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CAN WE USE NEAR-MISS REPORTS FOR ACCIDENT PREVENTION? A STUDY IN THE OIL AND GAS INDUSTRY IN DENMARK

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ABSTRACT

Background: The oil and gas industry in the Danish sector of the North Sea has always focused on reducing work-related accidents. Over the years, accident rates have been reduced, and near-miss reporting has gained in importance, because it allows the industry to learn from experience and prevent further accidents. Because of this importance, oil and gas companies use many resources to register and analyse near misses. The aim of this paper is to investigate near-miss reporting for the Danish offshore installations and to examine what the industry learns from near-miss reporting and how these reports can be used in the prevention of accidents.

Data: Data are derived from three oil and gas companies in the Danish sector of the North Sea. The material consists of documentary data such as procedures and reports as well as interviews and a database including near-miss reports. The near misses have been divided into thematic groups, and two types of near misses were chosen for further analysis: gas leaks and person related incidents.

Methods: Thematic analyses of documentary material, accident prevention procedures and selected near-miss cases.

Results: The preliminary results show that all companies have procedures and systems for accident and near-miss reporting. The paper shows that there are challenges and barriers for the use of near-miss reporting systems with regard to learning and improving the safety of off-shore installations, and suggestions are made for improvements.

Keywords: Near misses, accident prevention, offshore, learning

1. INTRODUCTION

The oil and gas industry is an industry that involves high risks. Therefore, the reduction of risks, the improvement of safety and the prevention of accidents receive ongoing attention. To reduce the number of accidents and their severity, lessons from earlier accidents can be learned and used for the prevention of future accidents. In our understanding, successful learning would mean that the causes are identified and that actions aimed at reducing these causes are implemented and evaluated (Kjellén; Van Court Hare; Laitinen and Ruohomäki 61-73). If there are reoccurrences on offshore installations of the same or similar types of incidents, it suggests a failure to use the information about these incidents and to learn from them. However, significant resources are used to register information about near misses – unwanted incidents that could result in material

damages or personal injuries. It is possible that this information could provide valuable information that enables the prevention of future accidents. According to van der Schaaf (1992), learning from near misses could be useful because near misses provide qualitative insight into how (small) failures or errors develop into near misses (van der Schaaf, p. 23). Near misses occur more often than accidents, and because of their greater number, near misses therefore provide statistically reliable insight into the occurrence of factors that create the risk of incidents (van der Schaaf). Not only are near misses more numerous than accidents, they are also less threatening to discuss because the consequences are limited. Moreover, although incidents with severe consequences gain significant attention, their impact decays over time. In our study, we aim to identify how near misses are reported and whether these near-miss reports are used as information to learn from. In our study, we assume that the corrections of errors or deviations that are made after a near-miss report would have a direct effect on reducing accidents because the errors or deviations that could lead to an accident are removed (Laitinen, Marjamäki, and Päivärinta 463-72). However, there is also an indirect effect if the organisation is learning from these events and the learning is used for the prevention of similar incidents. Thus, better knowledge about the reporting and use of near-miss data could improve the safety of offshore installations because it will allow for learning from these near misses and for the identification of technical, personal or organisational weaknesses.

This paper describes a study in the Danish offshore industry on how near misses are reported and how they are used in the prevention of future accidents or near misses.

Aims

The aim of this paper is to investigate the near-miss reporting procedures on Danish offshore installations, what the industry learns from near-miss reporting and the potential challenges and barriers for these systems for the further prevention of accidents. More precisely, we will investigate the following:

How can near-miss data contribute to the improvement of offshore safety on Danish oil and gas production installations?

- What are the procedures for reporting near misses?
- How are near misses reported in daily practice?
- What creates potential reporting barriers or facilitates reporting?
- How is the organisation learning from near misses?

To answer our questions, we use several data sources such as procedures, interviews and near misses. In the first step of our study, we aim to identify how the industry has formalised the reporting of near misses, and for this purpose, we study the procedures implemented by three operators in the Danish sector. Afterwards, we explore how the reporting works in daily practice through interviews. Then, we describe some examples of near misses, explore the process of analysing near misses and, finally, identify the potential challenges and possibilities within the system.

In the following section, we present the theoretical framework used in the study.

2. THEORY

To study near-miss reporting and the use of near-miss reports for learning, a model has been used for the analysis that is inspired by the models from Drupsteen, Van Court Hare and Kjellén. These models and their use in the analysis are described briefly in this section. The models cover aspects of learning, reporting procedures and feedback.

