University of Stavanger

FACULTY OF SCIENCE AND TECHNOLOGY

MASTER'S THESIS

Study programme/specialisation: Societal safety and Risk Management	Spring/ Autumn semester, 20.20 Open / Confidential
Author: Brath, Oda Bruaset	
Programme coordinator: Engen, Ole Andreas Hegland Supervisor(s): Sommer, Morten	
Title of master's thesis: Learning from incidents: Evaluating safety interventions after incident investigations	
Credits:	
Keywords: Learning from incidents, organizational learning, incident investigation, safety interventions, corrective measures, evaluation	Number of pages: 107 + supplemental material/other: 21 Stavanger, 15th June 2020 date/year

Master's thesis

University of Stavanger

Spring 2020

Learning from Incidents: Evaluating Safety Interventions after Incident Investigations

How can organizations within the Norwegian petroleum industry learn more from incidents through better practices for evaluating safety interventions implemented after incident investigations?

Oda Bruaset Brath

Candidate number: 228084

ACKNOWLEDGEMENTS

At the end of a two-year long journey studying societal safety and risk management at the University of Stavanger, this master's thesis came about. It was difficult to choose just one topic for the thesis, because we have been introduced to a wide range of different, but equally interesting issues worth addressing. Nevertheless, I have ended up with studying a topic that I personally found rewarding to explore, and would dare to argue is relevant to all areas of business. In addition, I would like to point out that this master's thesis is written for a wide group of readers. The intention has been for every reader to understand the content, and not just those within the safety and security community. Anyway, I will forever take good care of all my notes, expensive books and good memories of all the semesters at the University.

I want to use this preface to thank everyone that has helped me reach this milestone. First, I want to thank all the participants for sharing their experience with me, both positive and negative, and showing great interest in the issue addressed in the thesis. Some of you have already "ordered" follow-up from me, which I am very much looking forward to.

Secondly, I would like to thank my supervisor, Morten Sommer, for constructive and motivational advice along the way. I know you have spent a lot of time reading through all the versions of the thesis I have sent you. The end product is a result of good feedback every time. I am so glad I asked you to be my supervisor in this project.

Next, I want to thank those individuals that has functioned as my professional mentors. Thank you Øyvind Hebnes, for always providing me with both academic and moral guidance along the way. Thank you, Arleen Engeset, for making it easier to combine both work and study. Thank you Ronny Sæther, for always listening and supporting me with books. You will get them back some time soon, I promise. In addition, thank you Line Steinnes, for cheering on me and sharing your experience.

Last, but not less important. Thank you to my family members in Homestand, Vestby and Stavanger. You are the best supporters!

Oda Bruaset Brath

Vestby, June 2020

(Blank page)

SUMMARY

This master's thesis is about learning from incidents and following up on safety interventions implemented after incident investigations in oil and gas companies involved in the Norwegian petroleum industry. The starting point was previous research which has observed that several organizations often fail to exploit the learning potential that comes with undesirable incidents, because, among other things, they rarely evaluate the safety interventions they have implemented after investigations. The purpose of this thesis has been to test whether these findings also apply to organizations within the petroleum industry. It was therefore questioned whether the oil and gas companies could learn more from incidents by establishing better practices for evaluating safety interventions implemented after investigations.

To answer this, it has been an objective to generate empiricism that can say something about what is the current practice for evaluating safety interventions. Second, it has been an aim to explain *why* organizations in this industry may not evaluate. Third, it was natural to consider what kind of learning the oil and gas companies theoretically achieve by current practice for evaluation.

An intensive and exploratory research design underlies this study, where an abductive research strategy was followed. This combines both self-collected empiricism and pre-existing theories to answer the problem and research questions. Data were obtained by combining qualitative methods such as various forms of interviews and content analysis. In general, however, most of the data is based on expert opinions from individuals with good insight into how most oil and gas companies typically follow up on the safety interventions they implement, as well as possible explanations for current practice.

After the data collection was completed and the empirical findings were discussed in light of theoretical perspectives on organizational learning and evaluation, as well as compared with findings from previous research, it became clear that previous observations that organizations do not learn as much as they can from incidents because they do not evaluate implemented interventions, also apply to the oil and gas companies that participated in this study. The companies rarely evaluate the safety interventions they have implemented following investigations. The reason for this has been found to be multifaceted, where, based on the statements of the participants in this study, it appears that it is the combination of several factors

that results in interventions rarely being evaluated. Mainly, however, it seemed that the most salient explanatory factors were that evaluation is not prioritized despite being considered as important, that evaluation is perceived as challenging to perform in practice due to particularly lack of information about the objective(s) with, target group for and the background of a safety intervention, and that the Synergy information system is not optimal for the purpose of evaluating implemented interventions. The reason why evaluation is not prioritized is, based on the empirical results, a negative safety culture in which company employees think of evaluation as something that you do not have to prioritize if you do not want to, and that they are more concerned about "closing deviations" than checking whether implemented safety interventions actually have a positive impact on the safety level of the companies. At the same time, the reader should note that this is only one possible explanation for the problem, because an abductive logic was used to answer the research questions.

