance from the North Sea may be more positive about 3 weeks onshore due to less traveling time on a yearly basis.

⁶ Overview improvement actions since 2001 from Paragon Offshore.

The job characteristics, such as physical workload, may affect how well employees are able to work 3 weeks in a row in a healthy manner. And finally, employers may think certain conditions are important for implementing a 3-3 system in a safe manner.

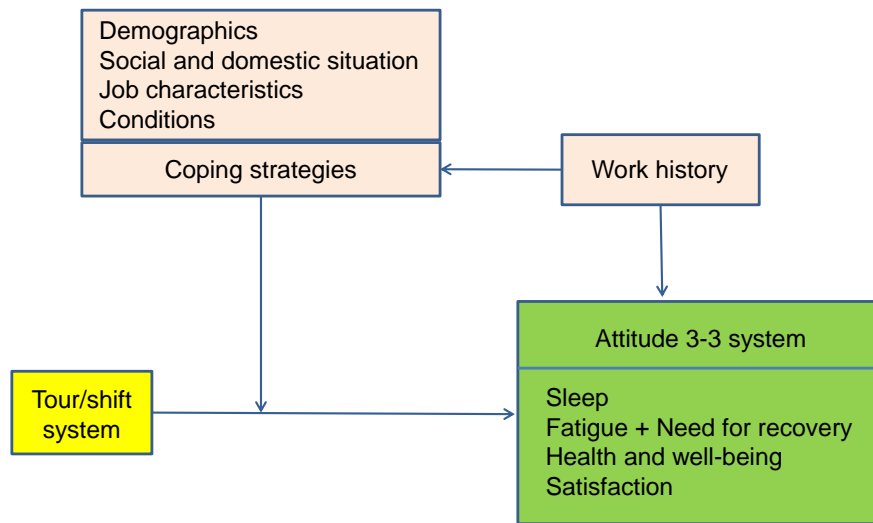


Figure 2.1 Model for the surveys

Table 2.1 Topics in the research model

Topic	Specification
Demographics	Age, Sex, Function, Tenure, Country
Social and domestic situation	Partners' opinion on working offshore, Children who need to be looked after, Work-Life balance
Work history	Experience in offshore shipping, experience in other systems that imply long periods away from home
Job characteristics	Working conditions, Organization of work, Mental and Physical Work Demands, Type of rig
Current working schedule	Tour and shifts details, Possibility for breaks during the shift
Sleep quality and sleep issues	Fall asleep and wake up before/after day/night shift, After shift change and in first days on/offshore; sleeping conditions offshore
Fatigue and need for recovery	Energy and tiredness, Recovery process
Health and well-being	Health complaints and absenteeism
Coping strategies	Strategy towards falling asleep, Staying awake, Intake of specific food, Physical exercise, Relaxation, Adjust work pace
Conditions	Under which conditions do employers think a 3-3 system can be implemented
Satisfaction with the current working schedule	(Dis)advantages of shift and tour system, Satisfaction from 1-10, Satisfaction with crew schedules (amount subsequent D/N shifts), Job attractiveness
Attitude to proposed 3-3 tour system	Expectations on safety, Family life, Adaptation, Efficiency, Commuting, Job attractiveness, etc.

Gathering of survey data:

1. A survey for employees was spread among:
 - › offshore (including the ‘hoppers’⁷) and outsourced employees working on the rigs (catering, laundry personnel, etc.). The offshore employees had the opportunity to fill in the (digital) survey in the waiting room of the helicopter platform in Den Helder. TNO was there to guide the survey process, answer possible questions of respondents and provide assistance when necessary;
 - › employees working on a rig in Denmark that, as far as we knew, would be moved to waters where they would work in a 3-3 schedule. The idea was to spread the survey among these employees before they go to work in this 3-3 schedule and after they have worked in this schedule. With this method, we should have been able to make a comparison within the same group of workers between the two different working time schedules. However, after spreading the survey we came to notice that this group of employees wasn’t going to work in a 3 -3 schedule. Therefore, survey II for employees was spread again, but this time among employees working on a rig in England where they work in a 3-3 schedule. Instead of making a comparison within the same group of workers, we made a comparison between a group that works in a 3 -3 schedule and all the other groups of workers;
2. A survey was directed towards the employers: 15 drilling rig employers operating in The Netherlands and 9 Dutch supply and service companies in the upstream oil and gas industry. NOGEPA provided a list with email addresses of the HR-managers/HSE & Q Managers of the drilling rig employers. The email addresses of the supply and service companies were provided by IRO. TNO has sent the digital survey to those email addresses.

Response, demographics and work characteristics employees

In total 607 employees responded to the survey. Respondents with missing values on most of the variables were omitted from the analysis. Therefore, 587 employees were included.

Most of the respondents are male (98%). Over 65% of the respondents are aged between 30 years and 49 years. They mainly live in The Netherlands (57%), but also in the United Kingdom (17%), Portugal (7%), Lithuania (5%) and various other countries (14%). More than half of the respondents (52%) have children who need to be looked after by them.

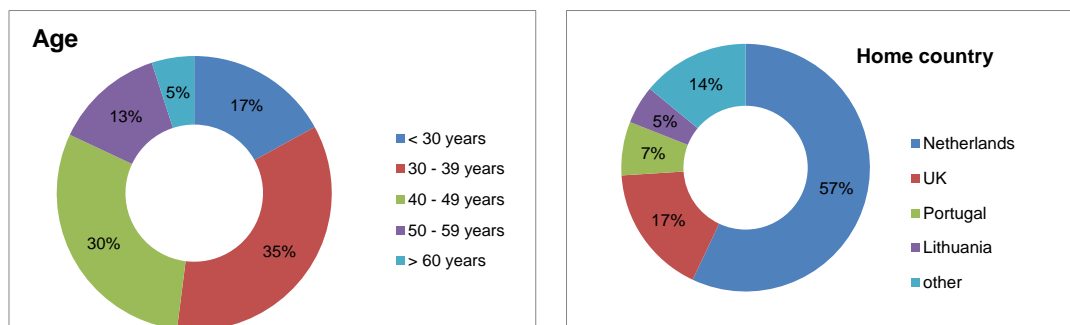


Figure 2.2 Distribution age and home country respondents employee survey

Respondents work in The Netherlands (80%), Denmark (10%), the United Kingdom (9%) and Germany (1%). Almost one out of three works for a drilling contractor (31%). The other employees work for Operators (22%), Agencies (21%) and Subcontractors (19%). The re-

⁷ Hoppers are the employees who answered ‘no fixed schedule’ to the question: ‘What is the offshore - onshore working schedule you have worked in the last period?’

spondents have various types of jobs, the most common are Drilling operator (20%), Production process operator (12%), Maintenance Support (10%), Marine and Deck operator (9%), Mechanical support (8%) and Electrical support (8%). Almost one out of three works mainly outdoors and one out of four mainly indoors.

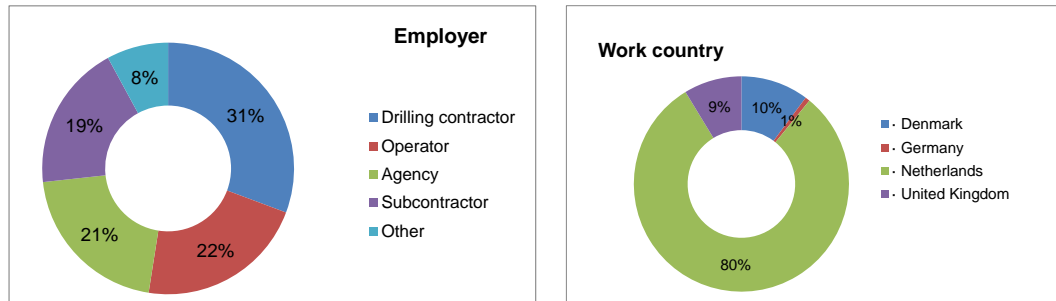


Figure 2.3 Distribution type of employer and work country respondents employee survey

Most respondents (76%) work in a 14 days offshore and 14 days onshore tour schedule (a 2-2 system). Almost 10% work in a 21 days offshore and 21 days onshore tour system (a 3-3 system). More than half of the respondents only work in day shifts, while more than one third work half of the time in night shifts and half of the time in day shifts.

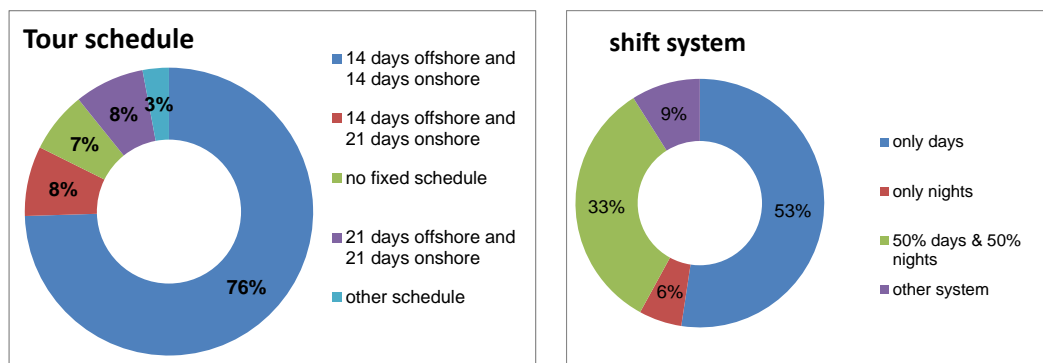


Figure 2.4 Distribution tour system and shift system respondents employee survey

When we compare respondents in a 3-3 system with other respondents we see that respondents who work in a 3-3 system are more often living in the UK and Portugal, are more often working for a drilling contractor, work less often only day shifts, work more often as a drilling operator, a marine and deck operator or in an administration function and say more often that their family is unsupportive.

Analysis of employee survey

First, we analysed the answers on the questions on sleep, fatigue, need for recovery, health, well-being, satisfaction and attitude towards the 3-3 tour system for the whole group of employees. Subsequently, employees who work in a 3-3 tour system are compared with employees who work in another system on the above mentioned variables. We analysed whether there are statistically significant differences in how the different groups (employees in different tour systems) answered. We used the Pearson χ^2 test and the t-test to identify statistically significant differences between each group and the other groups collectively. A statistically significant difference is a result that is not attributed to chance. The results of these analyses are given in Chapter 4.

Response and characteristics employers

In total 6 (only drilling companies) out of 24 employers responded to the survey. 25% is a low response rate. Therefore, the interviews with employers were an important additional source to gather more information on the employer's perspectives (see the next paragraph). The demographics of the 6 employers who did respond to the survey are as follows:

- › Currently used offshore - onshore working schedules:
 - 14 days offshore - 14 days onshore (3);
 - 14 days offshore - 21 days onshore (3);
- › Experience with:
 - 7 days offshore - 7 days onshore (5);
 - 14 days offshore - 14 days onshore (2);
- › Currently used shift schedule:
 - Only days (2);
 - 50% days & 50% nights (5).

NB: Because employers can use or have experience with more than one type of schedule, numbers can add up to more than 6.

2.5 Part II: Interviews

To have a deeper understanding of the results of the surveys we have interviewed the following stakeholders:

1. 22 employees (face-to-face); of which 3 employees from catering and 2 hoppers;
2. Employers' representatives of 11 companies: 4 drilling, 2 production, 3 combination of production and drilling, 2 catering (by telephone):
 - › 6 operation managers;
 - › 1 location manager;
 - › 1 sales managers;
 - › 1 HR manager;
 - › 1 director;
 - › 3 HSE&Q managers;
3. 4 medics working on the rig (by telephone);
4. 3 recognized physicians who perform the medical check of offshore personnel (by telephone).

Selection procedure for the interviews

We have approached employees for the interviews who were waiting for their helicopter flight on Den Helder Airport on May 12th. We have selected them based on different current tour systems, different home countries and different work contents.

We have approached employers, medics and recognized physicians by email and phone to make an appointment for an interview by telephone. The email addresses and phone numbers were provided by NOGEPa and IADC.

Interview content

In the interviews we have asked employees and employers questions to deepen our understanding of the survey outcomes. The HSE & Q managers provided more information on health and safety measures and developments on that topic. The physicians provided information on workers' health related complaints in relation to disturbance of the circadian rhythm and could give their expert views on the effects of tour duration. After presenting the first results of the survey to NOGEPa and stakeholders, we discussed which questions needed to be asked in the interviews.

Interview analyses

We have analysed the interview results by labelling the answers documented in the interview protocols. We have used the interview answers to enrich the survey results: the story behind the quantitative results. The labels used are: health, safety, conditions and attitude towards the 3-3 tour system.

Comments on used methods

Surveys and interviews are subjective research methods. The survey results consist of employees' self-reported situation and opinion. The interview results are subjective as well. Therefore, we enriched our research with an objective quantitative method: analyses of incident data. In the next paragraph we will discuss this method.

2.6 Part II: Analysis incident data

We have studied the event data of Paragon worldwide from 2012, 2013 and 2014. The data contain event and safety incident information from drilling rigs with different tour systems: within Europe and the Mediterranean 2-2 and 3-3 tour system, outside Europe all rigs have a 4-4 tour system. A limitation is that we do not have information about the actual rosters, swing shifts, working conditions, work culture, etc. on the rigs outside the North Sea.

Procedure

To examine whether or not there is a significant trend in the amount and severity of safety events and injuries related to the tour system we have done the following:

1. For these analyses we have built a backbone with information such as safety events, tour schedules, shift schedules, time of day, point of time in the tour. A backbone is a data file with all the necessary data which we can analyse. Before adding the data to the backbone, we have checked the completeness, the validity and reliability of the data. The quality of the data is an important first step;
2. After building the data backbone with the right data, we analysed the relationship between different tour schedules events and events with consequences.

Data backbone

Figure 2.5 shows the breakdown of variables included in the backbone. It is important to note that the available data are 'layered'. Not every cell in the data file is filled out, because it is dependent on whether or not events are with or without injuries. Only in case of injuries also information on the days into tour (days on the rig), hours into shift or sleep quality were available.

We merged the event data of Paragon worldwide from 2012, 2013 and 2014 into one file which led to a total of 3,179 events. We excluded all the onshore events, so only events on drilling rigs were included. Next, the events were coded as events with consequences (=1) and without consequences (=0). Therefore, the main interest of the analysis is on relationships between tour schedules and unsafe human acts. The events with consequences were coded as events due to unsafe human action (=1) versus events due to unsafe (external) conditions. Last, the events with work-related injuries due to unsafe human actions were broken down into those events characterized by 'poor/moderate sleep quality' (=1) and those with registered as 'good sleep quality' (=0). This variable is based upon the debriefing in case of injury. In Figure 2.5 we show this break-down schematically.

Also the number of events per schedule type are included. So in the data there are 2,898 events on rigs with a 4-4 schedule system, 211 events on rigs with a 3-3 schedule and 70 on rigs with a 2-2 schedule. It should be noted that there are far more rig activities outside Europe (which don't have a 4-4 schedule type). Because we did not have data on man hours worked, we can't construct a measure on number of events per 100 work hours. Therefore, no inferences on more or less events can be related to schedule types. Only the probability that certain characteristics of events are related to a specific schedule type could be examined.

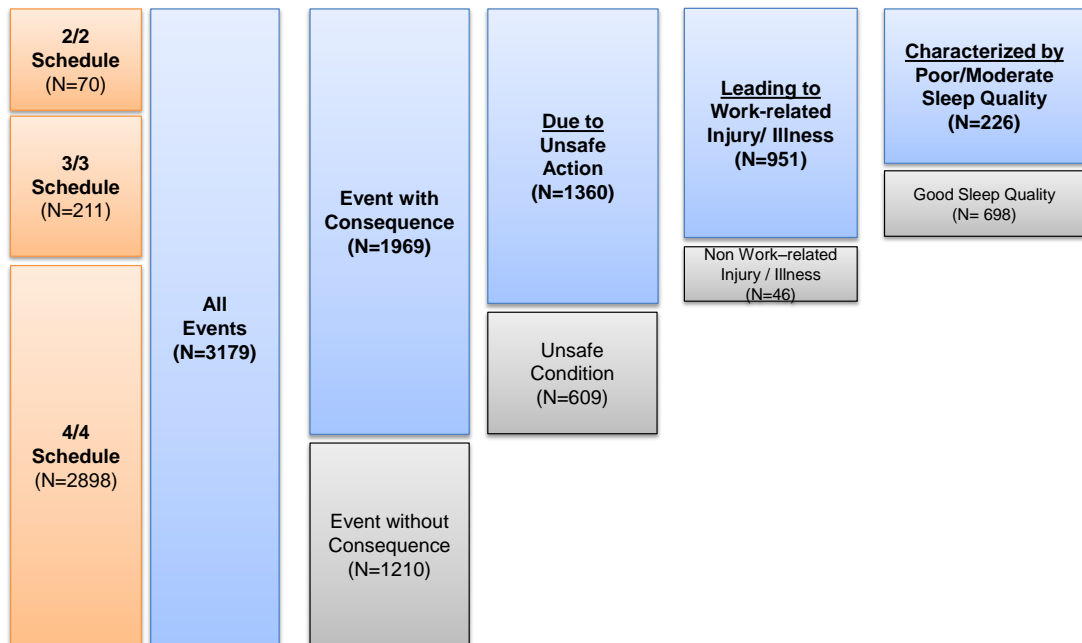


Figure 2.5 Event breakdown variables

Therefore, in all of the event analyses we talk about relationships between tour schedules and the risk that an event has a higher probability or chance of (1) having a consequence, (2) having a consequence due to unsafe human action, (3) having a consequence due to unsafe action leading to a work-related injury characterized by poor/moderate sleep quality.

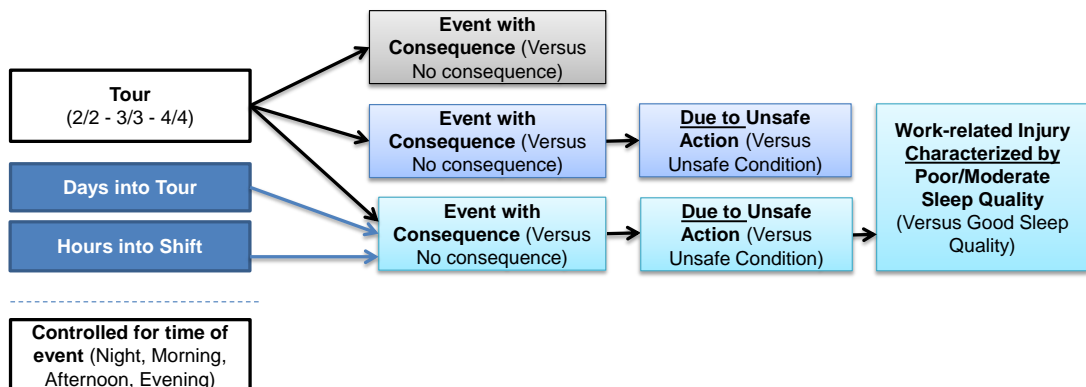


Figure 2.6 Final variables in the data backbone which were complete, unambiguous and reliable indicators

Research approach

Figure 2.7 above shows the final variables in the data-backbone which were complete, unambiguous and reliable variables. With these variables we could test the relationships of interest. Basically, there are two competing hypotheses that match the data available.