2.1 The learning from events process

In this study, near misses are defined as unsafe situations that did not result in severe consequences, i.e., a chain of events occurred that led to an accidental outcome, but the process was stopped before any consequences occurred. By reflecting on those near misses and learning from them, future unsafe situations that could have more serious consequences can be prevented. According to Drupsteen et al. (Drupsteen, Groeneweg, and Zwetsloot), it is necessary to follow certain steps after the reporting of a near miss to effectively learn from it. These authors describe learning from events as an organisational process in which events such as incidents are analysed and used to improve the organisation and to prevent future occurrences (Drupsteen, Groeneweg, and Zwetsloot). The ‘learning from events process’ then consists of sequential stages: reporting a situation, analysing the situation, making plans for improvement, performing those plans, and evaluating their effect and the learning process itself. This process could be applied to near misses as a specific type of event to learn from. In this study, the model of the learning process is used in the interviews to explore how the companies organise the process of reporting and following up on near misses.

Drupsteen et al. used the model of the learning process to identify where in the process the main hindrances occur and to determine the differences between the formal learning processes (i.e., how steps are supposed to be performed according to formal rules and procedures) and the actual learning process (i.e., how the steps are performed in daily practice (Drupsteen, Groeneweg, and Zwetsloot). The results illustrated that formally organising the steps, such as reporting, does not necessarily lead to successful performance of those steps in daily practice. This paper focusses on the first steps in learning – reporting information and analysing it – to identify the lessons to learn. Multiple methods are used to study both the formal reporting of near misses, meaning how near misses are supposed to be reported according to rules and procedures, and the actual reporting and follow up.

2.2 Formal reporting procedures

The reporting procedures for near misses are often described in the company procedures. The importance of these procedures is emphasised by Kjellén (2000). According to Kjellén, the procedure should include the following elements:

1. Scope and aim of the procedures
2. Definition of the type of events to be reported and investigated; definition of the severity classes
3. Responsibilities for notifications, investigation, documentation and the follow up of the results
4. Description of routines for the following:
    a. Immediate notification
    b. Securing of the accident site
    c. Supervisor's and safety representative's first report
    d. Investigation team
    e. Accident commission
    f. Contractor accident
    g. Commenting on the report to ensure adequate quality
    h. Distribution of the report
    i. Follow-up of remedial actions (assignment of responsibilities, deadlines, verification of implementation)
5. References and attachments: Forms for the documentation of the investigation results and the follow-up actions (Kjellén 2000, p.187-188)

In this study, we use Kjelléns' description of the procedure as the "ideal model" and compare it with the actual procedures within companies.

2.3 Actual reporting: near-miss reports

Kjellén suggests in his book that there are differences in the scope and depth of incident investigations and analyses. Not every incident requires the same level of investigation. He distinguishes between minor and serious incidents, based on their consequences. Minor incidents are mostly investigated by the first line supervisor, whereas serious incidents are investigated by independent commissions. Because these types of incidents are treated differently in their investigation, the outcomes will differ too.

Near misses can be classified as minor incidents. Near misses can also, however, lead to severe outcomes, in which case they would then be classified as a serious incident. According to Kjellén, minor incidents can be divided in two categories: those that occur once or those that occur frequently. The investigation of singular incidents is mostly focussed on the correction of the deviations, i.e., the direct preventive effect, while the investigation of frequent incidents is aimed at changing the contributing factors at the workplace, e.g., organisational strategies and procedures. The investigation of serious incidents is mostly aimed at identifying 'root causes' and will usually result in recommendations.

Kjellén's model represents a comprehensive approach for accident investigations at three levels. On the first level, the accidents or near misses are reported and investigated by the first-line supervisors. After the investigation, the implementation of remedial actions takes place. More frequent or severe events are investigated by a problem-solving group that suggests actions – these are second level investigations. For a third level investigation, an independent investigation commission investigates incidents with major severity. Based on the recommendations from the commission, actions like changes in procedures or improvement are implemented.

In this study, Kjelléns model for accident investigation is used to evaluate the process of handling near misses and exploring the possibilities for learning from them or the barriers to this learning.

2.4 Actual learning

Van Court Hare has developed a hierarchy of feedback based on experience in traditional industrial and military organisations. His focus was on the degree to which organisations learn from their experience. According to Van Court Hare, there are 5 levels of system order, from level 0, with no feedback, to level 4, which includes a goal-changing system. Van Court Hare emphasises the importance of organisational memory to allow learning from near misses. Table 1 shows the level of hierarchy from Van Court Hare.