Thereafter, it was discussed that the companies by current, almost “non-existent” evaluation practices result in a low level of organizational learning. The oil and gas companies are not learning as much as they could have done through better evaluation practices. To achieve higher order organizational learning, evaluation can be a very effective tool. An evaluation of both the effect of safety interventions and how the implementation process itself took place, could serve as an essential input to the companies' safety management.

Further, important findings from this master's thesis are also that it has been argued that failure to evaluate is a repeating pattern across most organizations within the industry in question. In addition, it was said that most companies generally rarely evaluate safety interventions, including those implemented outside of incident investigations. Therefore, the lack of evaluation of implemented interventions is a pervasive problem.

Finally, in order to stimulate to more evaluation of implemented safety interventions, some practical implications were proposed, i.e. some concrete suggestions for how the oil and gas companies can improve. Further, aspects that should be addressed in further research were also mentioned.

SAMMENDRAG

Denne masteroppgaven handler om læring etter uønskede hendelser og oppfølging av tiltak implementert etter granskinger hos olje- og gasselskap involvert i den norske petroleumsindustrien. Utgangspunktet var tidligere forskning som har observert at flere organisasjoner ofte mislykkes i å utnytte læringspotensialet som kommer med uønskede hendelser, fordi de blant annet sjeldent evaluerer tiltakene de har implementert etter ulykkesgranskinger. Hensikten med denne masteroppgaven har vært å teste om disse funnene også gjelder for organisasjoner innen petroleumsindustrien. Det ble derfor stilt spørsmålstegn ved om olje- og gasselskapene kan lære mer av uønskede hendelser ved å etablere bedre praksis for evaluering av tiltak implementert etter granskinger.

For å kunne svare på dette har det først og fremst vært et formål å generere empiri som kan si noe om hva som er nåværende praksis for evaluering av tiltak. For det andre har det vært et formål å kunne forklare *hvorfor* organisasjoner innen denne industrien eventuelt ikke evaluerer. For det tredje var det naturlig å vurdere hva slags type læring olje- og gasselskapene teoretisk sett oppnår ved nåværende praksis for evaluering.

Til grunn for denne studien ligger et intensivt og eksplorerende forskningsdesign, der det ble fulgt en abduktiv forskningsstrategi som kombinerer både egeninnsamlet empiri og allerede eksisterende teorier for å svare på problemstillingen og forskningsspørsmålene. Data ble fremskaffet ved å kombinere kvalitative metoder som ulike former for intervjuer og innholdsanalyse. I all hovedsak baserer likevel det meste av dataene seg på ekspertuttalelser fra individer med god innsikt i hvordan de fleste olje- og gasselskap typisk følger opp tiltakene de implementerer og mulige forklaringer på nåværende praksis.

Etter at datainnsamlingen var fullført og de empiriske funnene ble diskutert i lys av teoretiske perspektiver på organisatorisk læring og evaluering, samt sammenlignet med funn fra tidligere forskning, ble det klart at tidligere observasjoner om at organisasjoner ikke lærer så mye som de kan av uønskede hendelser fordi de ikke evaluerer implementerte tiltak, også gjelder olje- og gasselskapene som har deltatt i denne studien. Selskapene evaluerer sjeldent tiltakene de har implementert etter granskinger. Grunnen til dette har vist seg å være flerdelt, der det basert på utsagnene til deltakerne i denne studien virker som at det er kombinasjonen av flere forhold som resulterer i at tiltak sjeldent blir evaluert. I all hovedsak virket det likevel som at de mest

fremtredende årsaksforklaringene var at evaluering ikke prioriteres til tross for at det anses som viktig, at evaluering oppleves som utfordrende å få til i praksis på grunn av særlig manglende informasjon om hva som var målet, målgruppen og bakgrunnen for et tiltak, og at informasjonssystemet Synergi ikke er optimalt med hensyn til evaluering av implementerte tiltak. Grunnen til at evaluering ikke blir prioritert skyldes basert på de empiriske resultatene en negativ sikkerhetskultur der ansatte i selskapene tenker om evaluering som noe man ikke er nødt til å prioritere hvis man ikke ønsker det, og at man er mer opptatt av å «lukke avvik» enn å kontrollere om implementerte tiltak faktisk har en positiv virkning på sikkerheten til selskapene. Samtidig skal leseren bemerke seg at dette bare er én mulig forklaring på problemet, nettopp fordi det ble anvendt en abduktiv logikk for å få svar på forskningsspørsmålene.