Hypothesis 1 ('recovery-hypothesis'): The rigs with 2-2 schedules allow workers to recover more quickly and more often from their work on the rigs which allows for their physical condition and alertness to stay intact. This would mean that events on '2-2 rigs' will to a lesser extent be events with consequences due to unsafe human action and characterized by poor/moderate sleep quality, in comparison to '3-3 rigs or 4-4 rigs'.

Hypothesis 2 ('routine-hypothesis'): Workers on rigs with 2-2 schedules more often have to switch between the shore and working on the rigs, which hinders the needed routine in rig work and awareness of the major safety risks. This leads to a heightened chance of events with consequences due to unsafe human action in comparison to '3-3 rigs' or '4-4 rigs'.

In testing these hypotheses we also control for the time of the event (night, morning, afternoon and evening) as this could influence the results. Furthermore, for the events with work-related injuries, the days into tour and the hours into shift were registered. Where possible these variables were used to give the results more depth. Furthermore, we checked unusual patterns in the data which could indicate registration biases.

PART I: Literature review and expert consultation

3 Implications of an offshore length extension from 2 to 3 weeks

3.1 Effects of a change in tour and leave length

To be able to properly assess the implications of an extension in tour and leave length, it is important to identify the factors that may be affected directly by this extension. We have identified the following factors:

- › Duration offshore;
- › Circadian adaptation;
- › Travel;
- › Duration onshore.

In this chapter, we first discuss the direct research conducted on the comparison between 2-week and 3-week tour lengths. Then, we discuss the (possible) effects of the factors above more specifically. Finally, we discuss some remaining considerations.

3.2 Direct research comparing 2-week with 3-week tour lengths

In short:

- › Direct research comparing 2-week with 3-week tour lengths is limited.

An older review study, conducted by Collins et al. (2000) did conclude potentially detrimental effects of tour durations longer than two weeks. There exists a possibility that the longer the tour of duty, the more likely personnel becomes fatigued, less alert, and therefore more inclined to make serious errors which cause accidents (Collins et al., 2000). However, the statistics must be viewed with caution. Absolute injury rates could not be calculated due to the absence of exposure data. Collins et al. (2000), therefore, concluded that the effects of fatigue on performance and health in offshore platform personnel remained to be explicitly examined.

Ten years later, another review study was conducted by Parkes (2010). She concludes that research that has specifically investigated the effects from tour length duration is still very limited. There appears to be no clear evidence into the effects of extended offshore tours on risks, such as fatigue, health, performance and accidents on offshore installations. Also, still, little is known about the safety and health implications or the effects on family well-being of offshore tours longer than 2 weeks (Parkes, 2012). Furthermore, the limited evidence available does not lead to clear conclusions about whether working regular three-week tours poses substantial health and safety risks. Data obtained in onshore studies suggest that there may be adverse effects of extended periods of intensive work, but the extent to which these findings are applicable to the offshore environment (in which three-week work periods alternate with similar periods of shore leave) remains to be determined (Parkes, 2010). As Collins et al. (2000) already stated: “if appropriate work patterns and their regulation are to be implemented, they need to be based on concrete evidence of the nature and causes of fatigue, and not, on unsubstantiated beliefs or anecdotal evidence.”

3.3 Implications from duration offshore

In short:

- › Extending the amount of shifts in one tour to 21 shifts, increases the number of 12 hour shifts in a row. This could potentially increase cumulative fatigue build-up from an extended working day and a concern of workers. This is not supported by research however;
- › In this phase of the research, injury figures do not allow a clear causal interpretation. Therefore, there is no evidence that an extended tour duration to 3 weeks will lead to more injuries, although there exists an initial indication that it does. In the next phase of the research we will analyse again on more data;
- › Working overtime during an extended work period forms a potential risk for health, fatigue build-up and injuries.

Fatigue build-up/day-to-day recovery

Shifts that are 12 hours in length have been associated with a noticeable increase in fatigue near the end of the duty period. Studies typically show performance decreases and increases in errors/incidents after 8 to 9 hours on-duty (Starren et al., 2010). Extending the amount of days in one tour to 21 days, increases the number of days of 12 hour shifts. This suggests increasing potential cumulative fatigue build-up from an extended working day and a concern of workers. No research was found on fatigue build-up during three week shifts, however. The available research is on shorter periods and does not show clear evidence of fatigue build-up.

In the Parkes review (2010) the following was found:

- › Field studies showed little evidence of a fatigue build-up during a 2-week day-shift tour with 12 hour shifts;
- › Workers report being less alert at the end of shifts but off-shift hours appeared to provide adequate opportunity for day-to-day recovery and, in general, adverse effects did not accumulate;
- › Accident records suggest that the critical risk factor may not be cumulative fatigue but circadian disruption (night shifts). See also 'desynchrony load' in paragraph below;
- › Research from onshore industry comparing fatigue build-up from regular 40 hour working weeks and compressed working weeks (7x12 hours), showed no evidence of reduced test performance or elevated fatigue or sleepiness for the 84 hour group.

Similar results are described in Parkes (2012):

- › There was little evidence of changes in sleep hours across 3-week day-shift tours, although a weak trend of reduced alertness across the successive week was found;
- › Recovery appeared to occur during the off-shift periods, rather than a cumulative fatigue build-up;
- › Over a sequence of 2 weeks, patterns of subjective alertness, objective performance measures (e.g. reaction time), and sleep are generally found to be relatively stable.

In spite of the evidence from research, in interviews Parkes (2010) has held with offshore staff, the workers mentioned that "severe fatigue towards the end of three-week offshore tours was a source of concern to several participants". Parkes (2014) mentions that workers may well pace themselves based on the expected number of days they will be offshore, thus reducing a potential fatigue build-up.

Injury figures as markers for fatigue build-up

Collins et al. (2000) mention the possibility that the longer the tour of duty, the more personnel is inclined to make serious errors and cause accidents as a result. However, they state that absolute injury rates could not be calculated due to the absence of exposure data. They argue that accident data require closer inspection with regard to hours into shift and days into tour information, although reporting systems may not allow for this.

Because of lacking figures, Parkes (2010) looked at injury severity ratios (ratio between minor and severe injuries). Initial figures (Parkes & Swash, 2000) suggested a sharp increase in severity ratio in the third week, implying that an injury occurring in the third week was significantly more likely to be a severe one. It was found that for tour durations longer than two weeks, the ratios of fatalities and severe injuries to 3 or more day absence injuries did increase markedly, relative to durations of one and two weeks. However - and this was confirmed during the interview with Parkes (2014) - the number of injuries was small and *“the nature of the data analysis did not allow a clear causal interpretation”*. Furthermore, the data could not be corrected for confounding factors such as the installation’s age and ‘modernity’ and the safety standard on board. Moreover, we think one can also argue that a longer time offshore will lead to less handovers and higher situational awareness, which could lead to less injuries.

In the interviews held by Parkes (2010), workers also mentioned poor concentration during the last days of a tour. Fatigue could be the cause, however thinking of the upcoming leave was also suggested as a possible explanation. Similar information was given by a HSE & Q manager of Paragon Offshore during our visit to the rig. He was under the impression that most incidents happened in the last days, irrespectively of tour length. We have requested Paragon’s events figures to investigate this statement. The data received at this stage were not sufficient to come to any conclusions. In the next phase of the research we will analyse again on more data.

Overtime

Fatigue build-up due to overtime (working hours exceeding the contracted working hours) may be an extra risk if the offshore period is extended to 3 weeks (Merkus, 2014). Research indicates that overtime is associated with a higher risk for health problems and fatigue and increases the risk of injury (Härmä et al., 2007). Many workers appear to work overtime after their 12 hours shifts, at least in Norway (Merkus, 2014). In Norway, overtime and 16-hour work shifts are common according to a questionnaire (Lauridsen et al., 2006). It needs to be noted that overtime especially is a problem for workers in only dayshifts. Day/night shift workers report less overtime because back-to-back crews take over at the end of a 12-hour shift. This does not apply to workers who only work day shifts (Parkes & Clark, 1997a). Härmä et al. (2007) recommend to avoid overtime (work more than 12 hour shifts) during the extended working periods. They state this can be done for example by increasing reserve. We have spoken to State Supervision of Mines (SSM) and they stated working overtime is very unusual at the rig, because it is not allowed by law. Only in case of emergency workers will work more than 12 hours, but this is very rare according to the inspector of SSM.

3.4 Implications on circadian adaptation

In short:

Shift work requires circadian adaptation. Extending the time offshore can have the following effects, considering fixed shifts (only day or night shifts during whole tour) and midterm roll-overs (change to day or night shift in middle of the tour):

- › the number of sequential night shifts is higher (e.g., 21N or 21D, 10N and 11D);
- › the desynchrony load may be lower;
- › the number of required circadian adaptations may be lower;
- › reducing the number of circadian adaptations may also reduce safety risks from shift work.
- › These effects do not apply when a rig operates a swing shift of 7D+7N+7D. However, this schedule was not encountered in the available resources.

Circadian adaptation

It is common knowledge that night work and frequent circadian adaptation form a health risk (May & Kline, 1987; Finkelman, 1994). Therefore, reducing the yearly number of required circadian adaptations may reduce the associated risks, such as sleep problems, hypertension and obesity (Miles, 2000).

Collins et al. (2000) did find in their review study that circadian adaptation is possible on night shifts, especially for fixed shift schedules. They found that oil rig workers show circadian adaptation to night shifts while seafarers do not. Adjusting from day to night shift or vice versa takes a few days. Biologically, cortisol adaptation to night work is complete within a week. Re-adaptation from night work back to a daytime schedule offshore or at home, is generally slower than adaptation to night work (Fossum et al., 2013). In any case, adaptation may lead to reduced alertness (Parkes, 2010) and safety risks (Merkus, 2014). Therefore, reducing the number of circadian adaptations may also reduce safety risks from shift work.

Crew schedules

Different crew schedules are applied in the offshore industry, which have different implications for the circadian system and, as such, may lead to different build-up of fatigue over the course of a tour. The recovery process severely depends on the schedule used in the offshore period (Merkus, 2014). It should be noted that not all offshore workers work night shifts in their function and some workers work solely night shifts. For the former group, there will be no change in desynchrony load.⁸ For the last group, however, the sequential nights may substantially increase with an extended tour duration.

Many installations operate 'rollover' rotation systems with a mid-tour shift change (swing shift), usually from nights to days (e.g., 7N and 7D). This is said to be preferred by workers, so they can leave the platform in 'day modus' (Parkes, 2010). However, in terms of sleep, performance and alertness it is the least favourable shift schedule, as night shift adaptation during the first week is reversed during the second week. Harris et al. (2010) found no increase in health complaints from swing shift or reaction time in the shift from night to day work, but recovery from night shift takes longer. Saksvik et al. (2011) found that adaptation to swing shift was more difficult than adaptation to regular day and night shifts in terms of sleep. Re-adaptation to day work after 1 week of night work affected sleep negatively. Therefore, the worker's performance and alertness is only optimal for a few days during the tour (Parkes, 2010).

This is also reflected by the so-called desynchrony load. 'Desynchrony load' provides an overall indicator of the disruption that a particular rotation schedule causes to the circadian system over the tour duration. The lower the value, the better. In the study by Gibbs et al. (2005) average desynchrony load was found to be the highest for the 7N7D system (61.7

⁸ Gibbs et al. (2005) studied the circadian adaptation to the different schedules by (among others) measuring the urinary circadian rhythm marker 6-suphatoxy melatonin (aMT6s). Circadian adaptation is indicated by hours of phase shift. Desynchrony load refers to the cumulative hours desynchronized from daytime normal phase or fully adapted night shift.

hours over the two week period). Desynchrony load was also high in the 14N system (27.98). The majority of the workers adapted to the night shifts at the end of the first week. However, the workers in the 7N7D system experienced a second phase shift in the second week, which resulted in additional desynchrony load. It is unclear whether an extension in tour duration has different effects on fatigue build-up depending on the roster applied. Fatigue build-up could be largest in crew schedules with the highest desynchrony load. Gibbs et al (2005) found, however, a variability amongst individuals depending on their circadian time at baseline. This variability is an important aspect to be taken into account in further research.

Number of sequential night shifts

Night shifts are more detrimental to health than day shifts (Ross, 2009). On a yearly basis, the amount of night shifts would remain the same if the tour duration would be extended. However, because there could be more sequential shifts (e.g., 21N or 21D) and less frequent changes from day to night and vice versa are required, one could speculate that the worker spends less time adapting. This will not be the case if a 7D+7N+7D would be applied. As already mentioned, many installations operate 'rollover' rotation systems with a mid-tour shift change (swing shift). Dutch legislation prescribes an 8 hour rest between two shifts.⁹ This leads to a so-called 'short change' in the middle of the tour. A number of researchers believe that the number of adjustments is one of contributory factors to long term health problems in shift workers and therefore schedules with less adjustments should be better in the long term (Miles, 2000). Permanent shift systems should be preferred in offshore work compared to weekly rotating shift systems to support sleep, performance and safety (Härmä et al., 2007). Irrespective of direction, a mid-tour shift change imposes severe demands for circadian adjustment on the personnel concerned. Sleep, performance and alertness are disrupted during the first few days after the shift change (Parkes, 2010).

Too many night shifts in a row, however, are also considered very detrimental to workers' health (Spencer et al., 2006). Studies have also shown declining performance and increased chance of incidents and accidents across subsequent shifts, especially sequential shifts at night time (Starren et al., 2010). This is based on research on shift work in an onshore setting though. It appears that in the offshore setting, a worker's circadian system does adapt to working many sequential night shifts. This is due to the offshore environment in which social life, such as family and friends, does not interfere and in which cooking, laundry and cleaning are all taken care of (Merkus, 2014). The workers have the opportunity to fully adjust to a reversed day-night rhythm. This will happen after one week of night shifts (Merkus, 2014). Therefore, working many sequential nights is not as detrimental to health as it is for working nights in the onshore environment. It may even be better for workers' health than switching to days mid-tour (Merkus, 2014). In terms of sleep, no significant change was found from 14N/14D schedule to 21N/21D (Härmä et al., 2007). The third week did show declining alertness however. Comparison with 7D+7N+7N was not studied.

Miles (2000) stated that the shift pattern most popular with the UK workforce was the 7N+7D. This has the major advantage for the worker that the adjustment phases occur during the offshore period. Return to home takes place in a fully day modus. On the other hand, the 14N (alternating) places one adjustment offshore and one onshore.

⁹ No studies were found in which the rest period between shifts of 8 hours is compared to less hours rest. Short rest time between shifts is found to be a strong determinant of sleep length though (Eriksen & Kecklund, 2007).

3.5 Implications from travel changes

In short:

Extending the tour duration has four effects on travel to and from the installations:

- › the number of travels to and from the installation is reduced by 1/3;
- › reducing the number of travels will also reduce the risk associated with these (helicopter) travels;
- › the total yearly travel time (commuting) per employee is reduced;
- › although time per travel does not change, the travel's proportion of leave time is reduced.

According to Parkes and Clark (1997a), flights to and from installations are a significant source of anxiety for many offshore personnel, and their partners. Therefore, reducing travel frequency would have a positive effect on anxiety. Lodden (2000) states that the traveling time to the platforms is a factor increasing fatigue for offshore workers. He poses that the helicopters used to transport offshore workers to the platforms are often narrow and cramped. Stress during the flights could contribute to an increase in fatigue and the risk of accidents. Therefore, less flights could decrease these detrimental factors. Objectively, reducing the number of travels will also reduce the risk associated with these travels, simply because there are less.

Travel to and from the rig is not considered working time, therefore the employee may be tempted to shorten travel time as much as possible, e.g. by leaving extremely early to avoid an extra night away from home. As a consequence the employee starts his shift tired. With a change to a 3-3 system, the total yearly travel time (commuting) per employee would be reduced. Although time per travel does not change, the travel's proportion of leave time is reduced as well. Merkus (2014) argues this can help workers to recover more. If travel is less frequent and takes up less private time (per trip and in total), the worker might also be more inclined to choose travel times that allow for arriving fit offshore. On the other hand, anticipation is not a common human trait. This is also mentioned by Baulk et al. (2009), who write that employees' behaviour towards shift changes is more aimed at recovery than preparation. Therefore, research on this topic would be needed.

3.6 Implications from duration onshore

In short:

- › Duration onshore is also extended, allowing for more days uninterrupted at home per leave.
- › Longer time onshore may lead to workers creating extra income with onshore jobs.
- › Compensating for a potential build-up of fatigue from three week tours, there is an additional recovery period of 7 days.
- › Longer time onshore may change workers' attitude towards mid-tour rollovers.
- › Extended leave may reduce workers' situational awareness of operating processes.
- › Extended leave can have a positive effect on job attractiveness.

Private life - less frequent but 7 more days at home

The extended leave length can only be seen in connection with the tour length offshore. No research was found specifically with respect to appreciation of 3 weeks at home versus 2 weeks. This appreciation will most probably depend upon individual preferences, the household situation and the previous job (maritime or not).

On our visit to the drilling platform, workers (N = 4) mentioned that the situation at home, e.g. having young children or not, could mean that you would rather be at home more frequent,

even if it is shorter. In other situations, the less frequent yet longer time at home might be valued. Furthermore, if one tour is skipped, the stretch onshore is extended from 6 weeks to 9 weeks. This may also be appreciated by workers. This remains to be investigated in a worker survey.

Recovery - 7 more days to recover

Research indicates, that in offshore industry workers require 3 days to completely restore (Parkes, 1993; Parkes & Clark, 1997b; Slaven et al., 1995). The restoration period does depend on the working conditions, the physical constitution of the individual as well as the duration of the working period, though (Karlsen, 1981). Compensating for a potential build-up of fatigue (psychological or physical) from three week tours, there is an additional recovery period of 7 days. We do not know from research however, whether this is sufficient. During our visit to the drilling rig, one worker stated that a restoration period of 2 weeks seemed very short, especially if the worker has to travel for more than one day to get home. A change to a 3-3 system would in that sense, be an improvement.

During our visit to the rig, the HSE & Q manager mentioned that a longer onshore period would also have the advantage, that in case of onshore training this would take up a smaller proportion of workers' time off. Merkus (2014), however, stated that a potential risk is that training is moved (or added) to workers' onshore time and thus will take up workers' time off. This can also exist of administrative chores.

Shift schedule preference

The use of 7N+7D rosters is largely based on workers' preference to leave the installation in 'day-mode' so no time is lost on leave adapting to a daytime rhythm (Parkes, 2010). If roster preference is based on leave, then changes in leave duration could change the worker's attitude towards rosters that are better for health, performance and alertness.

On 3-3 tours, workers might have less objection to a fixed shift system of either 21 days or 21 nights offshore as the number of travels is reduced and travel proportionally takes up less time from the leave. A night to day adaptation during time off would leave enough spare time in day-mode and would be required only once every 12 weeks. Confronted with this theory, Parkes (2014) mentioned that she expected workers to be very persistent in wanting to maintain mid-tour rollovers. Merkus (2014) states that in interviews workers say they are fatigued the whole tour when they start the tour with night shifts and the work would benefit most from starting in day shifts. When private life is taken into account however, workers still prefer ending their tour in day time. Family life is a very important factor to take into account, Markus (2014) argues: "When the family is happy, the worker is happy".

Situational awareness

Extended leave may reduce workers' situational awareness of operating processes and may cause workers to lose some of their skilled performance (Parkes, 2010). Mikkelsen (2004) supports this by noting that a shorter restitution period is better for work safety because longer periods off work "make you a little rusty". This has led companies to introduce refresher trainings in the form of pre-mobilization briefings, immediately before personnel return offshore after a shore break. Lastly, Parkes (2010) notes that the longer the time off, the more changes may have occurred, the more important proper handover is.