An added column presents Kjellén's reformulation of the hierarchy to make it applicable for incident feedback. The first level is characterised by a very simple system with no memory storage and no feedback; the next level includes feedback, but without selective memory. The next level is a tactical system, which evaluates and acts on a wide range of different input. The subsequent level involves learning, meaning that it represents a system that has the ability not only to evaluate and act but also to learn and develop new plans and decisions based on experience. The final level is the goal-changing system, and it is characterised by developing, selecting and implementing new and improved goals.

Table 1 Comparisons of Van Court Hare and Kjellén's definition of system hierarchies

System hierarchy	Van Court Hare	Kjellén
0	The simple machine or transformation: so-called open system or simple operation without memory and feedback	Simple transformation without feedback: no follow-up of accidents with remedial actions
1	The simple machine with feedback: direct feedback is present for control, but no selective memory	Simple machine with direct feedback but without selective memory: corrections of deviations identified by accident investigation or safety inspections
2	The system with conditional selection of plans and predictive feedback – a so-called tactical system: error correction based on extensive memory facilities, the ability to evaluate and act on a wide range of different input conditions	Tactical system with memory organisation, conditional selection of pre-established plans and predictive feedback: starting a safety campaign following an increase in certain injuries
3	The system that learns – strategic system: the system not only performs the functions above but also can develop new plans or new decision rules, or it can change the value of plans and methods to handle new conditions	Strategic system, system that learns from experience and has the ability to correct the selection of plans and develop new plans: change in routines, instructions, rules or design on the basis of accident experience
4	The goal-changing system: system that learns, develops, selects and implements new and improved goals, system has increased "awareness" of data and patterns, both internal and external to the present needs of the system	Goal-changing system, system that learns and consciously develops, selects and implements new plans

In this study, Van Court Hare's model is used to classify the level of feedback for each report.

3. MATERIAL AND METHODS

This section describes the collection of information about reporting in three oil and gas companies by studying procedures and near-miss reports and by performing semi-structured interviews. The data are collected from three oil and gas companies in the Danish sector of the North Sea. Together, these three companies cover all operating companies in the Danish sector of the North Sea, employing approximately 3000 people. One of the companies is larger than the other two and has more production installations. Each company provided a contact person who facilitated data collection and other practical issues such as travel offshore or contact with offshore employees. The companies' management supported the study.

In the following, we present how the data was collected and, afterwards, how the data was analysed.

3.1 Data collection

3.1.1 Procedures

To study how organisations have formally organised near-miss reporting, we used three procedures for reporting near misses and accidents, one for each company. The companies regularly updated their procedures, and we receive updated procedures in fall 2011.

3.1.2 Near-miss reports

To determine how the near misses are reported, 550 near misses are studied. The study is limited to those near misses that are classified by the organisations as 'gas leaks' or as 'related to personal behaviour' and that occurred on production platforms between January 2008 and October 2011. The near misses are selected from a database including all near misses from the three organisations, containing a total of 2361 reports. After an initial selection, 778 near misses were excluded because they contained duplicate reports or near misses that were not related to production platforms, such as those related to supply vessels. One of the companies had two systems for reporting incidents; however, one database containing 330 cases was not included in the analysis because the cases contained too little information to allow for analysis.

The remaining 1583 near misses are sorted by the categories given to them within the companies, such as gas leaks, fire, chemical, person-related or falling objects. The companies have made a distinction between process safety and personal safety. Process safety includes cases that could have an influence on the production of oil and gas, while personal safety includes cases that are related to possible injuries of people and damage of equipment. To analyse if there are differences in the characteristics of learning from process related events versus person related events, two categories of near misses are selected: gas leaks and personal behaviour. We would like to know whether there is a difference between the handling of these two categories of cases from a process safety versus a personal safety standpoint. One of the categories of process safety is gas leaks; we chose this case because gas leaks are easily defined and a "rather" simple process.

This decision led to our final selection of 550 near-miss reports, including 98 gas leaks and 452 person related near misses.