Videre ble det diskutert at selskapene ved nåværende, nesten "ikke-tilstedeværende" praksis for evaluering resulterer i et lavt nivå av organisatorisk læring. Olje- og gasselskapene lærer ikke så mye som de kunne ha gjort ved bedre praksis for evaluering. For å oppnå organisatorisk læring av høyere orden, kan evaluering være et svært effektivt virkemiddel. En evaluering av både effekten av tiltak og hvordan selve implementeringsprosessen foregikk, vil kunne fungere som essensiell input til selskapenes sikkerhetsstyring.

Ytterligere er viktige funn fra denne masteroppgaven også at det har blitt hevdet at manglende evaluering er et gjentakende mønster på tvers av de aller fleste organisasjoner innen den aktuelle industrien. I tillegg ble det sagt at selskapene generelt sett sjeldent evaluerer tiltak, også de tiltak implementert utenom granskinger. Manglende evaluering av implementerte tiltak derfor et gjennomgående problem.

Avslutningsvis, for å stimulere til mer evaluering av implementerte tiltak, ble det foreslått noen praktiske implikasjoner, altså noen konkrete forslag til hvordan olje- og gasselskapene kan forbedre seg. Det ble også oppfordret til aspekter som bør adresseres i videre forskning.

CONTENT

Acknowledgements I

Summary III

Sammendrag V

List of figures IX

List of tables X

1 Introduction 2

1.1 Problem definition 3

1.2 Goals and motives 6

1.3 Literature review 7

1.4 Further structure 12

2 Context 14

2.1 Who conduct the incident investigations? 14

2.2 The incident investigations process 16

2.3 The regulations on evaluation 20

3 Theoretical framework 22

3.1 Incident investigations 22

3.2 Safety interventions 23

3.3 Learning 24

3.4 Evaluation 31

3.5 Summary: What should we bring from this? 39

4 Methodology and research Design 41

4.1 Research strategy 42

4.2 Literature review 45

4.3 Data collection 46

4.4 Data reduction and analysis 52

4.5 Research ethics 53
4.6 Generalization, Validity and reliability 55
5 Empirical results 60
5.1 The transition from incident investigation to the intervention process 61
5.2 The ideal intervention process vs. reality 68
5.3 The *Synergi* system does not support evaluation of interventions 70
5.4 Evaluating interventions is challenging 72
5.5 Evaluation of interventions is not a priority 79
5.6 Evaluating could be easier if you could look at examples from others 83
5.7 Closing criteria should be set 84
6 Discussion 87
6.1 What are the current practices for evaluating safety interventions? 87
6.2 If interventions are not evaluated after implementation, why not? 92
6.3 What type of learning is achieved by current practices for evaluation? 97
6.4 How can better practices for evaluating safety interventions contribute to more learning? 100
7 Conclusion 105
7.1 Practical implications: recommendations 106
7.2 Call for further research 107
References IX
Appendices XVI
Appendix A: Information letter to the participants (in Norwegian) XVI

LIST OF FIGURES

Figure 1: Utilized learning potential following events at various stages in the process "Learning from incidents" (Drupsteen, Groeneweg and Zwetsloot. 2013, page 73). 4

Figure 2: Steps to answer all the questions 6

Figure 3: Main bottlenecks to learning from incidents (Drupsteen, Groeneweg and Zwetsloot, 2013, Page 70) 11

Figure 4: Three levels of incident investigation (Based on Tinmannsvik and Kjellén, 2018) . 14

Figure 5: Flowchart describing the companies accident registration and incident investigation process (Based on Okstad, Jersin and Tinmannsvik, 2012) 17

Figure 6: LFI Barrier Model (Modified after Smith and Roels, 2015) 23

Figure 7: Learning from Incidents (LFI) process (Based on Parker et al. 2018) 28

Figure 8: The PDSA cycle (Based on The W. Edwards Deming Institute, 2020) 29

Figure 9:Learning from Incidents (LFI) process, highlighting evaluation (Based on Parker et al. 2018) 31