Merkus (2014) found in interviews with workers, that during the first 2 years, new workers have to get used to asking the right questions in the handover. For this group, an extended period onshore may be a risk for the situational awareness. For more experienced workers she expects it to be less of a problem.

Job attractiveness

Two weeks spent offshore means two weeks of allocated leave often viewed as the main attraction of working in the offshore oil industry (Collinson, 1998). We can imagine this also counts for 3-3 tours. Our conversations during our rig visit, support this view. Parkes (2010) also did find that 2-3 work/leave schedules often are introduced to improve recruitment and motivation, and reduce turnover and not because longer shore breaks would improve individual performance. Companies were afraid of losing skilled employees to companies using more attractive work schedules. This supports the view that the possibility of longer extended leave time contributes to job attractiveness. Since it is hard to find skilled and experienced personnel (NOGEP, 7th April 2014), this could be an important reason to change the tour system.

3.7 Conditions for implementing an extension with respect to health and safety

As has become clear from the research discussed in Chapter 2, there is no scientific support available that extended tours offshore to 3 weeks are detrimental to the health and safety of personnel. We were able to identify some conditions to ensure safety and health though, if tour duration will be extended to 3 weeks on/3 weeks off. In this chapter we discuss those conditions.

Shift schedules

The shift schedule used in a 3 weeks tour, is of significant importance to worker's health and safety, due to the desynchrony load. A schedule of 7N/7D/7N (alternating 7D/7N/7D) does not seem to be recommended due to the high number of circadian adaptations. 21N in a row may be better, as the workers' circadian system will fully adapt in one week (Merkus, 2014). An alternative pattern is 11D/10N (11N/10D), but the effects of this pattern have not been scientifically investigated and the swing shift does demand an adaptation. Furthermore, it depends on personal factors which schedule is the best fit for each worker. Therefore, it is recommended to provide the workers with some freedom of choice about the schedule they will work in.

TNO has developed a shift work evaluation system to assess shift schedules on health and social factors. However, this system is developed for the onshore work situation. We have altered the risks/factors to the offshore situation, based on the offshore literature study. Table 3.1 shows the factors we identified to be important in offshore shift schedules.

Table 3.1 Factors important in offshore shift schedules

	Schedule risks/factors	Explanation	Effect of change to 3-3 system?
1	Night shifts	Night shifts are detrimental to health. The less night shifts, the better.	On yearly basis same number of night shifts. More consecutive night shifts if 21N/21D schedule. More night shifts in one tour if 7N+7D+7N.
2	Swing shifts	A shift change in the middle of the tour demands circadian adaptation, which is believed to increase fatigue and decrease alertness.	Better for circadian adaptation if 21N/21D. Worse for circadian adaptation if 7N+7D+7N.

	Schedule risks/ factors	Explanation	Effect of change to 3-3 system?
3	12 hour shifts	A long shift duration increases fatigue and decreases alertness.	More 12 hour shifts in one tour. More consecutive 12 hour shifts if no swing shifts.
4	Early shift start (before 07:00)	Early starts are detrimental to health because workers' deep sleep is disturbed.	More consecutive early starts if 21D/21N. More early starts in one tour if 7D+7N+7D. Will change if start time early shifts is changed.
5	Extremely long workweek	Working more than 80 hours per week is detrimental to health and well-being.	More consecutive extremely long workweeks.
6	Breaks	Breaks during the shift are important to maintain alertness and recuperate.	No change.
7	Rest between shifts	Short rest time between shifts is a strong determinant of sleep length. Dutch law prescribes a rest of 8 hours minimum.	If 7N+7D+7N (vice versa), more short rest between shifts. If no swing shifts, always 12 hours.
8	Rest onshore	Rest at home is needed to recuperate and spend time with family/on social activities. Too long rest at home may lower situational awareness.	Longer: 3 weeks instead of 2 weeks.
9	Working/traveling weekends	Especially working/traveling half weekends disturbs the work-life balance.	More whole weekends at home.

Overtime

Working shifts more than 12 hours should be avoided during the offshore period, especially when the tour duration will be extended to 3 weeks, since overtime is associated with health problems, fatigue build-up and injuries (Härmä et al., 2007). Increasing reserve can be a measure. Overtime should especially be avoided for workers with highly (physical or mental) demanding working conditions. We have spoken to State Supervision of Mines (SSM) and they stated working overtime is very unusual at the rig, because it is not allowed by law. Only in case of emergency workers will work more than 12 hours, but this is very rare according to the inspector of SSM.

Handover procedures

Particularly critical during crew-change days is the handover from the outgoing crew to the incoming one. Fatigue or lack of attention during the handover process creates opportunities for information to be omitted or incorrectly transmitted, and thus increases accident risk (Lardner, 1996).

Parkes (2010): "By way of caution, it should also be noted that extending shore breaks to three weeks may reduce the extent to which offshore personnel can maintain situational awareness of operating processes, and the 'sharpness' of skilled performance, over the leave weeks. Effective crew handover procedures are therefore particularly important following longer shore breaks, possibly augmented by 'pre-mobilization briefing' sessions to update personnel on any changes that may have occurred while they were on leave."

Instructing employees

Since employees are not automatically focused on preparing for the offshore period, but rather focus on recovery, we recommend to periodically instruct workers on this matter. Instruction can, for instance, be provided on sleep strategy, taking time to travel, eating healthy, exercising and on how time is spent onshore in general. Employers should support safe commuting after extended work periods (Härmä et al., 2007) for instance. The risk of an 'in between job' during the 3 weeks time off, should be part of instruction as well. This instruction can take place in training time onshore. A consideration is to invite spouses to the instruction, as they can support the workers to prepare sufficiently. In Norway, some companies organize family days for the spouses to let them meet other offshore families and show them how offshore work works (Merkus, 2014). During our visit to the rig, it was mentioned that some Dutch companies also organize family days.

Improving the time of offshore facilities

If the duration offshore is extended, the workers stay in a fairly restricted environment for a longer uninterrupted period. Fletcher (2009) studied the difference between a 7N and 7D system and a 14N or 14D system. 14-14 schedules are only considered appropriate where the facilities support sleep and recovery. He states that an essential step in moving towards rosters with more sequential (night) shifts, would be sleeping facilities of 2-man rooms for day shift workers (and possibly single occupancy rooms for night shift workers). In addition, steps should be taken to improve soundproofing the sleeping facilities. Miles (2000) also states that: "if extended consecutive nights beyond 14 were intended i.e. 21 or 28, then day sleep quality would have to be as good as normal home night sleep so that no cumulative loss occurred". In Norway, the majority of the workers have a single room (Merkus, 2014). This is also an advantage when workers want to visit their room (for a rest) in a break during their shift. Otherwise they may interrupt their roommate in his/her sleep.

Since 2001 many improvements have already been made to the time off facilities on rigs.¹⁰ In a 3 week system, optimal facilities offshore are even more important. Sleeping cabins of two workers maximum (alternating day and night shifts) and which are isolated to noise, are strongly recommended. Furthermore, the facilities to relax, exercise and eat should provide the opportunity for workers to recover sufficiently and maintain a healthy lifestyle.

¹⁰ Overview improvement actions since 2001 from Paragon Offshore.

Part II: Survey, interviews and incident data

4 The (dis)advantages of a 3 weeks on/3 weeks off system

To show the (dis)advantages of a 3 weeks on/3 weeks off tour system, we will discuss the relationship between the different tour systems with sleep, fatigue, need for recovery (§ 4.1), health and well-being (§ 4.2) and safety (§ 4.3). Below, we show the (significant and remarkable) results of the employee survey, supplemented with information gathered in the interviews and we show the results of the analyses of the event data. See the tables in Appendix 2 for all the survey results.

4.1 Sleep, Fatigue and Need for recovery: Results employee survey supplemented with interview results

In short:

- › Employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in terms of difficulty falling asleep, sleep quality, amount of sleep, fatigue, and need for recovery.
- › In the interviews respondents, however, do pose increased fatigue, higher need for recovery and lower alertness as a possible risk of moving to a 3-3 tour system. Employees with experience in a 3-3 tour system (work history), state this is a matter of adaptation over a couple of months.
- › In general, a third of the employees report problems with the night shifts and with the amount of sleep they get during their stay offshore. One quarter of the employees report a high need for recovery.
- › Employees have more difficulties falling asleep during a swing shift than during a night shift. Almost half of all employees state they have difficulties falling asleep during a swing shift. Two out of three employees sleep badly during a swing shift.
- › Employees use different strategies to improve their sleep and to stay awake during their work. There are not many differences between employees who work in a 2-2 tour system or in a 3-3 tour system in the strategies they use.

Difficulties falling asleep

- › Employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in terms of difficulty falling asleep.
- › Swing shifts: Almost half of all employees state they have (frequently - almost always) difficulties falling asleep during a swing shift.
- › Night shifts: One out of five employees has difficulties falling asleep during night shifts. Additionally, employees reported in the interviews that when they have difficulties falling asleep, this often has to do with the level of noise onboard of the rig.

Sleep quality

- › Employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in terms of sleep quality.
- › Swing shifts: Two out of three employees sleep badly during a swing shift.
- › Night shifts: One out of three employees says he sleeps badly in the night between two night shifts.

Amount of sleep

- › Employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in their amount of sleep.
- › Half of all employees state they could do with more sleep.
- › More than one out of ten employees could do with a lot more sleep.

In the interviews we could replicate the idea that employees could do with more sleep. Most employees said that they sleep less than they would at home, but not problematically so.

Fatigue

- › Employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in terms of fatigue.
- › Night shifts: Almost one out of three employees feels (often - almost always) tired during night shifts.

In the interviews, multiple employees and managers have reported that after 10 days fatigue sets in. Other than this 10th day phenomenon, the interviews revealed no major problems with fatigue. Some employees thought that if a 3 week offshore system would be implemented this would result in significantly more fatigue in the 3rd week. Also some medics and HSE&Q managers mention lower alertness posing a probable risk when working 3 weeks in a row instead of 2. However, opinions on this subject were divided. Both manager and employees with 3-3 experience said that this additional fatigue would be a matter of adaptation and would disappear over the course of the first couple of months.

Need for recovery

- › Employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in their need for recovery.
- › On average, 17% of the employees often/always have a high need for recovery.
- › One out of four employees is (often - always) exhausted at the end of a shift.
- › Almost one out of four employees state the job makes them (often - always) feel quite worn-out at the end of a shift.

Interviews: Opinions about the effect on recovery time that a shift toward 3-3 would implicate, were diverse. Employees with experience in a 3-3 system said that the extra time at home makes up for the extra time onboard. However, employees without experience in a 3-3 system said that the burden of an extra week work would be heavier than the relief an extra week off could provide.

Coping strategies

We have asked the employees about their strategies to sleep better and to stay awake if needed. These strategies can help them to deal with the challenges of working offshore. It can be strategies which can be considered healthy as well as strategies which could be considered harmful, such as eating snacks and drinking too much caffeine.

To sleep better

- › More than 8 out of 10 employees try as much as possible to keep a regular sleeping pattern.
- › Almost 5 out of 10 employees try to relax before they go to bed, for example by taking a shower or listening to music.
- › More than 3 out of 10 employees make sure not to drink caffeinated beverages (e.g. coffee, black tea, cola) in the hours before going to sleep.
- › More than 3 out of 10 employees don't eat heavy meals in the hours before going to sleep.
- › Almost 3 out of 10 make sure they get enough exercise during the day.

- › More than 1 out of 10 use sleeping aids such as earplugs.
- › More than 1 out of 10 state that they try to sleep every time they have the chance.
- › Less than 1 out of 10 take sleeping pills.

In the interviews, the employees did not add new information about strategies to improve their sleep. Most interviewed employees mention that the sleeping facilities should be quiet. We will elaborate on that in the next chapter.

To stay awake

- › Almost 6 out of 10 employees get some fresh air.
- › 5 out of 10 employees use caffeinated beverages (e.g. coffee, tea, cola) to stay awake.
- › Almost 4 out of 10 employees look for variation in their tasks/activities.
- › Almost 3 out of 10 employees do some exercises.
- › Almost 3 out of 10 employees take a break when they feel they need one.
- › 1 out of 10 eat a snack (e.g. snickers).
- › 1 out of 10 eat something containing proteins.
- › Almost 1 out of 10 take a 15- to 20-minute nap (a powernap).

In the interviews, the employees did not add new information about strategies to stay awake.

Differences between employees

Employees who work in a 2-2 tour system (N=438)

Employees in a 2 weeks offshore - 2 weeks onshore tour system more often state that:

- › they make sure not to drink caffeinated beverages (e.g. coffee, black tea, cola) in the hours before going to sleep;
- › they don't eat heavy meals in the hours before going to sleep.

These employees may have had advice on this from their employer. However, we did not ask that.

56% live in the Netherlands, 31% work for a drilling contractor and 24% for an agency, 54% work only days and 35% work 50-50 nights and days, which is significantly more than employees in other tour systems.

Employees who work in a 3-3 tour system (N = 47)

- › Employees in a 3 weeks offshore - 3 weeks onshore tour system less often use caffeinated beverages (e.g. coffee, tea, cola) to stay awake.
- › 44% live in the UK, 77% work for a drilling contractor, 32% work only days, and 20% state that the family is unsupportive about the offshore work, which is significantly more than the employees in other tour systems.

Employees who work in a 2-3 tour system (N = 44)

- › Employees in a 2-3 tour system significantly more often state that they have difficulties falling asleep during days off.
- › 88% of the employees in a 2-3 tour system state they sleep badly during a swing shift.
- › Almost half of the employees in a 2-3 weeks tour system feel (often - almost always) tired during night shifts.
- › Employees in a 2-3 tour system more often state that they take sleeping pills. This may have something to do with their lower sleep quality and higher reported fatigue level.
- › 80% live in the Netherlands, 39% work for an operator, 61% work only days, and 44% think the offshore work interferes with private life (very) much, which is significantly more than employees in other tour systems.

This group could be studied more to understand why they differ (negatively) from the employees in other tour systems in terms of sleep and fatigue.

Hoppers (N = 39)

- › Hoppers significantly more often state that they get plenty of sleep.
- › Hoppers state significantly less often that they (often - always) find it hard to relax at the end of a shift.
- › Hoppers state significantly less often that people (often - always) have to leave them alone for a little while when they come home.
- › It seems that hoppers have more autonomy to organize their work and breaks according to their personal needs. Hoppers more often state that:
 - they make sure they get enough exercise during the day;
 - they try to sleep every time they have the chance;
 - they take a 15- to 20-minute nap (a powernap).This may have to do with their type of work.
- › 82% of the hoppers live in the Netherlands, 41% work for a subcontractor, 49% work only days, they have significantly less physical demanding tasks than employees in other tour systems, and 94% state that the family is supportive of the offshore work, which is significantly more than employees in other tour systems.

Age differences

- › Employees between 20 and 29 years old significantly more often state they have difficulties falling asleep (between night shifts, swing shifts and day shifts) than employees of other ages.
- › Employees older than 60 years significantly less often state they feel fatigued during night shifts than employees of other ages. However, only 10 employees older than 60 who also work night shifts, filled in the survey.

4.2 Health and well-being: Employee survey results supplemented with interview results

In short:

- › Employees in a 2-2 tour system do not report significantly better (or worse) health than employees in a 3-3 tour system. Almost all employees report their health is good to excellent.
- › Within the group of employees who do work night shifts, those who work in a 3-3 tour system more often say they were absent due to illness the last 12 months.
- › In the interviews with medics and HSE managers, the risk of more early evacuations¹¹ if the tour system would be extended from 2 to 3 weeks was posed.
- › In the interviews with medics and HSE managers, the risk of increased psychological problems if the tour system would be extended from 2 to 3 weeks was posed.
- › Furthermore, for physically demanding jobs, working 3 weeks offshore is considered too long according to some respondents.
- › Employees in a 2-2 tour system do not report significantly better (or worse) work-life balance than employees in a 3-3 tour system. In general, more than one third of the employees state they have a disturbed work-life balance due to the offshore job.

Health

- › Employees in a 2-2 tour system do not report significantly better (or worse) health than employees in a 3-3 tour system.
- › Almost all employees state their health is good, very good or even excellent.

¹¹ An early evacuation means that an employee has to be evacuated by helicopter instantly due to acute health problems, which cannot be treated offshore.

- › Employees in a 2 weeks offshore - 3 weeks onshore tour system state, more often than the other employees, that their health is good, instead of very good or excellent.

In the interviews we spoke with several physicians. They reported that cardiovascular diseases, along with lung problems are more prevalent with offshore personnel. They believed this had to do with the high amount of smokers onboard. Overweight is another issue that they reported is more prevalent in offshore work than onshore. One physician said that the issue of overweight is caused by bad eating habits onboard in combination with a rigid mentality toward changing their food pattern. Issues on the psychological spectrum were also mentioned several times. They claimed this had to do with the fact that it can be difficult to work with the same people for weeks and the difficulties of staying in touch with home while offshore. If this period is extended from 2 to 3 weeks, this problem can increase.

For physically demanding jobs, working 3 weeks offshore is considered too long according to some respondents. The physical complaints may increase. Others, on the other hand, state that a low workload can also pose a problem concerning psychological problems. Especially on production platforms where the work is done in a lower pace. Due to too little activity employees may get a depression, as one respondent stated.

Absence

- › More than one out of four employees was absent due to illness the last 12 months.
- › Within the group of employees who work night shifts also, those who work in a 3-3 system more often state they were absent due to illness the last 12 months.
- › More than one out of ten employees were absent due to an accident at work the last 12 months.

In the interviews, the physicians reported that the health criteria for offshore personnel are strict enough, leading to less serious illnesses than would otherwise occur onboard of the rigs. They associated the increase in offshore time with detrimental health issues that could cause early evacuations. One physician said that the implementation of a 3-3 system would increase the amount of early evacuations because with some health problems employees may not be able to cope for 3 weeks (2 weeks sometimes may be bearable, such as tooth problems). The interviews revealed that most of the accidents at work are light-injuries. According to some HSE&Q managers, these injuries are caused by the offshore mentality (wanting to do a good job and solve problems, as quickly as possible and with that making mistakes).

Work-life balance

- › Employees in a 2-2 tour system do not report significantly better (or worse) work-life balance than employees in a 3-3 tour system.
- › More than one out of three employees state the offshore - onshore working schedule interferes (very) much with the things he would like/has to do in the time off of work.

In the interviews, the employees mentioned that working offshore is something to get adjusted to in terms of being away from home long. "It's a style of life that you have to choose, I grew up in that environment. It's a sacrifice that you have to make and can make up for when you are home."

4.3 Safety: Results incident data

In short:

- › Analyses of the incident data show that there is no significant difference between the 2-2 and the 3-3 tour system in relation to the *probability* of an event with consequences due to unsafe human action, characterized by poor/moderate sleep quality in the 24 and 48 hours before the event.

- › Unsafe actions with consequences are related to the number of weeks into hitch. In 2-2 tour systems, there is a significant higher probability of injuries due to unsafe action in week 1 versus week 2. In 3-3 tour systems, there is no significant difference between the probabilities in week 1, 2 and 3.
- › At the level of work hours, the event data show a certain pattern which peaks at hour 8 into shift. This is not affected by the tour system.
- › Incidents in 4-4 tour systems are more often characterized by poor/moderate sleep quality than in 2-2 and 3-3 tour systems. This could indicate that less recovery time at the 4-4 rigs fosters more incidents due to unsafe human action.
- › Rigs in Africa, Mexico, Middle East and US score the highest on incidents characterized by poor sleep quality in comparison to European rigs.