3.1.3 Interviews

We studied how near misses are reported in daily practice by interviewing offshore employees during the 2009-2010 period. Altogether, 81 interviews were conducted by the same single researcher. Most of the interviews were conducted during offshore visits, but some of the interviews were conducted at the airport before going offshore because the respondents did not have time for the interview during the offshore visit. Four visits offshore lasted 3-4 days, and one visit lasted for only two days, during which two smaller installations were also visited. The interviews from those two installations were not taped but were written down, and mostly field notes were used for the analyses. The interviews varied from 18 minutes to over 1 hour. Altogether, there were 81 interviews conducted both offshore and onshore (47 individual interviews and 34 focus groups interviews):

- 14 interviews with safety representatives from operating and contracting companies
- 10 interviews with leaders and employees from the Health, Safety and Environmental Departments onshore
- 54 interviews with offshore employees at the management level and regular offshore employees
- 3 interviews with contact persons from each company about procedures and the near miss and accident processes

On each of the four installations, all of the primary leaders and safety representatives were interviewed. Apart from that, almost all of the foremen were interviewed. The foremen interviewed represented each trade group on the installation and there were representatives from both the day and the night shift. On the smaller installations, with about 60 employees, approximately 50% of the employees were interviewed. On the larger installations, with approximately 100 or more employees, 33% of employees were interviewed. The criteria for the selection of respondents were that they represented all of the trade groups on the installations from both the night and the day shifts. The interviews were semi structured and involved the following categories: information about safety, communication, attitude toward safety, role of the safety representatives, expectation of the safety representatives, management commitment to safety, procedures and accident prevention and the near-miss system. In this study, we only use those parts of the interviews that concern accident prevention and the near-miss systems.

The interviews with contact persons from each of the participating companies about procedures and near-miss processes took place onshore and were conducted in the fall of 2011. The interview duration was approximately 1 hour for each interview. The interview was semi structured and followed Drupsteen et al.'s steps

from the learning from events model. These interviews were not taped, but notes were taken, and the description of the process was sent to those interviewed for approval.

Apart from the interviews, the data includes observations on safety meetings both onshore and offshore (18 meetings). The observations were written down, and notes were used to analyse.

3.2 Data analysis

3.2.1 Procedures

The procedures were analysed using the criteria from Kjelléns' procedural description. Using Kjelléns' criteria, the procedures were analysed to determine whether they had all of the elements described by Kjellén. We looked for the scope and aim of the procedure, definitions of the near misses and incidents or descriptions of routines.

3.2.2 Near-miss reports

All of the selected near-miss reports where entered into Nvivo9 and coded into open and defined categories. The defined categories were based on Van Courts' Hare conceptual model. Table 2 shows our operationalisation of Van Courts' Hare hierarchy. In our operationalisation, we omitted level 4 because we are not able to estimate whether a system is a goal-changing system based on near misses. We also decided that the reporting of near misses is a sign of learning and therefore qualified the organisation as a level 1 with some exceptions if the report only had information about an incident, but no feedback.

Table 2 Our operationalisation of the system hierarchy suggested by Court Van Hare

System hierarchy	**Our operationalisation**
0= No feedback	Unreported incidents, reported incidents without any feedback
1= Simple feedback	Corrections of deviations identified by incidents investigation Discussion of incident at safety meetings Update/correction/ tightening of procedures
2= Conditional predictive feedback	Starting courses/ safety campaign Controlling other sections for similar problems
3= Learning system	Change in routines, instructions, rules New procedures

Another defined code in our analyses was the severity of an incident. Severity is defined by the organisations and is based on several factors, such as frequency, consequences and remaining barriers. Severity is defined on five levels from 1 to 5; table 3 presents the different levels.

Table 3 Definition of the five levels of severity used for the analyses

Level	Severity
1	Event
2	Minor incident
3	Serious incident
4	Significant Incident
5	Major incident

The level of severity was given in the near-miss reports. However, one of the companies had two different databases including the severity of the incidents. All of the near-miss reports contained the information about severity, but there was another database that was used to group and analyse near misses, where the severity was checked once again. The severity of near misses differed sometimes between those databases; in these cases, we decided to use the qualified estimate from the database where the near misses were grouped and not from the original near-miss report.

Aside from the defined categories, the near-miss reports were coded in open categories that focused on what kind of incident it was, what kind of action was taken and if the action taken was closed.

In the analysis, we are exploring which solutions are most often applied, and we queried to find connections between specific categories of near misses and solutions to discover whether the solution could be related to single loop or double loop learning. The two chosen types of near misses, gas leaks and personal behaviour, were analysed separately.

3.2.3 Interviews

All of the interviews were analysed using the qualitative data analysis software Nvivo9. The interviews were coded in open categories, which were afterwards merged into fewer categories. The interviews with offshore employees were mostly used to explore the possibilities and challenges in learning and the actual daily practice.

4. RESULTS

In this chapter, we describe the results of our analyses of procedures, reporting practises, the near-miss reports, and the follow-up on near-miss reporting in the three companies. Finally, we will present an analysis of the facilitators and barriers connected to the entire reporting process and the follow-up.