Figure 10: The research process undertaken 41

Figure 11: The abductive logic (Inspired by Kovacs and Spence, 2005) 43

Figure 12: A typical intervention phase in the petroleum industry 61

Figure 13: Synergi scheme 62

Figure 14: Part of the Synergi scheme regarding safety interventions 65

Figure 15: Synergi scheme, possibility for describing effects of safety interventions 71

Figure 16: Steps to answer all the questions (same as Figure 1) 87

Figure 17: A modified PDSA-cycle indicating oil and gas companies' practices for evaluating safety interventions 90

Figure 18: A modified LFI-process indicating oil and gas companies' practices for evaluating safety interventions (Modified from Parker et al. 2018) 91

LIST OF TABLES

Table 1: Who investigates, originally written in Norwegian, but translated to English (Based on Safety Forum 2019) 15

Table 2: Criteria for PSA to investigate (Based on Eriksson, 2010, page 13) 18

Table 3: Criteria for optimal functioning SIS (Based on descriptions in Aven et al. 2004) 31

Table 4: Types of intervention evaluations (Based on Robson et al. 2001; CDC, unknown purplish date; Dahl et al. 2017) 33

Table 5: Common evaluation methods (Modified from Robson et al, 2001, Page 54)..... 35

Table 6: Search words in literature review 46

Table 7: Questions in Interview guide 49

Table 8: Overview of data collection from different data sources 51

Table 9: Main themes and sub-themes after data analysis 60

Chapter One

Introduction

About this chapter:

The introduction chapter explains *what* has been studied in this master's thesis, and provides the reader with information about *why* this is relevant to explore. In addition, this chapter outlines the results of a comprehensive literature review, where the findings from this represent some pre-existing assumptions about different aspects of the issue addressed in the thesis. The purpose for this has been to provide the reader with the current status of the field in interest. Finally, the further structure of the master thesis is described.

1 INTRODUCTION

The petroleum industry has experienced several incidents over the years, all of which have demonstrated the devastating consequences unwanted events within this industry may lead to (Christou & Konstantinidou, 2012; Drupsteen-Sint, 2014; Dalane, 2015). Having paid a high price for several of the incidents, this specific sector has spent a great deal of resources on formal incident investigations, as it can be a useful tool to learn from experience (Kruke, 2012; Drupsteen and Wybo, 2014). The purpose of these analyzes is mainly to find out *what* happened and *why* it went wrong at the time of the incident. The overall goal is to learn from experience and to use the lessons learned to prevent the incident from recurring (Smith and Roles, 2015; NOU 2015: 11).

Nevertheless, it has been observed that the Norwegian petroleum industry has learning difficulties (Smith, 2015; PSA, 2019). Researchers claim organizations have problems reducing the number of incidents because they do not learn enough from experience (Tinmannsvik in PSA, 2019). Therefore, despite significant efforts being put into the investigations, undesirable events recur (Drupsteen-Sint, 2014). For example, Kletz (2002) writes the following:

> Almost all the industrial accidents that occur need not have occurred. Similar ones have happened before and have been described in published reports. Someone knew how to prevent them even if the people at work at the time did not. (Page 3)

According to previous research, the same learning difficulties have also been observed in other sectors. One explanation for this is that many organizations do not properly follow up on the results from the investigations (Hovden et al, 2004; Drupsteen et al. 2013; Drupsteen-Sint, 2014). This concerns especially follow-up activities such as planning, implementation and evaluation of safety interventions (Drupsteen, Groeneweg and Zwetsloot,2013; Cedergren, 2013). Some might use the terms corrective measure or remedial action instead of safety intervention. Together, these activities constitute what is often referred to as the intervention process (in Norwegian: tiltaksprosessen).

Because of this, it has been argued that many organizations could have had better practices for learning more from incidents (Engen et al. 2016). Literature on both incident investigation and learning in organizations argues that it is important to think about the incident

investigations as producing only a *potential* for learning. This means that formal analyzes of incidents do not automatically lead to learning. First, safety interventions must be implemented for the investigation to have any effect at all (Sklet, 2002). Second, it is argued that the interventions should be evaluated after implementation, to check what effects they actually had on the safety level. In other words, systematic follow-up of the incident investigation and safety interventions implemented afterwards are required (Jacobsson, Ek and Akselsson 2011). As an example, Drupsteen and Wybo (2014) have written the following:

> Most organizations aim to use experience from the past to improve safety, for instance through learning from safety-related incidents and accidents. However, whether an organization is able to learn successfully can only be determined afterwards. (Page 1)

This thesis addresses the issue of learning difficulties and explores practices concerning one specific follow-up activity that the literature has claimed to be required to succeed in learning from incidents; evaluation of safety interventions *after* they have been implemented. Focusing on the petroleum industry, it is questioned why oil and gas companies do not achieve optimal learning outcomes from their incident investigations, and more specific how evaluation of safety interventions possibly can contribute to increased organizational learning.