Because we did not have data on man hours worked, we can't construct a measure on number of events per 100 working hours. Therefore, no inferences on 'more' or 'less' events can be related to schedule types. Only the probability that certain characteristics of events are related to a specific schedule type could be examined.

Tour system x sleep quality

With regard to the incident data we could examine the following question:

'Does a 2-2 tour system have different incident-probabilities due to human action than 3-3 or 4-4 tour system?'

Logistical regression analysis¹² shows that there is **no significant difference** between different tour systems (2-2, 3-3 and 4-4) and the *probability* of event with consequences due to unsafe action (versus unsafe condition).

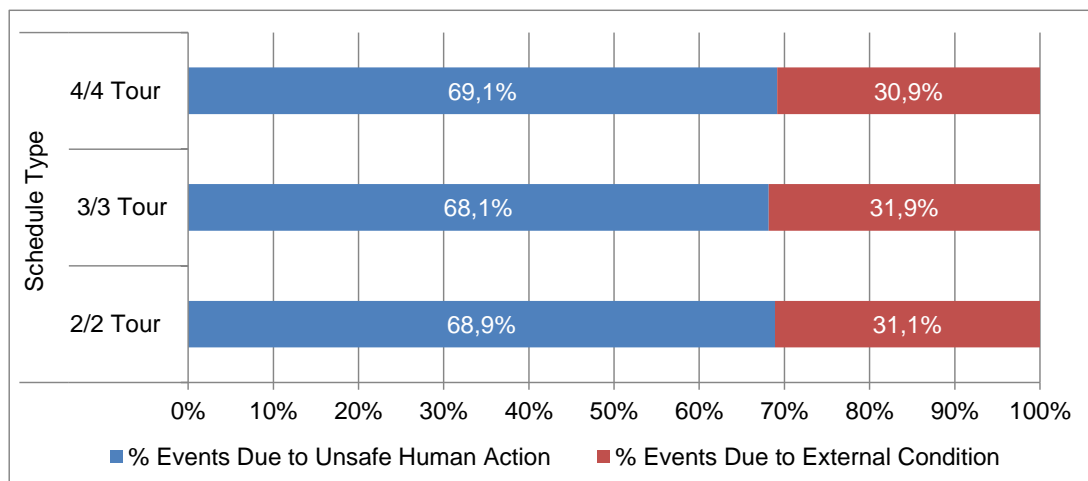


Figure 4.1 The bar graphs show the different percentages in events due to unsafe human action versus events due to external conditions

If we look at the probability that poor/moderate sleep quality was a characteristic (not possible to infer causality with the given data structure) of an event with injury due to unsafe human action:

- › there is **no significant difference** between 2-2 and 3-3 tour systems;

¹² Statistical technique to test significant relationships between variables and outcomes. It reports whether the probability of events with certain characteristics occur or not.

- › however, there is a moderate statistical difference between 2-2 and 4-4 tour systems. Also between 3-3 and 4-4 tour systems. In both cases **4-4 tour systems have a significant higher probability** that events with injuries are characterized by poor/moderate sleep quality in the 24 and 48 hours before the event. Note: this is something else than the general amount of events.

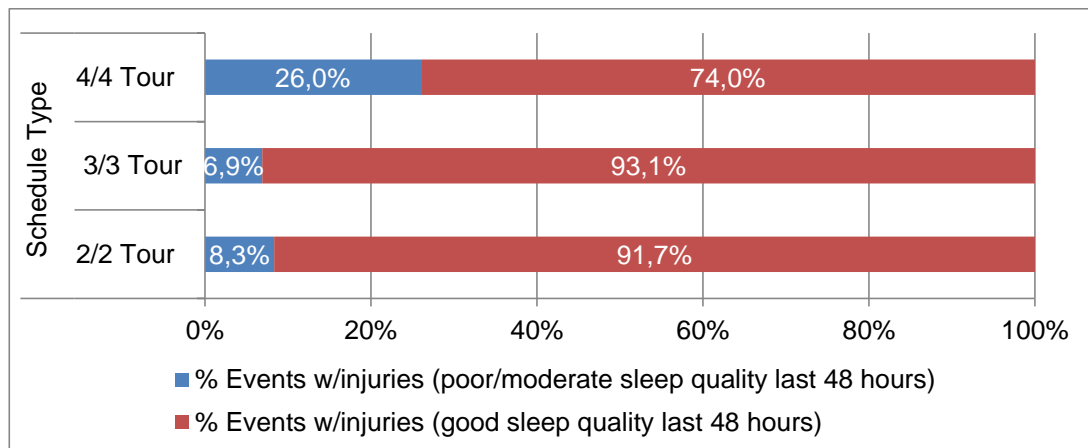


Figure 4.2 The bar graphs show the different percentages in events with injuries due to unsafe action characterized by poor/moderate sleep quality in the last **48** hours versus good sleep quality

On the basis of the data, we cannot conclude on the relationship between tour system types and the amount of events with consequences due to unsafe human action, but it does show that incidents in 4-4 tour systems are more often characterized by poor/moderate sleep quality, while good sleep quality is more often reported for 2-2 and 3-3 tour systems. In a discussion with Paragon, it was also suggested that the external climate can play a role. The 2-2 and 3-3 tour systems are typical for European rigs, while the 4-4 rigs are more often in areas where a hot/humid climate could explain the issue of poor/moderate sleep quality and not the tour system as such.

Additional analysis shows that rigs in Africa, Mexico, Middle East and US score the highest on incidents characterized by poor sleep quality in comparison to European rigs. However, Brazilian rigs actually show a lower probability of events with consequences in comparison to Europe. Further research on confounding factors, such as the climate-factor and work conditions, is encouraged, but (with the focus on 2-2 and 3-3 differences) it was beyond the scope of this report.

In conclusion, these findings are more in line with **hypothesis 1**, because events with injuries in 4-4 tour systems are more often characterized by poor/moderate sleep quality. This could indicate that less (or longer absence of) recovery time at the 4-4 rigs fosters more incidents due to unsafe human action characterized by poor/moderate sleep quality. However, alternative external explanations are imaginable (climate, more extreme weather conditions). Moreover, these findings do not provide a clear inside in the difference between the 2-2 and the 3-3 tour system.

Weeks into tour x shift system

With regard to the incident data, an additional analysis was done to examine if the number of weeks into tour would increase or decrease the probability that an event occurs as a result of unsafe human action (versus unsafe condition). With regard to the comparison of a 2-2 sys-

tem with the 3-3 and 4-4 systems, this is an important indicator when the focus is on the consequences whether extending the 2-2 system with a week is under review.

Looking at the total of all events, logistical regression analysis shows that in **week 3** the probability that an event with injuries occurs due to unsafe action (versus unsafe condition) is *significantly higher* when compared to the probability in **week 1**. This also accounts for week 2 and 4, but to a lesser extent. Overall, unsafe actions with consequences are related to the number of weeks into tour.

However, to be more specific we examined if this pattern holds for the rigs with different tour system types: does **week 1**, in comparison to the other weeks, have a lower probability that events with injuries occur due to unsafe human action (versus unsafe condition)? The statistical analyses show that:

- › In 2-2 tour systems, there is a *significantly higher* probability in week 1 versus week 2;
- › In 3-3 tour systems, there is no *significant difference* between the probabilities in week 1, 2 and 3.

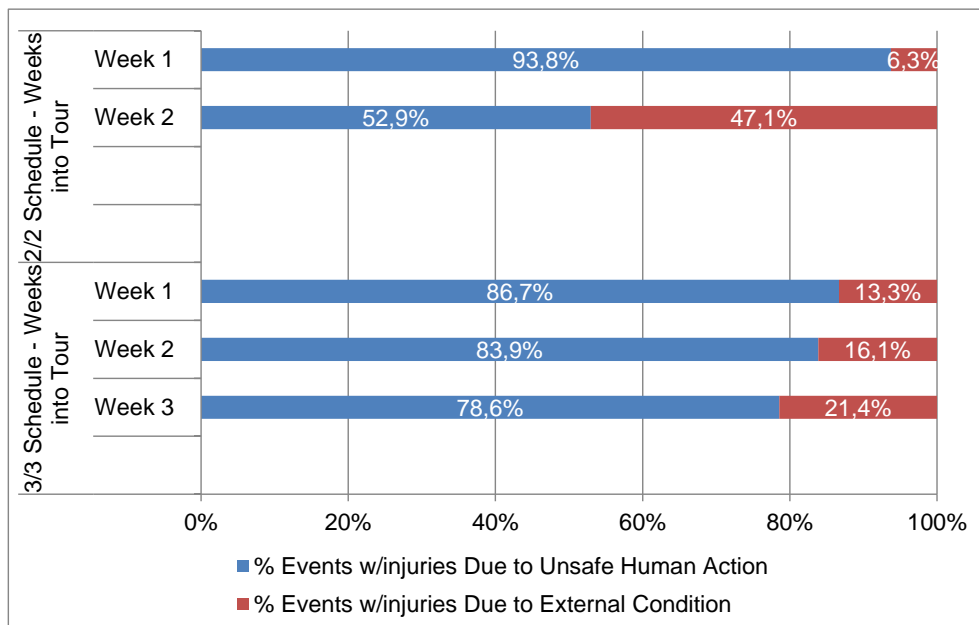


Figure 4.3 The bar graphs show the probability differences in events with injuries due to unsafe action. Horizontally, the difference between the schedule types are shown. Vertically, the differences between the weeks are shown

In conclusion, the first week seems to be the week with a smaller number of harmful safety events. However, for the 2-2 tour system this is not the case. Here, the first week has a higher event probability than the second week into tour. An explanation in line with **hypothesis 2** could be that in a 2-2 tour system, employees have more ‘first week’ instances a year. Because the hitches are shorter, the frequency of starting again with a new 2 week tour is higher (so there are more ‘weeks 1’ in a year). Here, the absence of routine (in comparison) could relate to this finding. However, caution is warranted because of the low number of event registrations on rigs in a 2-2 tour system type.

Hours into shift x pattern

To get a general idea of the relationship between work hours and injuries within different tour systems due to unsafe human action, we further examined whether the number of the hours

into shift is of relevance: is there a pattern in the work hours into shift in which more events with injuries occur that are attributable to unsafe human action?

The graph below (Figure 4.4) shows a pattern of events after a certain amount of working hours. The bigger the 'bubble' the more events take place. The higher the 'bubble' on the Y-axis the higher the probability that events with injuries are due to unsafe human action (instead of unsafe conditions).

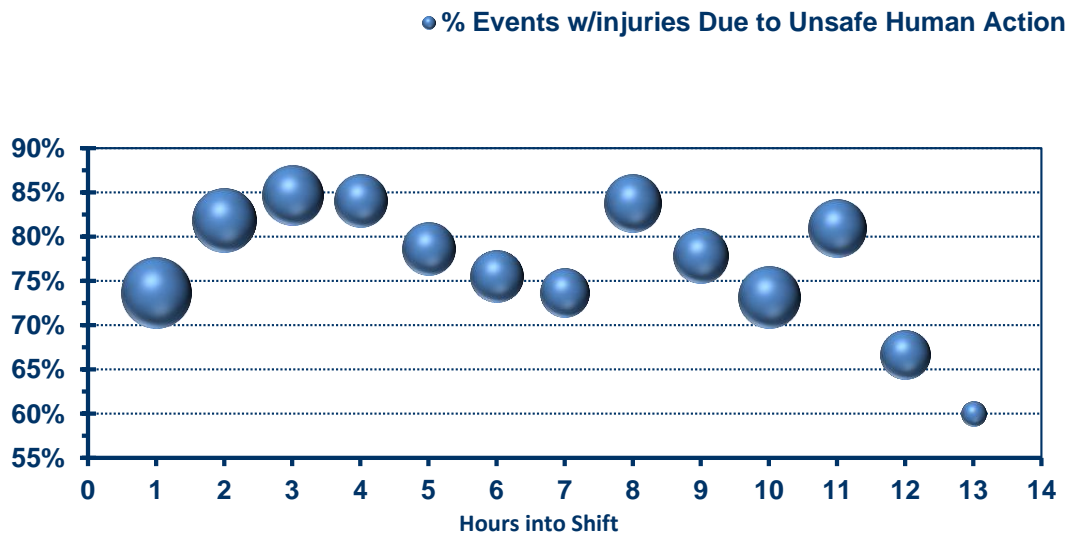


Figure 4.4 The 'bubble'-graphs shows both the frequency (size of the bubble) and probability (height on the Y-axis) of events spread out over the number of working hours ('heartbeat')

The figure shows the following:

- › The first hour into shift shows a higher number (a bigger bubble) of events, but has not the highest probability of being related to unsafe human action;
- › Towards the 8 hours into shift, the number of events per hour drop (gradually smaller bubbles compared to hour 1), but the chance that events are caused by unsafe human action increases between hour 1 and hour 4, but drops between hour 4 and hour 8;
- › In hour 8 there is both a higher number of events (size bubble) and a high probability that these are due to unsafe human action (height on y-axis);
- › After hour 8, the number of events stay relatively high, but 'human action'- probabilities drop.

Also, we applied the recovery and routine hypothesis on this pattern in working hours. For both hypotheses we find support. Recovery, because long working hours (less recovery) have high event frequencies. Routine, because with the passing of working hours (in the first 7 hours) there is a drop of event frequencies and after hour 4 also a drop in the probability that the event is caused by unsafe human action.

To be of relevance to the health issues with regard to 2-2 tour systems versus 3-3 tour systems, the graph below (Figure 4.5) shows a breakdown of the pattern in week 1 to week 4. In a discussion with Paragon, it was stated that if fatigue would be more related to 3-3 systems and 4-4 systems, then the pattern in week 3 should be different (more random) than in the first two weeks. This would show whether a third week would also lead to more events due to unsafe human action regardless of the number of hours into shift.

The graphical breakdown below shows that there is no indication that the pattern in week 3 (red square) is different from the pattern in week 1 (blue circle) and week 2 (green triangle). For instance, also, in week 3, there is a peak in hour 8 and also in week 3 probabilities are lower in hour 1 than in hour 2, hour 3 and hour 4.

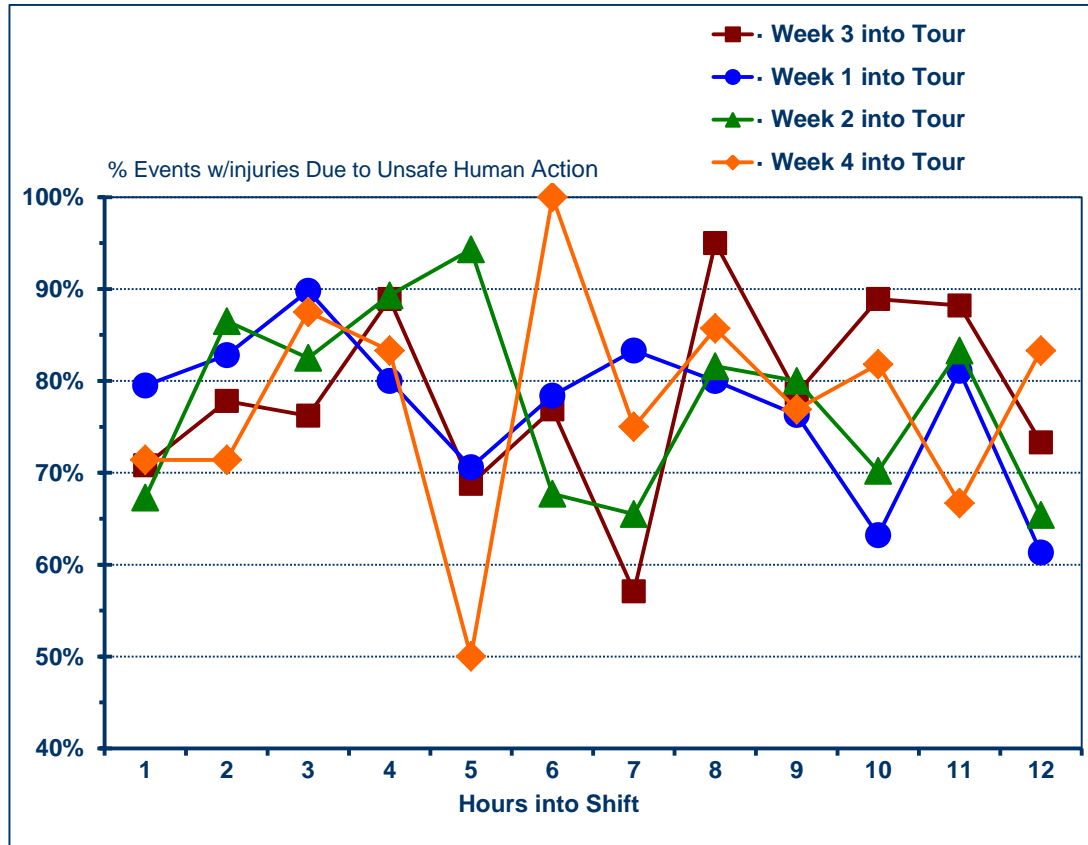


Figure 4.5 Line graph shows the breakdown of the pattern per week into hitch

In conclusion, at the level of working hours, the event data show a certain pattern which peaks at hour 8. However, there is no difference in week 3, which suggests that patterns are not affected by the tour system. Therefore, they are not in favour of either 2-2 or 3-3 tour systems.

Interview results

While interviewing HSE&Q managers on the subject of 3-3 versus 2-2, no real safety concerns came up. The decrease of helicopter flights in a 3-3 system seemed to be both a financial as well as a safety benefit. Multiple employers reported that 3-3 would improve the handovers on drilling rigs, because people have more time to finish their tasks, and thus reducing possible safety hazards.

The importance of safety and accident prevention was stressed in nearly all interviews (regardless of function). No managers would implement a 3-3 system if it would decrease safety in any significant way. Most complaints about (possible) safety hazards that would come with the 3-3 system came from employees (without experience in 3-3). The '10 day phenomenon' (decrease of interest and motivation and an increase of tiredness on the 10th day) was mentioned throughout the interviews. Some managers, employers and employees

with 3-3 experience discarded the phenomenon, saying the 10 days would shift toward 14 days in a 3-3 system (they stated that this phenomenon always occurs at $\frac{2}{3}$ of the shifts).

4.4 Satisfaction, preferences and attitude towards a 3-3 tour system

To get to know the satisfaction and preferences of employees and employers, we have asked questions about satisfaction with the job, type of work, tour and the shift system and the attitude towards a 3-3 tour system.

Below, we show the (significant) results of the surveys, supplemented with the interview results for these indicators.

4.4.1 Satisfaction with the tour system

In short:

- › Employees in a 2-2 tour system do not differ from employees in a 3-3 tour system in terms of satisfaction with their job, type of work, and shift schedule.
- › However, interviewed employees with experience in a 3-3 system, prefer 3-3 over 2-2 or 2-3 for travel time reduction and financial reasons.
- › In general, more than 75% of the employees is satisfied with the job and the type of work.
- › Almost 70% is (very) satisfied with the shift system they work in.
- › Employees in a 2-2 tour system are less satisfied with their tour system and the time onshore between tours, than employees in another tour system.
- › Almost a quarter of the employees is not satisfied with the number of swing shifts, especially employees older than 60 years. Employees who gave suggestions, propose no swing shifts or building in an extra resting period.