4.1 Procedures

All of the companies included in this study had a procedure for how to report accidents and near misses. For each of the companies, the procedures are studied in detail using Kjelléns model as described in section 2.2. In the scope and the aim of procedures, there were some differences between companies. Company A's scope and aim for the procedures were to comply with legislation, comply with the company's standards, secure data for statistical analysis and contribute to a high Safety standard. In company B, the aim and scope of procedures were registration, reporting, notification and preventing recurrence. Company C focused on using the incidents to support learning and prevention and to provide guidelines for addressing deviations from technical, procedural and legal decisions. The results of the analyses showed that most of the elements from Kjelléns' model were represented in the procedures. The procedures provide guidelines on how to report incidents and near misses and have information about which incidents must be reported to the authorities. The procedures include the definition of near misses and accidents; however, companies A and C also had a definition for observations that was quite similar to the definition for near misses. All of the definitions treat the near miss as an incident or event that could result in loss. The observations appear to be something that happens before the occurrence of the near miss, such as conditions that could result in a near miss. The similarities in definitions could result in defining some near misses as an observation. This problem is illustrated in company C, which has two different systems: one for observations and one for near misses. The observations system had a large number of observations, but there were not as many near misses. By splitting those two systems, there is a risk that some of the near misses are mistakenly classified as observations and therefore will not be investigated the way that they should be; some lessons that could be learned from them will be lost. A part of the definition for each of the procedures had a qualification for the severity of events. The descriptions of routines for securing the accident site, the investigation team, the accident commission and the accidents with contractors were limited or nonexistent. The same issues were seen for the follow up of remedial actions. Companies A and C used software, which provides notification for deadlines and the verification of implementation. The weakness of the system was that it was possible to postpone the deadline for closing cases or remedial actions, and in many cases, the deadline was postponed.

Only one of the companies – Company C – had guidelines on how near misses should be used in learning and the prevention of incident, and this company emphasised that before starting a job, a risk assessment should be conducted using the information that already exists in the system.

4.2 Reporting practice

As we could see in the previous section, all of the companies had procedures that describe the actions that should be taken when near misses occur. However, having the procedure does however not necessarily mean that the near misses are reported and analysed. This section presents the conditions for reporting, the results on the actual near-miss reports and the follow up on these reports.

4.2.1 Conditions for reporting

Information about the conditions that are necessary for reporting to occur was collected by means of interviews. The remarks can be divided into remarks that are related to reporting culture and those related to reporting systems.

One of the important issues with regard to learning from incidents is to have an open reporting culture. In the interviews, the employees were asked about the reporting of near misses. Most of the employees reported near misses but primarily related to equipment. There were differences between the companies regarding the reporting of near misses. In company B, the employees were to some degree anxious about reporting, especially the employees from the contracting companies; however, there were also employees who were not frightened at all. In company C, the employees were not fearful of reporting, and sometimes they reported mistakes that they made themselves. In company A, the attitude toward reporting was again different: some employees were anxious,

especially new ones, but with time, they became more willing to report. Table 4 shows some phrases from the employee interviews about reporting to illustrate these differences.

Table 4 Excerpts of interviews with employees from three oil and gas companies in the Danish sector of the North Sea, illustrating the near-miss reporting culture

Company A	Company B	Company C
We have reluctance from people to report on their colleagues. They don't like it because they feel that they gossip or they don't wish to hang someone up because the person did something wrong *Yes, there are a little bit (afraid of reporting). We still have a lot to wish with regard to it. But it's coming quietly, I think. As we have people with us for a longer time, they become more confident and dare to report.*	*R1: It is like the attitude has to be broken.* *I: Are people afraid?* *R2: Yes* *R1: There are some, the one I'm just sitting with is person behaviour related, there are some people who did something that they should not do … but most of them are about equipment* *R: They are probably afraid that something will happen. I think so.* *R1: They are afraid of getting a dismissal notice.*	*No, it is connected to that there is no-blame policy here at the installation and it shines right through. Of course, is it something which is completely unsafe, it will be also taken into account, but there is "no-blame" policy. We have to learn from each other's mistakes, we should not judge each other.* *Not at all. We emphasise in the introduction that it is a positive tool. We do not see it as a safety issue that we have quite big reporting, we look at it as a sign of awareness*

Another issue connected to reporting is whether the reporting system is user-friendly. Some employees, especially in companies A and B, complained that it was too demanding to report the near misses. In company A, the employees mostly complained about the time that it took to report. There were many fields that should be filled in, and the internet connection was slow, which made the process even more time consuming.