1.1 PROBLEM DEFINITION

The starting point for this thesis was reading the research article *Critical Steps in Learning From Incidents: Using Learning Potential in the Process From Reporting an Incident to Accident Prevention*, where researchers Drupsteen, Groeneweg and Zwetsloot (2013) studied several Dutch organizations' practices for learning from incidents. Their findings suggested that the organizations' achieved level of learning depends on whether they investigate the incidents they have experienced, and further what actions are being taken regarding planning, implementing and evaluating interventions afterwards. This phase can also be called the follow-up process after the incident investigation process (Hovden, Størseth and Tinmannsvik, 2011; Tinmannsvik, 2017).

As Figure 1 indicates, incidents offer a lot of valuable learning that organizations miss out on because of current practices for follow-up activities after incidents investigations. The learning potential is relatively high when they have finished an incident investigation. On this stage, the

organizations have a lot of knowledge about what went wrong at the time of the incident and are familiar with which areas that need to be improved. The performance of the next stages is what is interesting. The organizations do little or nothing in the so-called follow-up process. Therefore, the usage of learning potential from incidents decreases. At the evaluating step, less than 10% learning potential are successfully utilized. In other words, organizations do not learn as much as they could have (Drupsteen, Groeneweg and Zwetsloot, 2013).

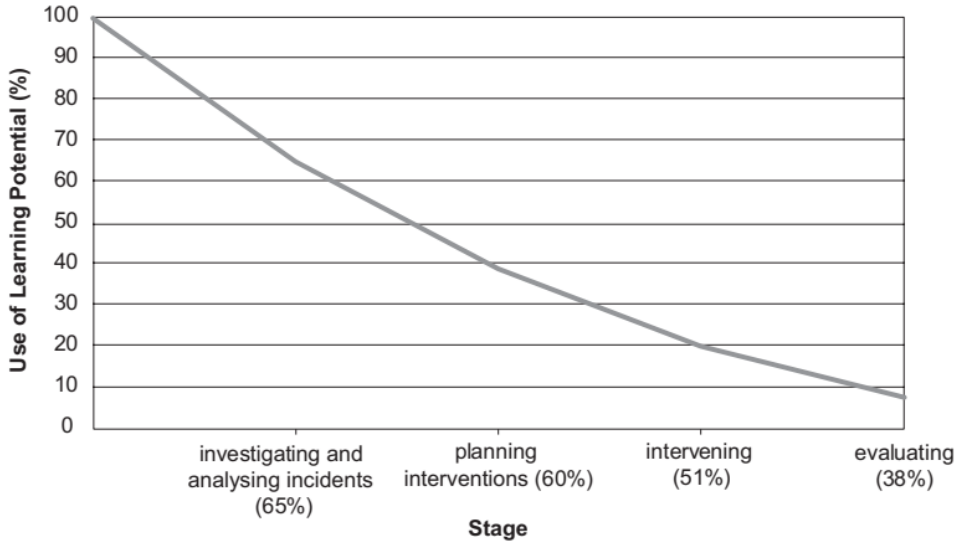


Figure 1: Utilized learning potential following events at various stages in the process "Learning from incidents" (Drupsteen, Groeneweg and Zwetsloot. 2013, page 73).

The findings in this research are based on data obtained from among others the energy sector, but it is not specified whether this includes the petroleum industry. As I worked with safety and emergency preparedness in an international oil and gas company when I started working on this master's thesis, I became interested in exploring whether these findings would apply for the Norwegian petroleum industry as well. In addition, a report from Safety Forum (2019) – a Norwegian party collaboration between the authorities and operating oil and gas companies – stated that based on experience they believe the findings from the Dutch organizations also apply to several organizations involved in petroleum activities at the Norwegian continental shelf. Based on this, a research design was developed, and the following problem statement was formulated.

How can organizations within the Norwegian petroleum industry learn more from incidents through better practices for evaluating safety interventions implemented after incident investigations?

The Norwegian petroleum industry is used as an umbrella term for several different organizations. Based on the limited scope of the thesis, it was possible to collect data from the entire population. Therefore, I chose to focus on oil and gas companies and collected expert opinions by using in-depth interviews with individuals with direct experience from both the investigation and the intervention process. Further descriptions of the sample are descried in Chapter Four.