Satisfaction with the job

- › Employees in a 2-2 tour system do not differ from employees in a 3-3 tour system in terms of satisfaction with their job.
- › In general, more than 3 out of 4 employees agree (strongly) that they are satisfied with the job.
- › In general, more than 6 out of 10 employees agree (strongly) that they would recommend this job to others.

Satisfaction with the type of work

- › Employees in a 2-2 tour system do not differ from employees in a 3-3 tour system in terms of satisfaction with the type of work.
- › In general, more than 3 out of 4 employees agree (strongly) that they are satisfied with the kind of work they do.

Satisfaction with the tour system

- › Employees in a 2 weeks offshore/2 weeks onshore tour system agree less often than the other employees that they are satisfied with their offshore - onshore working schedule and the time onshore between tours. 36% would prefer a 2-3 tour system, 28% would prefer the 3-3 tour system and another 28% would prefer to stay in the 2-2 tour system.
- › In general (regardless of tour system), almost 6 out of 10 employees agree (strongly) that they are satisfied with their offshore - onshore working schedule.
- › In general, almost 5 out of 10 employees are (very) satisfied with the time onshore between tours.

Satisfaction with the shift system

- › Employees in a 2-2 tour system do not differ from employees in a 3-3 tour system in terms of satisfaction with their shift schedule.
- › In general, almost 7 out of 10 employees agree (strongly) that they are (very) satisfied with the shift schedule they work in. Figure 4.6 shows the satisfaction on the different elements. Employees are the least satisfied with swing shifts.
- › Employees older than 60 years are significantly more (very) dissatisfied with the number of swing shifts than employees of other ages (62.5% is (very) dissatisfied).
- › Employees between 20 and 29 years old are significantly more (very) dissatisfied with the rest time between shifts than employees of other ages (12,9% is (very) dissatisfied).

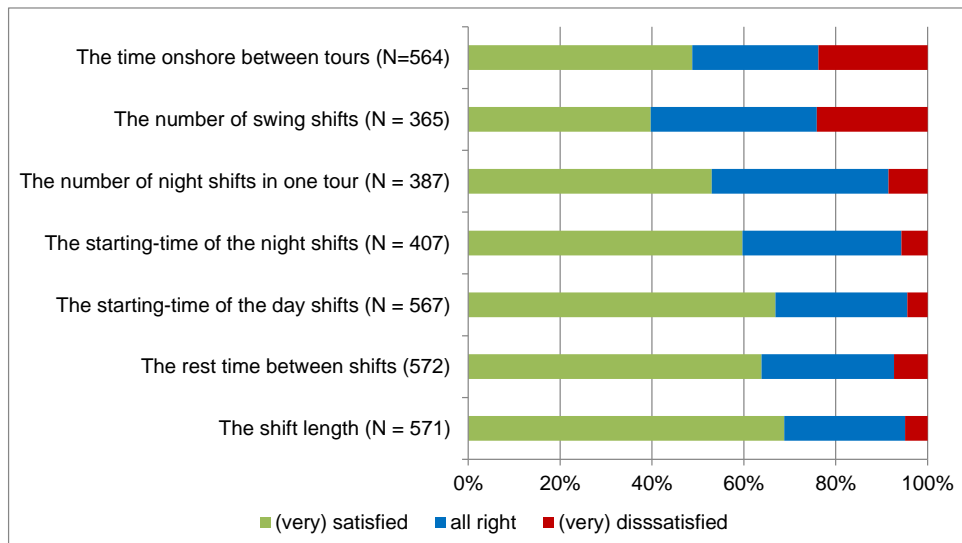


Figure 4.6 Employees' satisfaction with different shift system elements

Suggestions to improve the shift system

In the survey, employees were also asked for suggestions to improve the shift system. The suggestions given all covered the problems with swing shifts. They propose to work only in days or only in nights for one tour or build in an extra resting period. Some employees also propose to build in a resting period halfway the tour (independent of a swing in the middle) to recover.

Differences between employees

Employees in a 2-2 tour system do not differ significantly from employees in a 3-3 tour system in terms of satisfaction with their job, their work and their shift system.

Employees in a 2-3 tour system

Even though we saw before that employees in a 2-3 tour system have more problems with sleep and fatigue, they seem more satisfied than other employees. Employees in a 2-3 tour system agree much more often than the other employees that:

- › they are satisfied with the job;
- › they would recommend this job to others;
- › they are satisfied with their offshore - onshore working schedule;
- › they are (very) satisfied with the time onshore between tours;
- › they are satisfied with the shift system they work in.

Hoppers (no fixed schedule) agree much more often than the other employees that they are (very) satisfied with the time onshore between tours.

Figure 4.7 shows that having experience in a 3-3 tour system does seem to influence the satisfaction of employees who currently work in a 2-2 tour system. Employees who do have experience in a 3-3 tour system seem less satisfied in the current 2-2 tour system. The difference is significant for the kind of work, the shift system and the offshore-onshore working schedule.

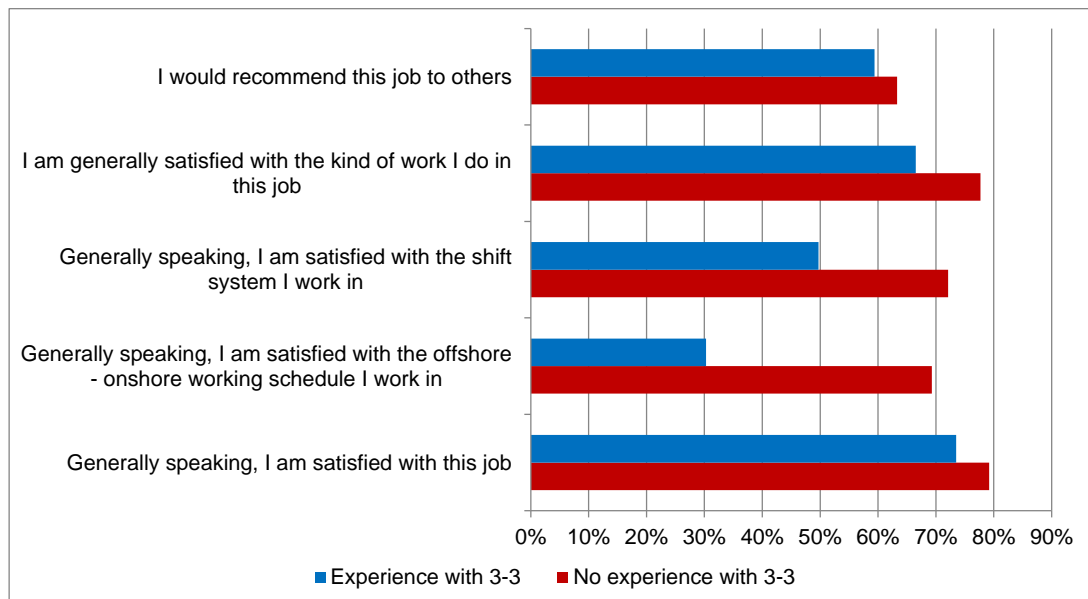


Figure 4.7 Difference between employees with and without experience in a 3-3 tour system in employees' satisfaction, of employees currently working in a 2-2 tour system

Employees only working days

Employees with only day shifts agree more often than the other employees that:

- > they are (very) satisfied with the shift system they work in;
- > they are (very) satisfied with the shift length;
- > they are (very) satisfied with the starting time of the day shifts.

Employees only working nights

Employees with only night shifts state more often than the other employees that they are (very) dissatisfied with the number of night shifts in one tour.

Employees working 50-50 day and night

Employees with 50% days & 50% nights state less often than the other employees that:

- > they are (very) satisfied with the shift length; they more often say that the shift length is 'all right';
- > they are (very) satisfied with the rest time between shifts;
- > they are (very) satisfied with starting-time of the day shifts; they more often say that the starting time of the day shifts is all right.

Demographic differences

- > Employees in the age between 30 and 39 years seem less strongly satisfied with their offshore job than employees of other ages. This may have to do with employees who have young children at that age. However, we do not find significant differences in sat-

isfaction between employees who do have children needed to look after and those who have not.

- › Employees who live in the Netherlands seem to be more strongly satisfied with their offshore job than employees who live in other countries. Smaller amount of commuting may influence this.

Interview results

The results stated above were mostly confirmed by the interviews. Reported satisfaction with the system employees work in, seems universal and not tour system specific. Employees that work 2-3 generally prefer that system over 2-2 and vice versa. The exceptions are employees with experience in a 3-3 system; there the general opinion is that 3-3 is preferable over 2-2 or 2-3 for both travel time reduction and financial reasons.

We spoke with a limited number of employees who work exclusively at night but the ones that did, reported no problems with the night work, only with the adaptation to a normal rhythm when back home. An interviewed manager however, mentioned that there is a difference in shifts between junior and senior personnel. He explained that the junior personnel (in some functions) do all the night work, whereas the seniors work during the day. It was mentioned that a change might be needed to decrease the workload for juniors or at least even the scales.

The starting times of the shifts did not seem a major concern among employees.

The employees were also asked whether the tour system influenced their decision to work at a certain employer. None of the employees said this was the case. However, they were not asked to consider the same dilemma in a hypothetical situation in which similar employers working in 3-3 and 2-2 were available.

4.4.2 Attitude towards a 3-3 system

In short:

- › The employees' attitudes towards a 3-3 tour system are divided. Advantages as well as disadvantages are mentioned.
- › Employees in a 3 weeks offshore/3 weeks onshore tour system and employees with former experience in a 3 weeks offshore/3 weeks onshore system are more positive about this system.
- › Employees in a 2 weeks offshore/3 weeks onshore tour system and employees of age between 50 and 59 are more negative about the 3-3 system.
- › Experience with the 3-3 system does seem to influence the employees' preference for a 3-3 tour system.
- › The employer interviews show the 3-3 tour system seems less relevant for production platforms than drilling platforms.
- › None of the employers would have a problem with having the option of the 3-3 system or the added flexibility in the law that a 3-3 system would provide.

Employee results

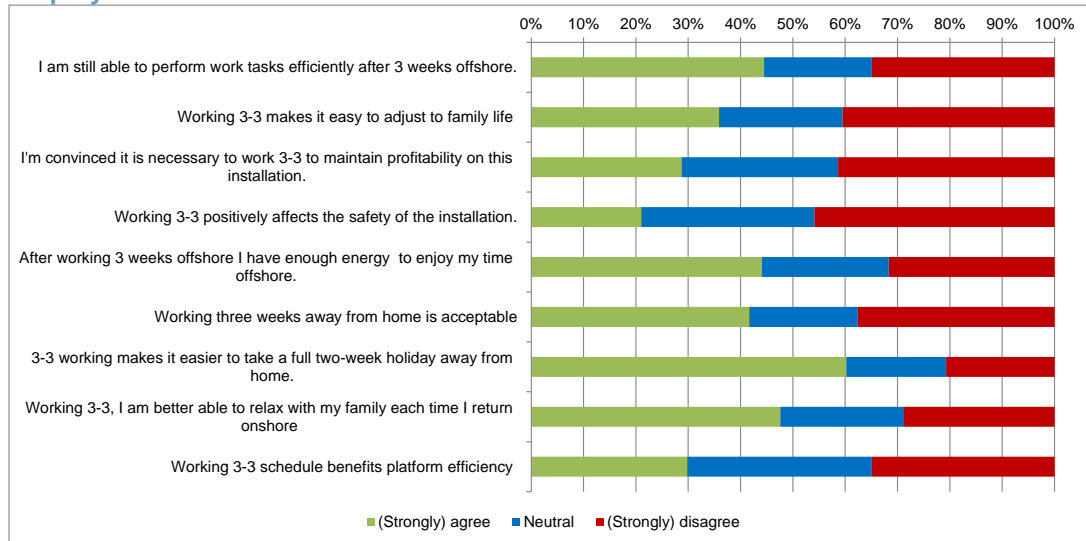


Figure 4.8 Employee's attitude towards 3-3 tour system (N=571)

Figure 4.8 above shows the survey results on the attitude towards a 3-3 tour system for all employees: those who currently work in a 2-2 tour system (N = 428), in a 3-3 tour system (N = 43), or in another system (N = 100), as well as those who have experience with a 3-3 tour system (N = 201) and those who have no experience (N = 370). We cannot find a clear positive or negative overall result; the attitudes are divided.

The advantages of working 3-3 system that were mentioned by employees in the survey:

- › It makes it easier to go on a holiday;
- › Less traveling;
- › If you need to do a course in your time off you have more time left at home;
- › Family life:
 - more time at home;
 - more stability.

The disadvantages of working 3-3 that were mentioned by employees in the survey:

- › Family life:
 - too long away from home (missing your family, children growing up);
 - the balance gets disturbed (planning work partner, care for children, social life);
- › You're getting tired (physically and mentally), fatigue;
- › Three weeks offshore doing heavy manual labour is too long;
- › Safety risks, making mistakes, accidents, less productive;
- › Too much info to give to the new crew.

Differences between groups of employees

When we take a closer look into the differences between employees who do have experience with a 3-3 tour system and those who have not, we see some pattern.

- › Employees in a 3 weeks offshore/3 weeks onshore tour system and employees with former experience in a 3 weeks offshore/3 weeks onshore system are more positive about the 3-3 tour system.
 - In this system, most employees come from the UK and Portugal, they mostly and more often work for a drilling contractor, and they more often state that their family is (fairly-extremely) unsupportive to them working offshore.

- › 6 out of 10 employees who currently work in a 3-3 tour system (N = 43) state they want to keep on working in this system.
- › Employees in a 2 weeks offshore/3 weeks onshore tour system are more negative about the 3-3 system:
 - In this system, most employees are Dutch and they more often work for an operator.
- › Hoppers more often state that they are neutral about the 3-3 system:
 - Most hoppers are Dutch, they more often work for a subcontractor, and they more often say that their family is (fairly-extremely) supportive.
- › Employees between 50 and 59 years old significantly more often (strongly) disagree with the statements and, therefore, seem more negative about a 3-3 tour system.

Employees who do not currently work in the 3-3 tour system (N = 528) were asked to give their opinion about possibly moving to a 3-3 tour system. More than 30% of these employees stated that they look forward to it and are convinced that a change would go smoothly. More than 40% stated that they would adapt well to it if the 3-3 tour system would be introduced (see Figure 4.9).

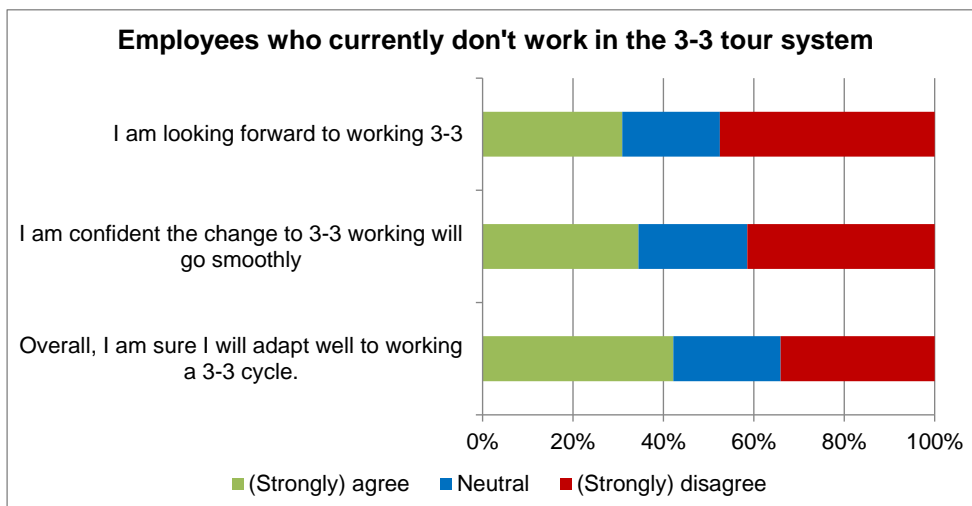


Figure 4.9 Attitude of employees who currently don't work in a 3-3 tour system

Preferred tour system

The employees who stated that they have former experience with different tour systems (N = 386), were asked to choose the tour system they preferred the most (see Figure 4.10). On average most employees chose 2 weeks offshore and 3 weeks onshore. However, when we take a look at those who have experience with the 3-3 system (N = 187) and those who have not (N = 199), we see a clear difference. The employees who do have experience chose this system almost as often as they chose the 2-3 system. The employees who do not have experience with the 3-3 system chose the 2-2 system almost as often as they chose the 2-3 system. We see that experience with the 3-3 system does seem to positively influence the preference for a 3-3 tour system.

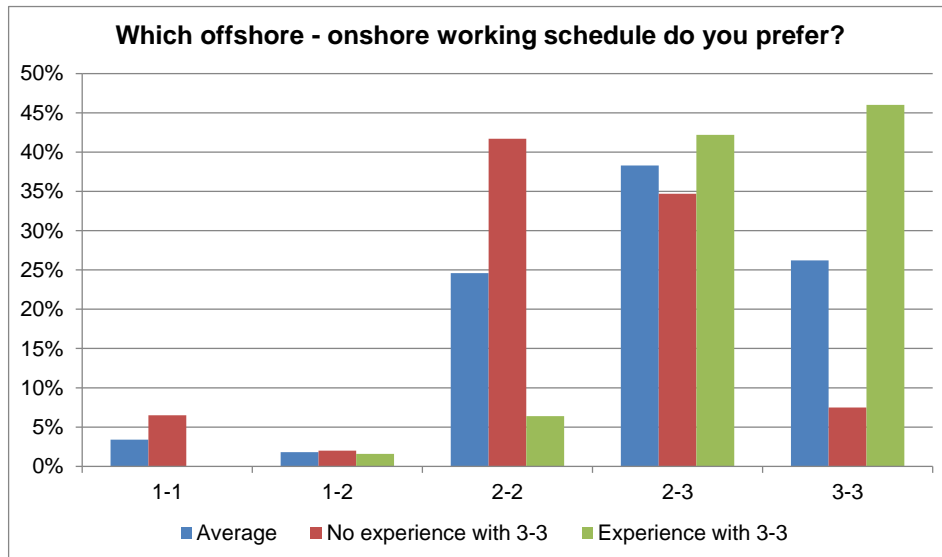


Figure 4.10 Employees' preference for different tour systems

In the interviews, most employees had no experience with a 3-3 system. A general consensus among this group seemed to be that they would prefer to stay in the system they work in right now (regardless of 2-3 or 2-2). Some employees went as far as to say that 3-3 would mean they would start looking for another job, since both themselves as their family strongly disliked the idea of 3 weeks offshore. They also believed that 3-3 would lead to more (near) accidents caused by fatigue in the 3rd week. We do not see this at the event data analyses. The decrease in travel time (on a yearly basis) was not convincing as most of these employees were Dutch and thus felt no need to decrease the travel time (they lived relatively close to the airfield). All these attitudes were not shared by foreign employees and employees with experience in 3-3.