"It is disturbing, what can I say; a lot of administrative work with the system, plus it does not always work optimally with the satellite connection" (Company A)

The consequence of the complex system in company A was that some employees did not bother to use their time to report small things. In company B, some of the employees complained about the amount of work connected to reporting and the difficulties in finding the form on the internal system:

"It is a hell, I think. It is too much work. It is a waste of time. I think it is quite difficult to fill out the form. You have to click here and there" (Company B)

The reporting system used in companies is mostly created to register data and not so much to enable analyses. Cases are categorised, but as several respondents mentioned, it is not really possible to find similar cases within the same category.

"Our system is not made this way, that if we say "ok lad, see 'fall at the east stairs'" and then you go to computer and type "fall at east stairs", then three others cases will show up. We can't do it. "(Company B)

4.2.2 Near-miss reports

In this paragraph, we focus on near-miss reports and how companies use them to learn based on the study of actual reports in the near-miss database.

Gas leaks

During the 2008-2011 period, there were 98 gas leaks. Of these 98, 70 of these were categorised as low-risk situations (events), and 2 cases were classified as major risks. Repair was the most common solution for gas leaks (76 cases). The next most common solutions were a discussion of the incident with the involved people and at safety meetings (16 cases). In 8 cases, control checks were performed to search for similar problems in other places. Procedures were updated as a result of 6 cases of gas leaks and another 6 cases resulted in an extra safety meeting. In 5 cases, the rules/procedures were tightened up.

Table 5 Categorising gas leak near-miss reports according to the Van Court Hare hierarchy and the severity of the incident

Severity	Van Court 0	Van Court 1	Van Court 2	Van Court 3
Event	1	57	5	1
Minor incident	0	11	2	1
Serious incident	0	2	3	0
Significant incident	0	1	0	1
Major incident	0	0	1	1
Total	1	71	10	4

Categorising the cases according to the Van Court Hare hierarchy (see table 5) illustrates that most of the incidents with low severity are on hierarchy 1 of Van Court, which corresponds with Kjelléns' model for accident investigations. In this model, the simple events were solved on a first line level, which means on the installation. Some of the events resulted in safety campaigns, one of which was based on the reoccurrence of a similar cause of gas leaks. During the years, there were no differences in how the cases where categorised; the pattern was the same over the years.

Personal behaviour

The incidents in this category were broader than in the gas leak category, and they covered different incidents such as housekeeping, cargo, behaviour, working conditions, falling objects or crane operations. In 216 cases, the issue was discussed at safety meetings or in smaller groups including the involved employees; in 4 cases, the employees were reprimanded, and in 15 cases, an extra safety meeting was organised. In 182 cases, items were repaired, and in 17 cases, a repair was planned. In 30 cases, a control check was performed to discover whether similar events had occurred elsewhere. In 12 cases, the procedures/guidelines were updated, and in 46 cases, the procedures were tightened up.

The near misses involve different categories: the most frequent was an equipment defect, the next most frequent category was processes somehow not performed properly (67 cases), and the third most frequent category was falling objects (66 cases). In 20 cases, poor work conditions were the reason for near-miss incidents; in 7 cases, employees went through barriers; in 8 cases, the procedures were breached; in 5 cases, employees did not used the proper personal protection equipment; and in 9 cases, the barriers were missing. One of the categories was knives in the laundry. Between 2008 and 2011, there were a few cases of knives in the laundry. Every time this occurred, the issue was taken up in the safety meetings, but the cases would appear again. This example a show how difficult is to learn from near misses. Examining the severity of incidents and Van Court Hares' hierarchy pattern, the division of incidents is the same as that for the gas leaks. We looked closely at 5 incidents with low severity that were without any feedback. These incidents occurred at companies A and B in 2008, 2009 and 2011, but we could not see any characteristics to explain why there was no follow up. On the other side of the scale, there were 11 cases with low severity that were actually categorised quite high on Van Court Hares' hierarchy. In 2008, there was one event from company B connected to crane operations that was categorised in the fourth level in the Van Court Hare hierarchy. In 2009, 3 events and 2 minor incidents from Company A resulted in new procedures and working routines. All 5 cases were very different from each other. The only case in 2010 was from company B and concerned poor work conditions and falling objects. The last 4 cases in 2011 were from Company A and Company C. Some of the cases concern cooperation between the contracting companies and the operating company. All of the cases were different, and they did not have any specific characteristics, which make these cases more suitable for learning then others.