The terms incident and accident have often been used interchangeably, which can cause confusion. In this thesis, the term accident is understood as all events that have had undesirable consequences for one or more individuals. The term incident refers to events with both actual and *potential* undesirable outcomes. In other words, the term incident is used for describing both accidents and near-misses (Drupsteen, Groeneweg and Zwetsloot (2013).

The scientific purpose of this master thesis has been to evaluate whether oil and gas companies involved in the Norwegian petroleum industry achieve optimal learning outcomes after incident investigations by current practices for evaluating safety interventions, or if they need to establish better practices. Further, the intention has been to use these results to test if the findings from the previous research applies to the petroleum industry as well. To achieve an explanation for this, I had to explore current practices in order to understand and describe how the selected oil and gas companies currently evaluate implemented safety interventions. Then I had to explain *why* the oil and gas companies eventually do not evaluate interventions after they are implemented. Based on this, it would be possible to make an assessment of what kind of learning organizations in the petroleum industry achieve through current practice, and further suggest how they can learn more through better and more structured practice. This led me to the formulation of the following research questions:

1. What are the current practices for evaluating safety interventions?
2. If safety interventions are not evaluated after implementation, why not?
3. What type of learning is achieved by current practices for evaluation?

These research questions have provided both focus and direction for the master thesis. The intention behind these research questions was to concretize the problem statement and specify what type of knowledge that I wanted to end up with by conducting this study (Blaikie, 2010). The idea is that by answering the research questions, I would be able to explain the research problem. To illustrate this, I have developed the following figure (See Figure 2).

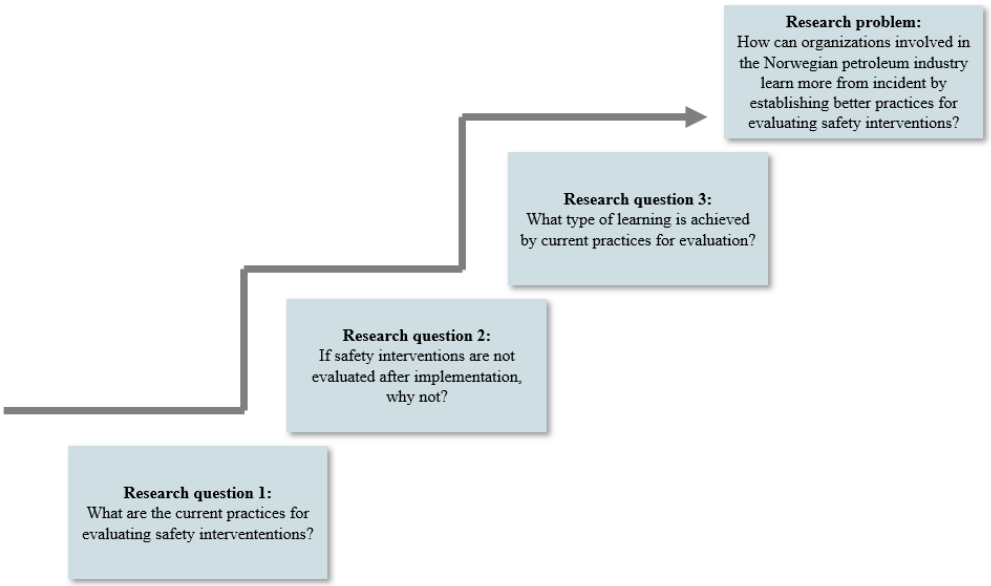


Figure 2: Steps to answer all the questions

1.2 GOALS AND MOTIVES

In addition to the purely scientific purposes of the thesis, it should also be added what my personal goals and motives have been. The point is to clarify which conditions have formed the background for a desire to address this particular topic.

First of all, one goal has been to contribute with empirical based information about how oil and gas companies evaluate the safety interventions they implement after incident investigations. This were related to an academic motive to close a knowledge gap in the existing literature about learning from incidents. The reason for this were limited empirical material about how organizations in real-life try to learn from incidents in the intervention phase after the incident investigation process (Cedergren, 2013; Drupsteen-Sint, 2014; Stemn et al. 2017). At the same time, it is argued that evaluation of interventions is a crucial step in the process of achieving organizational learning. It therefore seems that there is a knowledge gap in the literature on learning after incidents.