Employer results

The attitude towards a 3-3 tour system of the 6 respondents to the employer survey is (Table 4.1):

Table 4.1 Attitude towards a 3-3 tour system, employer survey (N=6)

	Agree	Neutral	Disagree
I am not convinced that it is necessary to move to a 3-3 tour system to maintain profitability on an installation.		3	3
My employees are still able to perform work tasks efficiently after 3 weeks offshore.	1	2	3
Working 3-3 will positively affect the safety of the installation.		2	4
Overall, I am sure my company will adapt well to working a 3-3 tour system.	1	3	2
Moving to a 3-3 tour system will benefit platform efficiency.		5	1
I am confident that a possible change to a 3-3 tour system will go smoothly.	2		4
Overall my company is motivated to implement a 3-3 tour system.		3	3
The likelihood that my company will implement a 3-3 tour system is high.			6

We see that these 6 respondents do not have a positive attitude towards a 3-3 tour system. All 6 do not think that the likelihood that their company will implement a 3-3 tour system is high. Because this is a small number of respondents, it is difficult to draw strong conclusions. The interview results provide more information on employers' views.

During the interviews, it was learned that there is a difference in relevance for a shift toward 3-3 between production platforms and drilling rigs. The managers working for (or on) production platforms said that - though worth considering - the 3-3 system was not relevant for them. The platforms do not change positions (in contrary to drilling rigs) and the crew is mostly Dutch (thus making the travel time argument obsolete). They also mentioned that because they have been working in a 2-2 (or 2-3) system for such a prolonged period of time, they have developed a very efficient schedule. Adapting to 3-3 could be financially relevant in the long run, but adjusting their current system would simply cost too much (both in effort and cost-effectiveness). For drilling rigs, these arguments are invalid. These rigs move over borders, have an international crew and work less in a system and more task-related. Managers working for (or on) drillings rigs said (almost universally) that they would implement the 3-3 system as soon as it was an option. It would increase positive handovers, decrease travel time and helicopter flights while at the same time increasing job-ownership. They also mentioned that the talent pool from which they can recruit would increase as professionals from around the world would be more open to working in the 3-3 system (and will not work in the 2-2 system).

None of the managers said that they would have a problem with having the option of the 3-3 system or the added flexibility in the law that a 3-3 system (in a 2-2 company) would provide. Rig managers went as far as to say that even if a 3-3 system cannot be implemented a change in the law to allow for more flexibility in the tour system would be a necessity.

Implementation wise the interviews revealed that Dutch employees show much more resistance towards a 3-3 tour system (mainly caused by social factors). Managers all mentioned that before implementing a new system there would have to be a widespread support and that implementation would at least require a dialogue with the employees. None of the managers said they would change the tour system if the resistance would be persistent. In the drilling industry the managers did not foresee as much resistance, resulting in a much quicker and streamlined implementation of the tour system change.

5 Summary of results

In this chapter we summarize the study results (part I and part II) about the implications on safety and health of an offshore tour and leave length extension from 2 to 3 weeks.

The main research questions of our study were:

1. What would be the health implications of an extension of the offshore working time from 2 weeks to 3 weeks?
2. What are the conditions for implementing this extension in a healthy way?

In part I, we did a literature study to find an answer to these questions. Because former research could not provide us with a clear answer, follow-up research was needed. In part II, we have conducted a survey and interviews and analysed safety event data to more specifically compare the 2-2 system to the 3-3 system. The surveys and interviews are subjective research methods. We have complemented the research with an objective quantitative method: analyses of safety event data. In Paragraph 5.1 we will summarize the results of first research question. In Paragraph 5.2 we will summarize the results of the second research question.

5.1 Health implications of an extension

Below, we discuss the study results of part I and II based on our research model, to answer the research first question.

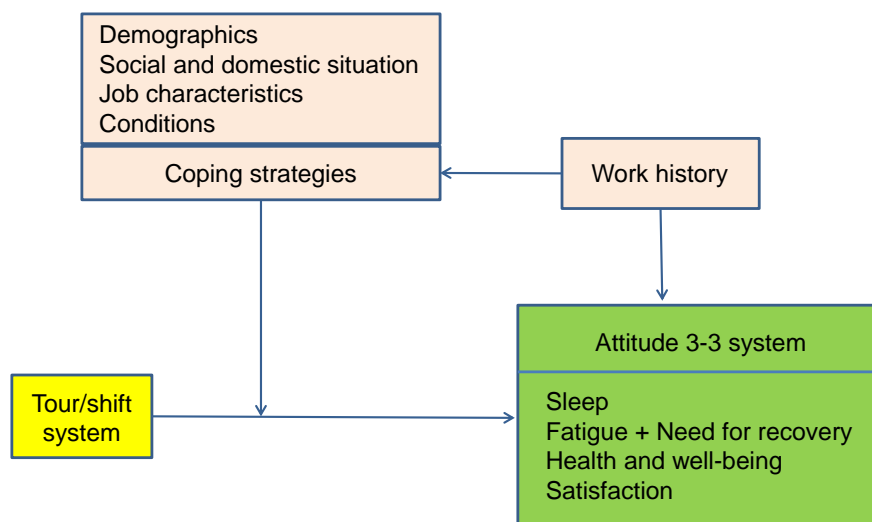


Figure 5.1 Model for the surveys

5.1.1 The relationship between tour system and sleep, fatigue and need for recovery

› Part I

- Extending the amount of shifts in one tour to 21 shifts, increases the number of 12 hour shifts in a row. This could potentially increase cumulative fatigue build-up from an extended working day and a concern of workers. We did not find support for this in the literature.

- In the literature, we found working overtime during an extended working period forms a potential risk for health, fatigue build-up and injuries, but SSM states working overtime is very unusual at the rigs.
- › *Part II*
 - Based on the survey results, employees who work in a 2-2 tour system do not differ significantly from employees who work in a 3-3 tour system in terms of **sleep, fatigue, and need for recovery**.
 - In the interviews, respondents however, do pose increased **fatigue** and higher **need for recovery** as a possible risk of moving to a 3-3 tour system. Employees with experience in a 3-3 tour system (**work history**), state this is a matter of adaptation over a couple of months. We recommend to take swing shifts into account when moving to a 3-3 tour system.
 - Certain **conditions** may influence the relationship between tour system and sleep, fatigue and need for recovery:
 - The survey and interview results show that swing shifts either should be avoided as much as possible or the rest period during the swing shifts should be extended;
 - Furthermore, the noise level on the rig near the sleeping facilities should be limited as much as possible.
 - **Coping strategies** can buffer the possible negative relationship between **tour/shift system** on **sleep, fatigue and need for recovery**. Employees use different strategies to improve their sleep and to stay awake during their work. There are not many differences between employees who work in a 2-2 tour system or in a 3-3 tour system in the strategies they use.

5.1.2 *The relationship between tour system and health and well-being*

- › *Part I*
 - In the literature, we found the following: Shift work requires circadian adaptation. Extending the time offshore can have the following effects, considering fixed shifts (only day or night shifts during whole tour) and midterm roll-overs (change to day or night shift in middle of the tour):
 - The number of sequential night shifts is higher (e.g., 21N or 21D, 10N and 11D);
 - The desynchrony load may be lower;
 - The number of required circadian adaptations may be lower;
 - Reducing the number of circadian adaptations may also reduce safety risks from shift work.
 - These effects do not apply when a rig operates a swing shift of 7D+7N+7D. However, this schedule was not encountered in the available resources.
- › *Part II*
 - In the survey, employees in a 2-2 tour system do not report significantly better (or worse) **health** than employees in a 3-3 tour system. Almost all employees report their health is good to excellent. However, there are some points to take into account if moving to a 3-3 tour system:
 - In the interviews, the risk of increased psychological problems and more early evacuations if the tour system would be extended from 2 to 3 weeks, was posed;
 - For physically demanding jobs (**job characteristics**), working 3 weeks offshore is considered too long according to some respondents;

- Within the group of employees who do work night shifts, those who work in a 3-3 tour system, more often state they were absent due to illness the last 12 months.
- Employees in a 2-2 tour system do not report significantly better (or worse) work-life balance (**well-being**) than employees in a 3-3 tour system. In general, more than one third of the employees state they have a disturbed work-life balance due to the offshore job. Of course this may have to do with the **social and domestic situation**.

5.1.3 *The relationship between tour system and satisfaction*

› *Part I*

- The possibility of longer extended leave time contributes to job attractiveness. Since it is hard to find skilled and experienced personnel, this could be an important reason to change the tour system.
- On 3-3 tours, workers might have less objection to a fixed shift system of either 21 days or 21 nights offshore as the number of travels are reduced and travel proportionally takes up less time from the leave.
- Extending the tour duration has effects on travel time:
 - The total yearly travel time (commuting) per employee is reduced;
 - Although time per travel does not change, the travel's proportion of leave time is reduced.

› *Part II*

- Employees in a 2-2 tour system do not differ from employees in a 3-3 tour system in terms of **satisfaction** with their job, type of work, and shift schedule.
- In general, more than 75% of the employees are satisfied with the job, the type of work.
- Almost 70% are (very) satisfied with the shift schedule they work in.
- Employees in a 2-2 tour system are less satisfied with their tour system and the time onshore between tours, than employees in another tour system.
- Almost a quarter of the employees are not satisfied with the number of swing shifts, especially employees older than 60 years. Employees who gave suggestions, propose no swing shifts or building in an extra resting period.
- Interviewed employees with experience in a 3-3 system (**work history**), prefer 3-3 over 2-2 or 2-3 for travel time reduction and financial reasons.

5.1.4 *The relationship between tour system and attitude 3-3 system*

› *Part I*

In the literature we found the following aspects that can influence employee attitude:

- If duration onshore is extended, this allows employees for more days uninterrupted at home per leave;
- Longer time onshore may lead to workers creating extra income with onshore jobs;
- Compensating for a potential build-up of fatigue from three week tours, there is an additional recovery period of 7 days;
- Longer time onshore may change workers' attitude towards mid-tour rollovers.

› *Part II*

- The results of the survey show that the employees' attitudes towards a 3-3 tour system are divided. Advantages as well as disadvantages are mentioned.
- Employees in a 3-3 tour system and employees with former experience in a 3-3 tour system (**work history**) are more positive about the 3-3 tour system.
- The employer interviews show the 3-3 tour system seems less relevant for production platforms than for drilling platforms.

- The interviews revealed much resistance with Dutch employees and employees between 50 and 59 years old (**demographics**) towards a 3-3 tour system. All interviewed managers mentioned that before implementing a new system, there would have to be a widespread support and dialogue with the employees.

5.1.5 Safety

› Part I

- Injury figures did not allow a clear causal interpretation. Therefore, there was no evidence that an extended tour duration to 3 weeks will lead to more injuries, although there exists an initial indication that it does.
- Extended leave may reduce workers' situational awareness of operating processes.
- Reducing the number of travels will also reduce the risk associated with these (helicopter) travels.

› Part II

- To further compare the different tour systems, we have analysed event data of three years. Analyses of the incident data show that there is no significant difference between the 2-2 and the 3-3 tour system in relation to the probability of an event with consequences due to unsafe action, characterized by poor/moderate sleep quality in the 24 and 48 hours before the event.
- Unsafe actions with consequences are related to the number of weeks into hitch. In 2-2 tour systems, there is a significantly higher probability of injuries due to unsafe action in week 1 versus week 2. In 3-3 tour systems, there is no significant difference between the probabilities in week 1, 2 and 3.
- At the level of working hours, the event data show a certain pattern which peaks at hour 8 into the shift. This is not affected by the tour system.

5.2 Conditions for implementing the extension

Whether or not moving from a 2-2 to a 3-3 tour system will have an effect on employee health and safety also relies on the conditions under which the system would be implemented. In part I (literature research and expert consultation) of our research, we were able to identify some conditions to ensure safety and health if tour duration would be extended. In part II of our research we have asked interview questions about the conditions under which specifically the 3-3 tour system could be safely implemented.

5.2.1 Shift schedules: swing shifts and freedom of choice

In part I we have discussed the importance of the shift schedules used. Swing shifts do not seem to be recommended due to circadian adaptations. From the employee survey results we see that one third of the employees works 50% days and 50% nights which may imply swing shifts. Although 40% are satisfied with the number of swing shifts, the employees provide suggestions to improve the shift schedule on this point: no swing shifts or longer rest period during the swing. We recommend to pay special attention to the swing shifts (especially among employees older than 60 years), regardless of moving to a 3-3 tour system.

Furthermore, we have stated in part I that it depends on personal factors which schedule is the best fit for each worker. The survey results did show for instance that workers in the age of 30-39 are less satisfied. This may be due to specific needs in that age. Therefore, it was recommended to provide the workers with some freedom of choice about the schedule they will work in. In the interviews we asked to what extent employees do get the opportunity to

adjust their schedule to their needs. It was generally stated that for specific situations it is possible to make adjustments for the individual. However, in principle all employees work in a fixed system. It is logistically very difficult to introduce more flexibility in the crew systems.

5.2.2 *Handover procedures*

In part I of our research we saw that the handover from the outgoing crew to the incoming one is particularly critical during crew-change days. From the interviews it becomes clear that respondents think that with a 3-3 tour system there will be less handovers and employees have more margins to finish their tasks and do a proper handover. Employees themselves, on the other hand, state that there may be too much information to hand over after 3 weeks work. Therefore, handovers are still a factor to take into consideration when moving to a 3-3 system. The handover procedures may have to be adjusted.

Analyses of incident data show that in a 2-2 system the first week has a higher event-probability than the second week into tour. We recommend to pay special attention to this first week in the 2-2 tour system in terms of handover procedures.

5.2.3 *Facilities*

Improving the facilities offshore for time off, is a factor we have discussed in part I as well. The interviews in part II revealed the differences in facilities per rig (or platform). The gym facilities were rated (very) poor to okay, dependent on the rig's age (older rigs have smaller gyms). Some rigs have adequate options to spend leisure time (game rooms, TVs, computers, etc.) whereas on other rigs these facilities are cause for complaints by employees. Because of the fact that social interaction was named as a possible stressor (being stuck with the same colleagues for weeks), this could prove to be problematic in a 3-3 system. Opportunities of social contact with family while offshore should be given extra attention if moving to a 3-3 tour system.

For the possible implementation of 3-3 the most important facilities seem to be internet and sleep facilities. Both WIFI and computer access vary vastly per rig (depending on rig age), making contact with families more difficult for some employees. The same goes for sleeping facilities. Noise levels seem to differ on each rig (depending on rig age), both in technical noise and noise policy (no shouting near cabins, etc.). Also, the climate on the rig can be too dry. A medic on the rig advises employees to lower the temperature in their sleeping cabins and shut the door. This can prevent problems to the nose and ears. These kinds of advice become more important when employees stay on the rig 3 instead of 2 weeks.

5.2.4 *Work conditions and job characteristics*

The survey results show that employees who state to 'always have to do lifting and dragging' and who state 'their job is almost always mentally strenuous', significantly more than others, state they 'almost always feel tired during their day shift'. In addition, for physically demanding jobs, working 3 weeks offshore is considered too long according to some respondents in the interviews. The physical complaints may increase. Others, on the other hand, state that a low workload can also pose a problem concerning psychological problems. Especially on production platforms where the work is done in a lower pace. Due to too little activity employees may get a depression, as one respondent stated. In the survey, we did not ask questions about the work pace or level of activity however. We do state though, that it is important to take into account the conditions under which the employees in different jobs work.

5.2.5 Policies

In part I instructing employees was mentioned as an important condition. We have asked respondents in the interviews if policies, such as training or health checks should be adjusted if a 3-3 tour system was implemented. An interviewed physician mentioned that there will probably be more appeal to the medics on the rig by employees with health issues. This is due to the fact that employees may not be able to cope with their complaint for 3 weeks and cannot wait to see a doctor when they get onshore again. The medics may get assignments from onshore doctors to solve the problem offshore. First aiders should be trained better on this, according to the interviewed physician. Some physicians claimed that if a 3-3 system was implemented this could affect the standards by which medical exams are measured. One of the physicians interviewed states he will be more strict when performing the medical check every two years.

Finally, we recommend to advise employees on healthy coping strategies. Those can buffer the possible negative relationship between tour/shift system on sleep, fatigue and need for recovery. The survey results show that employees use different strategies to improve their sleep and stay awake during their work. We recommend to educate and advise all employees on which strategies are healthy and which are less healthy, such as eating snacks to stay awake or drinking too much caffeine.

In terms of safety training or health training, the respondents do not think this has to be changed if a 3-3 tour system would be implemented. The work itself does not change, is their argument. Currently, the companies have occupational health and safety service providers instructing the employees about working offshore (e.g. ergonomics, sleep, nutrition, etc.).

5.2.6 Dialogue

The study results of part II clearly show that the attitudes towards the 3-3 tour system among employees are divided. The survey reveals that employees without experience in a 3-3 tour system are sceptic. The interviewed employers all mentioned that before implementing a new system a dialogue with the employees is required. None of the managers said they would change the tour system if the resistance would be persistent. We support this statement by strongly recommending to continue the dialogue between employer and employee representatives about the goals and possible urgency to move to a 3-3 tour system and about measures which are necessary to implement a 3-3 system in a healthy and safe manner.

6 Conclusions and recommendations

In part I (literature review and expert consultation), we have given an overview of the (possible) effects of an extension from 2 to 3 weeks offshore working time. In Table 6.1, we have added the findings of part II (survey, interviews, incident data) to this overview. The surveys and interviews are subjective research methods. We have complemented the research with an objective quantitative method: analyses of incident data.

Overall, our study results do not provide a clear case for or against implementation of a 3-3 tour system. The literature doesn't give an unambiguous answer to the research questions. The survey, interviews and incident data analyses don't show conclusive results that a 3-3 system overall has negative or positive implications on the employees' health, safety and well-being.

6.1 Conditions

We recommend to take into account the following conditions if a 3-3 tour system would be implemented:

- › Shift schedules: swing shifts and freedom of choice:
 - We recommend to pay special attention to the swing shifts, since we see some negative effects of these shifts;
 - We recommend to provide the workers with some freedom of choice about the schedule they will work in, as much as is logistically possible.
- › Handover procedures:
 - Handovers are a factor to take into consideration when moving to a 3-3 system. The handover procedures may have to be adjusted.
- › Facilities:
 - Improving the facilities offshore for time off on older rigs: larger gym, faster WIFI and less noise in rooms;
 - Opportunities of social contact with family while offshore should be given extra attention if moving to a 3-3 tour system;
 - Decreasing noise levels: both in technical noise and noise policy (no shouting near cabins, etc.);
 - Advices on climate control become more important when employees stay on the rig 3 instead of 2 weeks.
- › Work conditions and job characteristics:
 - It is important to take into account the conditions under which the employees in different jobs work: too much physical workload or too little activity.
- › Policies:
 - There may be more appeal on the first aiders on the rigs to solve health problems which cannot wait the whole 3 weeks, therefore, they may need more training.
 - If a 3-3 system would be implemented, this could affect the standards by which medical exams are measured;
 - Finally, we recommend to advise employees on healthy coping strategies.