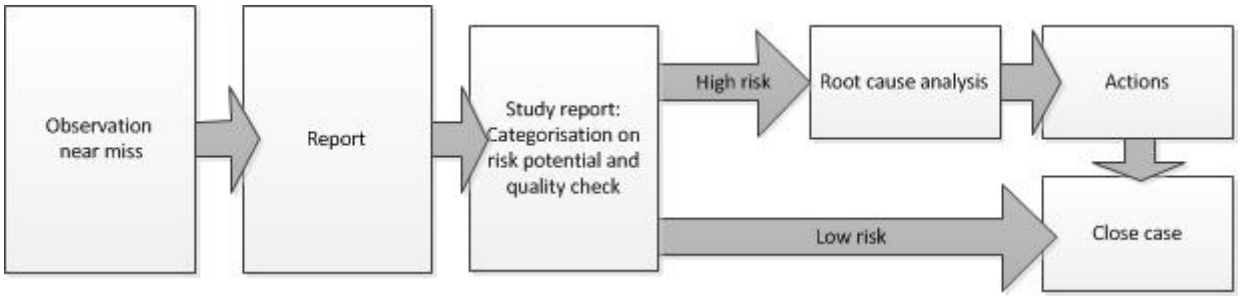
Table 6 Categorising personal behaviour near-miss reports according to the Van Court Hare hierarchy and the severity of the incident

Severity	Van Court 0	Van Court 1	Van Court 2	Van Court 3
Event	4	233	16	5
Minor incident	1	91	12	6
Serious incident	0	25	10	2
Significant incident	0	4	1	1
Major incident	0	0	0	3
Total	5	353	37	14

4.2.3 Near-miss processing after reporting

We asked in the interviews with the three contact persons within the companies how the near misses are processed after reporting. The process is similar in all three companies. Figure 1 illustrates the process that was identified based on the interviews.

Figure 1 Process for near misses



When the near miss takes place, it is reported in the system. Every company has an electronic system, in which the near misses should be reported, but the employees can also complete a special form and submit it at the installation, or they can ask the safety representative to complete it for them. After reporting, the quality check takes place. The first quality check is performed on the offshore installation, and then the report is sent onshore, where the risk potential is estimated and, sometimes, a new quality check is performed. The quality check should assure the quality of the near-miss report and its usefulness for future learning, but it could also lead to a "subjective" rewriting of the near-miss report. Depending on the severity of the incident, a root cause's analysis is performed, and actions are formulated; if the risk potential is estimated as low, the case will be closed without further analysis.

Both Kjellén and Drupsteen focus on feedback and follow up on the action taken. Based on the three interviews with the contact persons within companies, the follow up on the action was very limited. Companies A and B emphasised the lack of resources for follow up. In company A at the time of the study, the system that is used to register the near misses was not designed for the follow up of the activities, but the company was in the process of changing the system to a better one. Another problem was that actions were not completed; in particular, company A had problems with closing the cases.

"We have a challenge to close our actions in the program. The problem is that it is easy to create the action in the program and you can actually "give" it to yourself and to others. But this way, you risk that the task will not be prioritised and they will be not planned. It gives some frustrations sometimes, because suddenly there is red light lighting. An action which should be closed" Company A

In company A, there was a delay with closing actions and it resulted in employee frustration. At the safety meeting offshore, employees emphasised their frustration about being encouraged to report near misses or improvement suggestions without anything happening with them. As the one of participants at the meeting said:

"For God's sake, don't put it on the action list because then it will never be done!" Company A

Another employee said in the interview about this situation:

"Oh, the improvement suggestions are never used. I don't believe that they look at them onshore. We don't get much answer from them. It's too little" Company A

Another problem with processing near misses is to find the roots causes for the incidents, which could be a challenge. As one of the leaders from Company A emphasises:

"But again, it is maybe the reactive way of doing it. You do it when you have another incident again. So you look at it, and you find out that you had a similar incident three or four years ago. So that way you think: how do we find the real causes? Because if you don't indentify the root causes, you can't start the proper action and prevent incidents" Company A

Aside from the weaknesses in the follow up process for the near misses, many employees and leaders were satisfied with the existence of the system, stated that the system was good and believed that it was right way to try to prevent accidents. However, they emphasised that the system should be used in the proper way and not be abused.