Secondly, a motive has been to help identify areas for improvement regarding the learning difficulties introduced earlier, and to stimulate to better practices for evaluating safety interventions after implementation. Although it has been stated that several claim incident investigations themselves will have a positive impact on the organizations' safety level (Rollenhagen, Westerlund, Lundberg and Hollnagel, 2010), this thesis were set out to argue that it is equally important - if not more important - to actually implement safety interventions that can prevent unwanted incidents from recurring. Further, these interventions should be evaluated to control the impact they have on the actual safety level.

Finally, there has been a personal motive to gain insight into how incident investigations is followed up within the petroleum industry, and to explore which activities are being done to ensure a good learning outcome. This is something I personally had little knowledge about, and thought would be educational to address.

1.3 LITERATURE REVIEW

As mentioned, limited research has dealt with the evaluation of interventions implemented following incident investigations and questioned *why* organizations may not evaluate (Drupsteen-Sint, 2014). Nevertheless, reference may be made to some selected examples that have covered different aspects of the issue, by observing organizations in different sectors. The purpose has been to provide an overview of previous research and to indicate the status in this field. The following seven key points have been highlighted:

1. Many organizations miss out on learning opportunities from incidents
2. Several organizations have tended to focus more on investigating incidents than implementing, planning and evaluating safety interventions
3. Organizations have tended to think of learning as sharing knowledge and investigation reports between individuals
4. The information systems/databases used for learning from incidents are not optimal for achieving a high degree of organizational learning
5. There is little exchange of experience between organizations
6. Organizations within the petroleum industry are more concerned with "closing deviations" than learning from incidents
7. The evaluation phase after investigations holds many bottlenecks for effective learning

1.3.1 Key Point One

Most of the existing literature that deals with learning in organizations after incidents indicates that many organizations miss important opportunities for learning (Christou & Konstantinidou, 2012; Smith, 2015Margaryan, Littlejohn and Lukic, 2018; PSA, 2019). The literature review also revealed that this is a trend across several different sectors. Thus, it seems that the inability to learn from incidents is a universal problem. An inability to learn from events is referred to as the inability of organizations to acquire, retain and use learning points from past events to prevent future recurrence of similar or similar events (Jacobsson, Ek and Akselsson, 2011). This is a problem because a lot of research has come to a common consensus that organizations need to improve their ability to learn from experience to achieve a high safety level (Stemn et al. 2017). An interesting and noteworthy finding from the literature review is that several claim that many organizations obviously want to learn, and that the learning difficulties are therefore not due to lack of motivation. Many organizations try to learn from experience, but still fail.

In the literature where it appears that organizations miss out on important opportunities for learning, several explanations for this problem are suggested. Some of these are explained in the following, based on their relevance to the research questions in this paper.

1.3.2 Key Point Two

One reason that organizations do not learn as much as they should is that they focus more on reporting and investigating incidents than on implementation, planning and evaluation of actions (Drupsteen, Groeneweg and Zwetsloot, 2013; Drupsteen and Wybo, 2014; Margaryan, Littlejohn and Stanton, 2017). According to previous research, several organizations use a lot of resources to report and register incidents and then investigate among other things causal factors that contributed to the incidents. When this phase of the learning from incident process is considered completed, there are rarely any follow-up of the results (Lindberg, Hansson and Rollenhagen, 2010; Lundberg, Rollenhagen and Rankin, 2012; Tinmannsvik and Størseth, 2013; Drupsteen-Sint, 2014).). As an example, Drupsteen, Groeneweg and Zwetsloot (2013, page 70) say investigations are being carried out, but that follow-up activities "…. were more often neglected than the earliest steps".

After the literature review, it became clear that very little is being done in the evaluation phase. For example, Kjellén (2000) have written that organizations should ideally monitor and

evaluate the interventions they take to learn from events, but that in reality most do not. As he and several others have tried to clarify, successful learning after events requires systematic and structured follow-up. Thus, in order to protect and maintain the knowledge of events in the organizational memory, it is not enough to "just" investigate an incident (Stemn et al. 2017).

Another interesting finding were that it seems research on learning from incidents has focused on which investigation methods are best suited to uncover causal factors, who should be involved in an investigations process, and further which practical implications in the investigation process that can promote and / or inhibit learning in organizations. In other words, not only do many organizations tend to pay less attention to follow-up activities such as evaluation of safety interventions, also most research up to this date have focused on other issues.