Table 6.1 Overview of (possible) effects of an extension from 2-2 to 3-3 tour system

	Implications	Effects found in offshore literature and part II	Possible effects in offshore literature	Notes (possible effects outside literature)
Duration offshore	More consecutive shifts in 12h/12h	<p>Part I: No empirical evidence for fatigue build up</p> <p>Part II: Employees in a 3-3 tour system don't differ significantly from other employees in their sleep quality, quantity, fatigue and need for recovery.</p> <p>The event data show a certain pattern which peaks at hour 8 into shift. This is not affected by the tour system.</p>	Part I: A weak trend of reduced alertness across the successive week	
	Longer away from home	Part II: Employees currently in 2-2 without 3-3 experience state being too long away from home in the 3-3 system will disturb the work-life balance		
	Injuries	<p>Part I: No empirical evidence on increase/decrease amount of injuries</p> <p>Part II: Analyses of the incident data show that there is no significant difference between the 2-2 and the 3-3 tour system in relation to the probability of an event with consequences due to unsafe action, characterized by poor/moderate sleep quality in the 24 and 48 hours before the event.</p>	<p>Part I: More injuries because of cumulative fatigue build up</p> <p>Part II: This was confirmed in the interviews. Making mistakes due to lower alertness. However, not confirmed by event data analysis.</p>	<p>Part I: Less injuries because of less handover procedures and higher situational awareness</p> <p>Part II: confirmed in interviews. Less handovers and more time for proper handovers. Analyses of incident data show that in a 2-2 system the first week has a higher event-probability than the second week into tour. An explanation could be that in a 2-2 tour system, employees have more 'first week' instances per year.</p>
Circadian adaptation	Amount of adaptations: less in fixed shift schedule, more in swing shifts with 2 rollovers		Part I: Less adaptation may reduce safety- and health risks	Part II: swing shifts are mentioned by employees as a challenge
	Amount of night shifts: more in fixed schedules	Part I: No significant change was found from 14N/14D to 21N/21D in terms of sleep		Part I: It may be better for workers' health than switching to days mid-tour

	Implications	Effects found in offshore literature and part II	Possible effects in offshore literature	Notes (possible effects outside literature)
Travel changes	Less travels to and from rig	Part I: Less travels: reduced risk associated with these (helicopter) travels Part II: this was confirmed in the interviews	Part I: Less travels: less anxiety and stress among workers	
	Less commuting	Part I: Total yearly travel time per employee is reduced and the travels' proportion of leave time is reduced Part II: this was confirmed in the survey and interviews, especially by employees who live outside the Netherlands.		
Duration onshore	More time at home	Part II: survey and interview results show that especially employees with longer travel time appreciate 3 weeks onshore. Part II: if training days are planned in the 3 weeks period onshore, employees have more time left at home		Part I: Appreciation depends on situation at home Part II: travel time seems to be more important than family situation
		Part I: More time to recover	Part I: Onshore training would take up a smaller proportion of workers' time off.	
	Longer away from rig		Part I: Possible reduced situational awareness of operating processes and may cause workers to lose some of their skilled performance.	Part I: Reduced situational awareness in particular for new employees
Satisfaction		Part II: Employees in a 2-2 tour system do not differ from employees in a 3-3 tour system in terms of satisfaction with their job, type of work, and shift schedule.		
		Part II: Employees in a 2-2 tour system are less satisfied with their tour system and the time onshore between tours, than employees in another tour system.		
Attitude		Part II: attitudes towards the 3-3 system are divided. Experience with the 3-3 system and long travel time seem to have a positive influence on the attitude.		

Index:

Green: pro a 3-3 system

Red: con a 3-3 system

White: no empirical evidence for pro or con

6.2 The importance of a careful implementation process

A careful implementation process is needed, since we see an obvious difference between employees' perception on the implications of a 3-3 tour system. Employees who don't have experience with a 3-3 system and who live in the Netherlands have a more negative attitude towards this system. Dependent on the private situation, some employees may show more resistance than others. The interviewed employers all mentioned that before implementing a new system a dialogue with the employees is required. We support this statement by strongly recommending to continue the dialogue between employer and employee (representatives; works councils and trade unions) about the goals and possible urgency to move to a 3-3 tour system and about measures which are necessary to implement a 3-3 system in a healthy and safe manner. We consider the joint initiative for this research a valuable part of this dialogue and believe it provides important input for further discussion and well-grounded decisions.

References

Reference	Country	Participants
Baulk, S. D., Fletcher, A., Kandelaars, K. J., Dawson, D., & Roach, G. D. (2009). A field study of sleep and fatigue in a regular rotating 12-h shift system. <i>Applied Ergonomics</i> , 40(4), 694-698.	Australia	20 male shiftworkers, smelting plant, several different types of job.
Collins, A., Matthews, V., & McNamara, R. (2000). <i>Fatigue, Health & Injury Among Seafarers & Workers on Offshore Installations: A Review</i> . Cardiff: Seafarers International Research Centre.	Review study covering many countries, such as UK, Australia, US, Norway, Canada.	-
Collinson, D. L. (1998). "Shifting lives": Work-home pressures in the North Sea oil industry. <i>Canadian Review of Sociology and Anthropology</i> , 35(3): 301-324.	Two UK platforms in North Sea area	85 employees (different occupations, most male) 10 managers
Eriksen, C. A., & Kecklund, G. (2007). Sleep, sleepiness and health complaints in police officers: the effects of a flexible shift system. <i>Industrial Health</i> , 45(2), 279-288.	Sweden	533 police officers, 26% females
Finkelmann, M. (1994). A large database study of the factors associated with work-induced fatigue. <i>Human factors</i> , 36(2), pp 232-243.	US	3.705 temporary agency workers
Fletcher, A. (2009). <i>Literature Review Report: 7 on / 7 off versus 14 on / 14 off Rosters with respect to Fatigue and related Factors</i> . Melbourne: Integrated Safety Support.	Review study covering many countries, such as Norway, Finland, Australia, Scotland, Brasil.	-
Fossum, I. N., Bjorvatn, B., Waage, S., & Pallesen, S. (2013). Effects of shift and night work in the offshore petroleum industry: a systematic review. <i>Industrial health</i> , 51(5), 530-544.	Review study covering Norway, UK and Brazil.	-
Gibbs, M., Hampton, S., Morgan, L., & Arendt, J. (2005). <i>Effect of shift schedule on offshore shiftworkers' circadian rhythms and health</i> . Guildford (United Kingdom): Health and Safety Executive, Offshore Safety Division.	North Sea (60°N) and Morecombe Bay (54°N)	63 male offshore oil and gas installation workers
Härmä, M., Sallinen, M., Puttonen, S., Salminen, S., & Hublin, C. (2007). <i>Risk factors and risk reduction strategies associated with night work with the focus on extended work periods and work time arrangement within the petroleum industry in Norway</i> . Helsinki: Finnish Institute of Occupational Health.	Review study Petroleum Industry North Sea area	-
Harris, A., Waage, S., Ursin, H., Hansen, Å. M., Bjorvatn, B., & Eriksen, H. R. (2010). Cortisol, reaction time test and health among offshore shift workers. <i>Psychoneuroendocrinology</i> , 35(9), 1339-1347.	Norway	19 healthy oil rig workers
Karlsen, J. E. (1981). <i>Oljearbeidernes familiesituasjon</i> (The Family Situation of Offshore Workers). RF Conference Proceedings No. 16/800, Stavanger.	Norway	-

Reference	Country	Participants
Lardner, R. (1996). <i>Effective Shift Handover (Oto 96 003)</i> . London: Health and Safety Executive.	Review study of offshore incidents and general shift work studies, covering many countries	-
Lauridsen, Ø., Bjerkebaek, E., Danielsen, I., & Loland, G. (2006). Work Hours and Serious Occupational Injuries: Petroleum Safety Authority Norway (PSA). Data presented at a meeting in Helsinki, Finland in autumn 2006.	All companies on the Norwegian Continental Shelf	serious occupational injuries
Lodden, T. (2000, January). The Effect on the Health and Safety of Older Offshore Personnel-Long Shifts and Working Night Shift. In <i>SPE International Conference on Health Safety and Environment in Oil and Gas Exploration and Production</i> . Society of Petroleum Engineers.	Paper on offshore work in Northern Europe	-
May, J., & Kline, P. (1987). Measuring the effects upon cognitive abilities of sleep loss during continuous operations. <i>British Journal of Psychology</i> , 78, 443-455.	Wales	135 soldiers
Mikkelsen, A., Ringstad, A. J., & Steineke, J. M. (2004). Working time arrangements and safety for offshore workers in the North Sea. <i>Safety science</i> , 42(3), 167-184.	Norway	30 offshore workers on three different platforms in the North Sea owned by three different companies were interviewed
Miles, R. W. (2000, January). Developments in the understanding of working on extended nights offshore. In <i>SPE International Conference on Health Safety and Environment in Oil and Gas Exploration and Production</i> . Society of Petroleum Engineers.	Paper on offshore work in UK	-
NOGEPa, 7th April 2014, news item on website NOGEPa. http://www.nogepa.nl/nieuws-detail/?newsitemid=289013760	-	-
Parkes, K. (2010). <i>Offshore working time in relation to performance, health and safety. A review of current practice and evidence</i> . London: Health and Safety Executive.	Review study, North Sea oil/gas installations	-
Parkes, K. R. (1993). <i>Human Factors, Shift Work and Alertness in the Offshore Oil Industry. Part I: A Survey of Onshore and Offshore Control-room Operators. Part II: Alertness, Sleep, and Cognitive Performance</i> . Report OTH 92-389. London: HMSO.	UK North Sea	172 control-room operators onshore and offshore +18 interviews
Parkes, K. R. (2012). Shift schedules on North Sea oil/gas installations: A systematic review of their impact on performance, safety and health. <i>Safety science</i> , 50(7), 1636-1651.	Review study, North Sea Area	-
Parkes, K. R., & Clark, M. J. (1997a). <i>Psychosocial aspects of work and health in the North Sea oil and gas industry. Part IV. The offshore environment in the mid-1990's: A Survey of Psychosocial Factors (OTH 96 530)</i> . London: Health and Safety Executive.	UK, North Sea area	1.462 male offshore personnel employed on 11 production platforms and 6 drilling rigs

Reference	Country	Participants
Parkes, K. R., & Clark, M. J. (1997b). <i>Psychosocial aspects of work and health in the North Sea oil and gas industry. Part V. Offshore work/leave schedules: data analysis and review. (OTO 97 012)</i> . London: Health and Safety Executive.	Review study North Sea + Study Pilot Interviews	1.130 offshore workers day-shift personnel (n=55) 18 spouses
Parkes, K. R. & Swash, S. (2000). <i>Injuries on offshore oil and gas installations: An analysis of temporal and occupational factors</i> . London: Health and Safety Executive.	UK, North Sea	HSE data 2.602 incidents
Ross, J. K. (2009). Offshore industry shift work—health and social considerations. <i>Occupational medicine</i> , 59(5), 310-315.	Review study, mostly North Sea area	-
Saksvik, I. B., Bjorvatn, B., Harvey, A. G., Waage, S., Harris, A., & Pallesen, S. (2011). Adaptation and re-adaptation to different shift work schedules measured with sleep diary and actigraphy. <i>Journal of occupational health psychology</i> , 16(3), 331.	One platform in the North Sea	19 offshore workers
Slaven, G. M., Flin, R. F., & Mearns, K. (1995). Shift-work and rotation schedules in the UK oil industry: a review. Paper prepared for the 12th International Symposium on Night- and Shiftwork, 13–18 June 1995, USA.	Review study, UK	-
Spencer M. B., Robertson K. A., & Folkard, S. (2006). <i>The development of a fatigue / risk index for shiftworkers</i> . Norwich: HSE, Research report 446.	Literature review injury studies (many countries)	
Starren, A., Van Kampen, J., Simons, M., Gallis, H., & Klein Hesselink, J. (2010). <i>Risk assessment of rostering at the Gorgon project with a fatigue management perspective (Phase 1)</i> . Hoofddorp: TNO.	Australia	Interviews with employees with different occupations on a ship
Tetrick, L. E., & LaRocco, J. M. (1987). Understanding, prediction, and control as moderators of the relationships between perceived stress, satisfaction, and psychological well-being. <i>Journal of Applied Psychology</i> , 72(4), 538.	US	physicians, dentists, and nurses (N = 206)
Tiemessen I., Valk P., & Goudswaard A. (2009). <i>Roosterevaluatie en het effect op de fysieke prestatie – een onderzoek bij KLM E&M Hangar 11</i> . Hoofddorp: TNO.	Netherlands	500 Engineering & Maintenance employees aircrafts

Interviews

- › 30 July 2014: Dr. Kathy Parkes, researcher at Oxford University, author of many articles on psychosocial workload in offshore environments, including systematic reviews. Most research was funded by the UK health and safety executive.
- › 11 August 2014: Suzanne Merkus, PhD Fellow at EMGO+ Institute and IRIS (International Research Institute of Stavanger), conducting PhD research within Occupational Health: stress research, work-family balance, recovery and re-adaptation from shift work.

Appendix 1 Dutch regulations offshore mining

Schematisch overzicht van werktijdregelingen volgens de ATW en het ATB.¹³

Arbeid verricht in een bestendig en regelmatig arbeidspatroon op mijnbouwinstallaties

normen voor werknemers 18 jaar of ouder	hoofdnorm ATW	ATB artikel 5.14:2
<i>Minimumrusttijden</i>		
• wekelijkse rust	36 uur aaneengesloten of 72 uur per 14 dagen te splitsen in stukken van minimaal 32 uur	14 dagen in elke periode van 28 dagen; t.o. iedere 24 uur doorgebracht op een mijnbouwinstallatie staat 24 uur rust aan wal
• dagelijkse rust	11 uur, 1 x per week in te korten tot 8 uur	12 uur per 24 uur, 4x per 4 weken in te korten tot 8 uur
<i>Zondagsarbeid</i>		
Zondagsbepaling	ten minste 13 vrije zondagen per jaar (afwijking mogelijk bij collectieve regeling én individuele instemming)	ten minste 13 vrije zondagen per jaar (afwijking mogelijk bij collectieve regeling én individuele instemming)
<i>Maximum arbeidstijden (structureel)</i>		
• arbeidstijd per dienst	12 uur	11 uur
• arbeidstijd per week	60 uur	7x11 uur = 77 uur
• arbeidstijd per 4 weken	gemiddeld 55 uur per week (afwijking mogelijk bij collectieve regeling)	–
• arbeidstijd per 16 weken	gemiddeld 48 uur per week	gemiddeld 40 uur per week
<i>Aanvullende regels indien er sprake is van nachtdiensten (arbeid tussen 00.00 en 06.00 uur)</i>		
• minimum rust na een nachtdienst die eindigt na 02.00	14 uur en 1x per week 8 uur	12 uur per 24 uur, 4x per 4 weken in te korten tot 8 uur
• minimum rust na een reeks van 3 of meer nachtdiensten	46 uur	12 uur per 24 uur, 4x per 4 weken in te korten tot 8 uur
• maximum arbeidstijd per nachtdienst	10 uur; 12 uur, mits 12 uur rust na de dienst, maximaal 5 maal per 2 weken en maximaal 22 maal per 52 weken	11 uur
• maximum arbeidstijd per 16 weken	gemiddeld 40 uur per week (indien ≥ 16 nachtdiensten per 16 weken)	gemiddeld 40 uur per week
• maximum aantal nachtdiensten die eindigen na 02.00 uur	36 per 16 weken, bij collectieve regeling 140 per 52 weken of 38 uur tussen 00.00 en 06.00	36 per 16 weken, bij collectieve regeling 140 per 52 weken of 38 uur tussen 00.00 en 06.00

¹³ Source: Arbeidstijden in de mijnbouwsector. (juli 2014). Staatstoezicht op de Mijnen. [Available at <http://www.sodm.nl/sites/default/files/redactie/arbeidstijden%20in%20de%20mijnbouwsector%20versie%2017-7.pdf>].

normen voor werknemers 18 jaar of ouder	hoofdnorm ATW	ATB artikel 5.14:2
<ul style="list-style-type: none"> maximum aantal achtereenvolgende nachtdiensten 	7	14
<i>Overwerk kent de arbeidstijdenwet niet meer</i>	–	–
<i>Pauze (tijdsruimte van minimaal ¼ uur)</i>		
<ul style="list-style-type: none"> arbeidstijd per dienst >5½ uur 	30 minuten, eventueel 2x15 minuten	–
<ul style="list-style-type: none"> arbeidstijd per dienst >10 uur 	45 minuten eventueel 3x15 minuten bij collectieve regeling 15 minuten bij > 5½ uur arbeidstijd	ongeacht duur arbeidstijd minimaal 1 uur per dienst; pauze mag worden gesplitst in twee of meer pauzes
<i>Consignatie</i>		<i>uitsluitend bij collectieve regeling</i>
<ul style="list-style-type: none"> maximum arbeidstijd per 24 uur 	13 uur	13 uur
<ul style="list-style-type: none"> maximum arbeidstijd per week 	40 uur gemiddeld in 16 weken; 45 uur gemiddeld in 16 weken mits voldaan aan een aantal voorwaarden	85 uur

Arbeid verricht in een niet-bestendig en -regelmatig arbeidspatroon offshore en onshore

normen voor werknemers 18 jaar of ouder	hoofdnorm ATW	ATB artikel 5.14:2
<i>Minimumrusttijden</i>		
<ul style="list-style-type: none"> wekelijkse rust 	36 uur aaneengesloten of 72 uur per 14 dagen te splitsen in stukken van minimaal 32 uur	6 dagen in elke periode van 21 dagen waarvan 72 uur aaneengesloten; t.o. iedere 24 uur doorgebracht op een mijnbouwinstallatie/locatie of in de nabijheid ervan staat; 24 uur rust elders binnen een periode van 26 weken
<ul style="list-style-type: none"> dagelijkse rust 	11 uur, 1 x per week in te korten tot 8 uur	12 uur per 24 uur (3x per 21 dagen in te korten tot 8 uur)
<i>Zondagsarbeid</i>		
Zondagsbepaling	ten minste 13 vrije zondagen per jaar (afwijking mogelijk bij collectieve regeling én individuele instemming)	ten minste 13 vrije zondagen per jaar (afwijking mogelijk bij collectieve regeling én individuele instemming)
<i>Maximum arbeidstijden (structureel)</i>		
<ul style="list-style-type: none"> arbeidstijd per dienst 	12 uur	11 uur
<ul style="list-style-type: none"> arbeidstijd per week 	60 uur	7x11 uur = 77 uur
<ul style="list-style-type: none"> arbeidstijd per 4 weken 	gemiddeld 55 uur per week (afwijking mogelijk bij collectieve regeling)	–
<ul style="list-style-type: none"> arbeidstijd per 16 weken 	gemiddeld 48 uur per week	–
<ul style="list-style-type: none"> arbeidstijd per 26 weken 	–	gemiddeld 40 uur per week (max. 1040 uur in 26 weken)

normen voor werknemers 18 jaar of ouder	hoofdnorm ATW	ATB artikel 5.14:2
<i>Aanvullende regels indien er sprake is van nachtdiensten (arbeid tussen 00.00 en 06.00 uur)</i>		
<ul style="list-style-type: none"> • minimum rust na een nachtdienst die eindigt na 02.00 	14 uur en 1x per week 8 uur	12 uur per 24 uur (3x per 21 dagen in te korten tot 8 uur)
<ul style="list-style-type: none"> • minimum rust na een reeks van 3 of meer nachtdiensten 	46 uur	12 uur per 24 uur, 3x per 21 dagen in te korten tot 8 uur)
<ul style="list-style-type: none"> • maximum arbeidstijd per nachtdienst 	10 uur; 12 uur, mits 12 uur rust na de dienst, maximaal 5 maal per 2 weken en maximaal 22 maal per 52 weken	11 uur
<ul style="list-style-type: none"> • maximum arbeidstijd per 16 weken 	gemiddeld 40 uur per week (indien ≥ 16 nachtdiensten per 16 weken)	–
<ul style="list-style-type: none"> • maximum aantal nachtdiensten die eindigen na 02.00 uur 	36 per 16 weken, bij collectieve regeling 140 per 52 weken of 38 uur tussen 00.00 en 06.00	36 per 16 weken, bij collectieve regeling 140 per 52 weken of 38 uur tussen 00.00 en 06.00
<ul style="list-style-type: none"> • maximum aantal achtereenvolgende nachtdiensten 	7	15
<i>Overwerk kent de arbeidstijdenwet niet meer</i>	–	–
<i>Pauze (tijdsruimte van minimaal ¼ uur)</i>		
<ul style="list-style-type: none"> • arbeidstijd per dienst $>5\frac{1}{2}$ uur 	30 minuten, eventueel 2x15 minuten	–
<ul style="list-style-type: none"> • arbeidstijd per dienst >10 uur 	45 minuten eventueel 3x15 minuten bij collectieve regeling 15 minuten bij $> 5\frac{1}{2}$ uur arbeidstijd	ongeacht duur arbeidstijd minimaal 1 uur per dienst; pauze mag worden gesplitst in twee of meer pauzes
<i>Consignatie</i>		<i>uitsluitend bij collectieve regeling</i>
<ul style="list-style-type: none"> • maximum arbeidstijd per 24 uur 	13 uur	13 uur
<ul style="list-style-type: none"> • maximum arbeidstijd per week 	40 uur gemiddeld in 16 weken; 45 uur gemiddeld in 16 weken mits voldaan aan een aantal voorwaarden	85 uur