5. DISCUSSION

The aim of our study was to explore how near-miss data can contribute to the improvement of the accident prevention on offshore installations with a focus on procedures, daily practice, barriers, facilitators and learning aspects. In our study of oil and gas companies in the Danish sector of the North Sea and of their practices for near-miss reporting, we could see that near misses occur more often than accidents, and they provide more information about deviations or unsafe acts. However, the effect of near misses on the prevention of accidents is difficult to estimate based on the data that we have. One limitation of using near misses is that the learning is thus based on an analysis of retrospective data. The disadvantage of retrospective learning based on accidents is that the systems are rarely static, which means that new incidents will occur in a different context. Another challenge in learning based on retrospective analyses is peoples' ability to adopt systems to their purposes; this adoption is not a random process that could be predictable and controllable (Leveson 55-64). However, according to Leveson (2011), in some cases, reactive learning is useful, especially in industries where the basic design changes slowly, such as in the nuclear power industry. According to Leveson, the introduction of new technology, particularly digital technology increases the complexity in the system and can lead to new potential hazards. The oil and gas industry could be treated as an industry where the basic design changes slowly, and therefore, we believe that it could take advantage of retrospective learning.

Another limitation of our study is its generalisability to other industries and other countries. Some of the types of near misses are very specific to oil and gas production and could only be used in the oil and gas industry, but other categories related to personal behaviour could be used in other industries, such as housekeeping issues. However, our study showed the differences within companies and the influence of each organisation's culture on reporting and learning from the incidents. The influence of culture means that the generalisability is not very high.

The severity of the incidents used in the analyses could also be a limitation to the study because severity is an estimate that can be subjective. Despite these limitations, this study still contributes with new knowledge about the reporting of near misses and the learning from them in the Danish oil and gas industry. The study is based on different data sources and therefore provides a more detailed picture of the process around near misses and learning from them. The large number of near misses in the data provides good insight into the near misses that are reported and the potential for learning.

In our study, we could recognise that there is some learning in the oil and gas industry based on near misses. All of the companies have a basis for learning from incidents within the procedures for reporting accidents and incidents, and they have a reporting system. However, providing a basis for learning does not mean that the companies are learning from their incidents. The results showed that the daily practice in reporting is a barrier. One of the barriers in reporting was the employees' unwillingness to report on their own or their colleagues' behaviour. Another barrier was connected to the near-miss reporting system. The reporting process was sometimes too demanding and discouraged employees from reporting. However, some direct preventive approaches are taking place at the time of the incident, i.e., simple operations without memory and feedback. Some learning is also taking place and providing possibilities for indirect prevention, but this is mostly ad hoc learning, i.e., local learning without selective memory. Another barrier connected to the reporting system for near misses is that the system primarily serves as a data collection system; only to a lesser degree does it serve as a lead indicator in a proactive monitoring strategy. The use of near misses as lead indicators on offshore installations must be seen as a proactive approach in the monitoring of safety. Safety performance indicators, by definition, must include measures of root causes and the safety related performance of the production process. Only in this way can the safety performance indicators serve as a reliable instrument for monitoring the safety on offshore installations. However, the prerequisite is that the performance indicators must be based on practical or scientific evidence about the causal relationship between the indicators used and the unwanted outcomes (Dyreborg 474-75; Leveson 55-64; Dyreborg 474-75). Another element in learning, which both Kjellén and Drupsteen focus on, is feedback and follow up. However, this element is to some degree limited in the companies and therefore a barrier for future learning.

6. CONCLUSIONS

We studied how near misses are reported and used for learning. Although most organisations have procedures in place that they comply with, near-miss reports are still not optimally used for learning. The reporting of near misses in daily practice is a barrier because not all near misses are reported. Thus, important information is not collected on the near misses on offshore installations. It might be difficult to achieve the full reporting of near misses, but companies must strive to report as many near misses as possible. One potential barrier is that the definition of a near miss is unclear, and it could be difficult to delimit what events should be included. Another barrier is that it is too demanding to report a near miss in the system, which discourages the

employees from reporting. Moreover, because of the fear of blame, the person-related near misses appear to be underreported in comparison to the process safety incidents, and thus, the person-related near misses provide biased information. The reporting systems as they are currently designed are mostly aimed at gaining an overview and at registering the reports, and thus, they provide limited grounds for learning from the near misses. In many cases, however, actions are determined and implementation is started, but these steps are not completed or evaluated. Finally, it appears that learning across situations and units is limited because the learning is mostly oriented to the actual case. Therefore, learning is not achieved from the many smaller cases of near misses, and important preventive possibilities are missed. Overall, it appears that the collection of data on near misses work well, but the organisational learning from them is sparse. Therefore, attempts must be made to improve the learning process, e.g., by setting up a follow-up team.

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