Appendix 2 Survey results

Percentages are column percentages, and are tested with the Pearson χ^2 test (horizontal comparisons). The contrast is each subgroup versus all other cases (weighted deviation contrast). ▲: $p < 0,05$ (and ▼): Significant high (low) percentage (2-tailed tests). Symbols are based on significance only, not on effect size. ◇: Most deviant significant percentage or mean in this subtable (based on Cohen's d)

Sleep

How well do you normally sleep? (percentage moderately - extremely badly)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
Between successive day shifts	15,7	18,6	16,1	21,4	11,1	3,0▼
N	547	43	411	42	18	33
Between successive night shifts	32,6	24,3	33,6	50,0	10,0	25,0
N	371	37	280	24	10	20
During a swing shift	67,8	59,5	69,5	88,0▲	33,3▼	50,0
N	363	37	272	25	9	20
Between successive days off	12,8	18,4	13,6	15,0	0	0▼
N	514	38	389	40	17	30

Do you have difficulty in falling asleep? (percentage frequently - almost always)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
Between successive day shifts	12,3	9,3	12,2	16,7	18,8	9,1
N	545	43	411	42	16	33
Between successive night shifts	19,7	16,2	20,4	24,0	22,2	10,0
N	376	37	285	25	9	20
During a swing shift	48,6	50,0	47,6	58,3	50,0	47,4
N	358	36	271	24	8	19
Between successive days off	14,2	16,2	13,1	25,0▲	31,3▲	3,2
N	507	37	383	40	16	31

How do you feel about the amount of sleep you normally get? (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
N	563	43	421	43	18	38
nowhere near enough	5,3	7,0	4,5	11,6	5,6	5,3
could do with a lot more	9,4	9,3	10,0	11,6	5,6	2,6
could do with a bit more	36,4	25,6	37,3	37,2	44,4	34,2
get the right amount	44,2	58,1	44,2	32,6	38,9	44,7
get plenty	4,6	0	4,0	7,0	5,6	13,2▲

Fatigue

Do you ever feel tired during ...? (percentage frequently - almost always)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
day shifts	16,0	21,4	15,1	23,1	11,8	13,5
<i>N</i>	545	42	410	39	17	37
night shifts	29,1	25,0	28,4	47,8▲	20,0	28,6
<i>N</i>	368	36	278	23	10	21
days off	9,1	13,9	8,8	8,1	6,3	9,4
<i>N</i>	507	36	386	37	16	32

Need for recovery

Percentage often - always

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
At the end of a shift, I am exhausted.	25,1	20,9	25,2	29,3	33,3	21,1
My job makes me feel quite worn-out at the end of a shift.	23,3	16,3	24,0	31,7	22,2	15,8
I am not able to pay much attention to other people when I have just come home from work.	20,3	16,3	21,1	24,4	11,1	15,8
When I come home, people have to leave me alone for a little while.	18,1	18,6	18,0	29,3	22,2	5,3▼
I find it hard to relax at the end of a shift.	13,1	14,0	12,9	17,1	27,8	2,6▼
I feel stressed because of my work.	10,2	7,0	10,1	14,6	16,7	7,9
I find it hard to concentrate in my time off work.	7,7	14,0	7,2	7,3	11,1	5,3

Health

Generally speaking my health is ... (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
excellent	11,0	17,1	11,3	4,9	5,6	10,5
very good	39,9	39,0	40,1	26,8	55,6	44,7
good	47,1	39,0	47,1	65,9▲	38,9	39,5
moderately - extremely bad	2,0	4,9	1,4	2,4	0	5,3
<i>N</i>	554	41	416	41	18	38

Were you absent due to illness the last 12 months? (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
not absent	73,0	66,0	73,7	81,8	57,9	71,8
absent	27,0	34,0	26,3	18,2	42,1	28,2
<i>N</i>	588	47	438	44	19	39

Were you absent due to an accident at work the last 12 months? (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
not absent	88,3	80,9	88,8	88,6	84,2	94,9
absent	11,7	19,1	11,2	11,4	15,8	5,1
<i>N</i>	588	47	438	44	19	39

How many working days were you absent due to illness the last 12 months?

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
Mean	3,49	6,46	3,77	0,88	1,00	1,21
<i>N</i>	554	41	416	41	18	38

How many working days were you absent due to an accident at work the last 12 months? (*N*; mean)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
Mean	1,70	2,54	1,95	0,24	0,33	0,37
<i>N</i>	554	41	416	41	18	38

Satisfaction

Generally speaking, I am satisfied with this job (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
disagree (strongly)	2,1	2,2	2,3	0	0	2,6
disagree slightly	1,4	0	1,6	0	5,3	0
neutral	9,7	15,6	9,8	9,1	10,5	2,6
agree slightly	8,9	13,3	9,1	0▼	5,3	12,8
agree (strongly)	77,9	68,9	77,2	90,9▲	78,9	82,1

Generally speaking, I am satisfied with the offshore - onshore working schedule I work in (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
disagree (strongly)	10,3	6,7	11,9▲	0▼	0	12,8
disagree slightly	7,2	8,9	8,0	2,3	5,3	2,6
neutral	12,8	15,6	13,0	2,3▼	21,1	15,4
agree slightly	10,4	4,4	11,6	4,5	0	15,4
agree (strongly)	59,3	64,4	55,5▼	90,9▲	73,7	53,8

I am generally satisfied with the kind of work I do in this job (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
disagree (strongly)	1,4	0	1,6	0	0	2,6
disagree slightly	1,5	0	1,4	4,5	5,3	0
neutral	10,1	13,3	11,6▲	0▼	5,3	2,6
agree slightly	11,3	11,1	11,6	9,1	5,3	12,8
agree (strongly)	75,7	75,6	73,7	86,4	84,2	82,1

I would recommend this job to others (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
disagree (strongly)	3,1	2,2	3,0	4,5	0	5,1
disagree slightly	1,4	0	1,6	0	5,3	0
neutral	19,1	22,2	20,5	6,8▼	10,5	17,9
agree slightly	13,8	17,8	13,0	9,1	15,8	23,1
agree (strongly)	62,6	57,8	61,9	79,5▲	68,4	53,8

How satisfied are you with the time onshore between tours? (percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
(very) dissatisfied	23,8	15,9	28,1▲	2,3▼	0▼	18,2
all right	27,5	29,5	28,6	16,3	47,1	15,2
(very) satisfied	48,8	54,5	43,3▼	81,4▲	52,9	66,7▲
<i>N</i>	564	44	427	43	17	33

Satisfaction with shift system

How satisfied are you with ... (percentages)

	Total	only days	only nights	50% days 50% nights	33% days 33% nights 33% days	33% nights 33% days 33% nights	other system
The shift length							
(very) dissatisfied	4,9	4,7	6,1	5,2	14,3	11,1	0
all right	26,3	18,5▼	27,3	38,1▲	0	22,2	32,3
(very) satisfied	68,8	76,8▲	66,7	56,7▼	85,7	66,7	67,7
N	571	297	33	194	7	9	31
The rest time between shifts							
(very) dissatisfied	7,3	6,7	3,0	9,8	14,3	0	3,2
all right	28,8	25,8	30,3	33,5	0	33,3	32,3
(very) satisfied	63,8	67,4	66,7	56,7▼	85,7	66,7	64,5
N	572	298	33	194	7	9	31
The starting time of the day shifts							
(very) dissatisfied	4,4	3,3	3,7	6,2	0	11,1	3,3
all right	28,7	22,7▼	37,0	35,6▲	28,6	44,4	33,3
(very) satisfied	66,8	74,0▲	59,3	58,2▼	71,4	44,4	63,3
N	567	300	27	194	7	9	30
The starting time of the night shifts							
(very) dissatisfied	5,7	-	6,1	5,7	0	11,1	4,2
all right	34,6	-	27,3	38,5	14,3	33,3	25,0
(very) satisfied	59,7	-	66,7	55,7	85,7	55,6	70,8
N	407	-	33	192	7	9	24
The number of night shifts in one tour							
(very) dissatisfied	8,5	-	18,8▲	6,9	28,6	11,1	14,3
all right	38,5	-	28,1	40,7	14,3	55,6	38,1
(very) satisfied	53,0	-	53,1	52,4	57,1	33,3	47,6
N	387	-	32	189	7	9	21
The number of swing shifts							
(very) dissatisfied	24,1	-	-	32,1▲	28,6	33,3	40,0
all right	36,2	-	-	31,6	42,9	33,3	30,0
(very) satisfied	39,7	-	-	36,4	28,6	33,3	30,0
N	365	-	-	187	7	9	20
Generally speaking, I am satisfied with the shift system I work in							
disagree (strongly)	6,7	1,9▼	3,0	12,4▲	14,3	22,2	15,2▲
disagree slightly	5,3	3,2▼	12,1	8,2▲	0	0	3,0
neutral	13,5	10,4▼	18,2	17,0	14,3	22,2	15,2
agree slightly	8,9	6,8	21,2▲	9,8	0	22,2	9,1
agree (strongly)	65,6	77,7▲	45,5▼	52,6▼	71,4	33,3▼	57,6
N	585	309	33	194	7	9	33

Strategies

(Percentages)

	Total	Recent tour system				
		3-3	2-2	2 off-3 on	other system	hoppers
<i>N</i>	568	43	426	43	18	38
I try to keep a regular sleeping pattern as much as possible	82,0	76,7	83,1	79,1	83,3	78,9
I try to relax before I go to bed, for example by taking a shower or listen to music	45,8	44,2	47,7	46,5	22,2▼	36,8
I make sure not to drink caffeinated beverages (e.g. coffee, black tea, cola) in the hours before going to sleep	33,5	25,6	35,9▲	30,2	11,1▼	28,9
I don't eat heavy meals in the hours before going to sleep	31,7	23,3	34,7▲	20,9	11,1	28,9
I make sure I get enough exercise during the day	25,5	20,9	25,4	18,6	22,2	42,1▲
I use sleeping aids such as earplugs	13,6	9,3	14,1	16,3	0	15,8
I try to sleep every time I have the chance	12,9	9,3	12,4	9,3	16,7	23,7▲
I take sleeping pills	2,6	4,7	2,1	9,3▲	0	0
I use another strategy	2,1	0	2,3	0	0	5,3
I get some fresh air	57,2	67,4	56,3	58,1	44,4	60,5
I use caffeinated beverages (e.g. coffee, tea, cola)	50,0	34,9▼	52,1	53,5	44,4	42,1
I look for variation in my tasks/activities	36,4	46,5	35,9	39,5	27,8	31,6
I do some exercises	27,3	20,9	28,6	18,6	16,7	34,2
I take a break when I feel I need one	27,5	30,2	25,8	32,6	27,8	36,8
I eat a snack (e.g. snickers)	10,0	11,6	10,6	9,3	0	7,9
I eat something containing proteins	10,0	9,3	10,8	9,3	5,6	5,3
I take a 15- to 20-minute nap (a powernap)	8,6	4,7	7,7	11,6	11,1	18,4▲
I take medication	1,2	2,3	1,2	2,3	0	0
I use another strategy	1,2	0	1,4	0	0	2,6

Attitude

I am still able to perform work tasks efficiently after 3 weeks offshore. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	35,0	9,3▼	35,0	55,8▲	38,9	38,5	46,8▲	13,4▼
neutral	20,5	16,3	18,9	18,6	38,9▲	35,9▲	23,8▲	14,4▼
(strongly) agree	44,5	74,4▲	46,0	25,6▼	22,2	25,6▼	29,5▼	72,1▲
<i>N</i>	571	43	428	43	18	39	370	201

Working 3-3 makes it easy to adjust to family life/Working 3-3 will make it much easier to adjust to family life. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	40,5	9,3▼	39,5	74,4▲	50,0	43,6	55,7▲	12,4▼
neutral	23,6	18,6	23,1	14,0	27,8	43,6▲	25,4	20,4
(strongly) agree	35,9	72,1▲	37,4	11,6▼	22,2	12,8▼	18,9▼	67,2▲
<i>N</i>	571	43	428	43	18	39	370	201

I am convinced that it is necessary to work 3-3 to maintain profitability on this installation./I am convinced that it is necessary to move to 3-3 working to maintain profitability on this installation. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	41,3	9,3▼	40,4	74,4▲	50,0	46,2	56,5▲	13,4▼
neutral	29,9	27,9	29,9	20,9	27,8	43,6	28,4	32,8
(strongly) agree	28,7	62,8▲	29,7	4,7▼	22,2	10,3▼	15,1▼	53,7▲
<i>N</i>	571	43	428	43	18	39	370	201

Working 3-3 positively affects the safety of the installation./Working 3-3 will positively affect the safety of the installation. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	45,9	18,6▼	43,5▼	86,0▲	55,6	53,8	59,7▲	20,4▼
neutral	33,1	41,9	34,3	9,3▼	27,8	38,5	27,6▼	43,3▲
(strongly) agree	21,0	39,5▲	22,2	4,7▼	16,7	7,7▼	12,7▼	36,3▲
<i>N</i>	571	43	428	43	18	39	370	201

After working 3 weeks offshore I have enough energy to enjoy my time offshore./After working 3 weeks offshore I will still have enough energy to enjoy my time offshore. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	31,7	9,3▼	31,3	67,4▲◇	33,3	20,5	42,2▲	12,4▼
neutral	24,2	23,3	23,8	9,3▼	27,8	43,6▲	27,3▲	18,4▼
(strongly) agree	44,1	67,4▲	44,9	23,3▼	38,9	35,9	30,5▼	69,2▲
<i>N</i>	571	43	428	43	18	39	370	201

Working three weeks away from home is acceptable./Working three weeks away from home is acceptable. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	37,7	9,3▼	38,6	60,5▲	38,9	33,3	50,0▲	14,9▼
neutral	20,7	23,3	18,9	27,9	33,3	23,1	20,5	20,9
(strongly) agree	41,7	67,4▲	42,5	11,6▼	27,8	43,6	29,5▼	64,2▲
<i>N</i>	571	43	428	43	18	39	370	201

3-3 working makes it easier to take a full two-week holiday away from home. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	20,7	2,3▼	20,1	53,5▲	22,2	10,3	29,7▲	4,0▼
neutral	19,1	9,3	18,2	20,9	38,9▲	28,2	24,1▲	10,0▼
(strongly) agree	60,2	88,4▲	61,7	25,6▼	38,9	61,5	46,2▼	86,1▲
<i>N</i>	571	43	428	43	18	39	370	201

Working 3-3, I am better able to relax with my family each time I return onshore./When working 3-3, I will be better able to relax with my family each time I return onshore. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	28,9	4,7▼	27,8	69,8▲	33,3	20,5	40,5▲	7,5▼
neutral	23,5	14,0	22,0	20,9	33,3	48,7▲	28,1▲	14,9▼
(strongly) agree	47,6	81,4▲	50,2▲	9,3▼	33,3	30,8▼	31,4▼	77,6▲
<i>N</i>	571	43	428	43	18	39	370	201

Working 3-3 schedule benefits platform efficiency/Moving to a 3-3 schedule will benefit platform efficiency. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	35,0	7,0▼	35,7	67,4▲	33,3	23,1	48,1▲	10,9▼
neutral	35,2	41,9	34,1	23,3	38,9	51,3▲	33,0	39,3
(strongly) agree	29,8	51,2▲	30,1	9,3▼	27,8	25,6	18,9▼	49,8▲
<i>N</i>	571	43	428	43	18	39	370	201

Overall, I am sure I will adapt well to working a 3-3 cycle. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	34,1	--	31,3▼	62,8▲	44,4	28,2	45,7▲	7,0▼
neutral	23,7	--	22,2	20,9	22,2	43,6▲	25,7	19,0
(strongly) agree	42,2	--	46,5▲	16,3▼	33,3	28,2	28,6▼	74,1▲
<i>N</i>	528	--	428	43	18	39	370	158

I am confident the change to 3-3 working will go smoothly. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	41,5	--	38,8▼	76,7▲	38,9	33,3	54,3▲	11,4▼
neutral	24,1	--	23,1	16,3	27,8	41,0▲	23,8	24,7
(strongly) agree	34,5	--	38,1▲	7,0▼	33,3	25,6	21,9▼	63,9▲
<i>N</i>	528	--	428	43	18	39	370	158

I am looking forward to working 3-3. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	47,5	--	43,9▼	83,7▲	50,0	46,2	60,0▲	18,4▼
neutral	21,6	--	20,8	11,6	27,8	38,5▲	22,4	19,6
(strongly) agree	30,9	--	35,3▲	4,7▼	22,2	15,4▼	17,6▼	62,0▲
<i>N</i>	528	--	428	43	18	39	370	158

I'd like to keep on working in a 3-3 schedule. (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
(strongly) disagree	14,0	14,0	--	--	--	--	--	14,0
neutral	23,3	23,3	--	--	--	--	--	23,3
(strongly) agree	62,8	62,8	--	--	--	--	--	62,8
<i>N</i>	43	43	--	--	--	--	--	43

Which offshore - onshore working schedule do you prefer? (percentages)

	Total	Tour system					Experience 3-3 tour system	
		3-3	2-2	2 off-3 on	other system	hoppers	No	Yes
7 days offshore and 7 days onshore	3,4	0	2,3▼	3,7	28,6▲	5,9	6,5▲	0▼
7 days offshore and 14 days onshore	1,8	3,8	1,7	3,7	0	0	2,0	1,6
14 days offshore and 14 days onshore	24,6	0▼	28,5▲	3,7▼	14,3	35,3	41,7▲	6,4▼
14 days offshore and 21 days onshore	38,3	30,8	35,8▼	88,9▲	7,1▼	41,2	34,7	42,2
21 days offshore and 21 days onshore	26,2	57,7▲	28,1	0▼	7,1	0▼	7,5▼	46,0▲
Other schedule	4,7	3,8	3,6	0	35,7▲	5,9	6,0	3,2
No fixed schedule	1,0	3,8	0▼	0	7,1▲	11,8▲	1,5	0,5
<i>N</i>	386	26	302	27	14	17	199	187