1.3.3 Key Point Three

Another reasons why some organizations do not learn enough is that they misunderstand what organizational learning is about and what it takes to achieve a high degree of learning. Based on the literature review, it seems that many organizations believe it is appropriate to share an investigation report with employees so that they have access to updated information. On the other hand, research on learning in organizations after incidents have showed that reading a report is not enough to keep new knowledge in the organizational memory. The individuals may learn something new by being presented to new knowledge about, for example, a work routine, but it is not given that *all members* of the organization then will follow this routine on a daily basis (Drupsteen-Sint, 2014; Lukic, Margaryan and Littlejohn, 2010; Margaryan, Littlejohn and Stanton, 2017).

1.3.4 Key Point Four

The existing literature has also mentioned that the reason organizations do not learn enough is that the databases or information systems they use for reporting, recording and investigating incidents and working with safety interventions are not optimal regarding monitoring and maintaining lessons identified in the organizational memory (Jocobsson, Ek and Akselsson, 2011). According to Kjellén (2000), it has been observed in many organizations that the information systems do not work how they ideally should. The systems must support various

activities, including evaluating the effectiveness of interventions, but according to him they are rarely designed to do so.

1.3.5 Key Point Five

According to existing research, unutilized learning potential are in several cases also due to little exchange of experience across the organizations. Experience must be shared both within the organization and with others (Tinmannsvik & Øien, 2010). According to Kletz (2002), many industrial accidents could have been avoided if the organizations provided better exchange of experience. He has stated that many organizations tend to not help others learn as much as they potentially could have done if the organizations had been better at sharing experiences.

1.3.6 Key Point Six

Previous research has observed that selected players involved in the industry in question tend to be more concerned with "closing deviations" than implementing effective and appropriate safety interventions after incident investigations. Some have claimed that it seems organizations are more concerned with implementing the first alternative for a safety intervention, than making sure one actually learns something. An example is a study of learning in Statoil (now Equinor), were IRIS has concluded that the organization in question has problems with learning after investigations. Instead of implementing safety interventions that actually will correct the errors or deviations detected in an investigation, this study pointed to results that suggest a trend in which the organization is rather concerned about simply closing deviations.

This were also evident in a study of learning and follow-up of undesirable incidents of maintenance contractors involved in Norwegian petroleum activities, conducted by Tinmannsvik and Øien (2010). They have claimed that their findings suggest that organizations have established a common practice of "closing" (meaning finished) interventions when implemented, not after the interventions has been evaluated as to whether it has had the desired effect.

1.3.7 Key Point Seven

Some studies have found that the evaluation phase, as a final step in the learning from incident process, is *the* part that contains most bottlenecks for organizational learning. Drupsteen along with other researchers (2013) which studied several Dutch organizations within different

sectors and asked the organizations which steps they take to learn from incidents and which of these steps are most difficult to perform. They presented the following figure (see Figure 3).

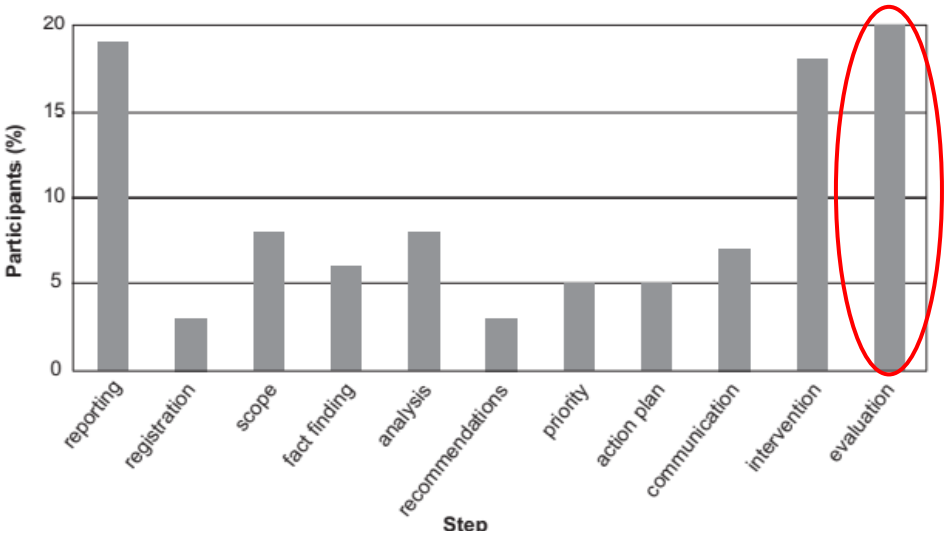


Figure 3: Main bottlenecks to learning from incidents (Drupsteen, Groeneweg and Zwetsloot, 2013, Page 70)

The findings from their research suggest that organizations find evaluation of implemented safety interventions can be challenging, and that this activity is more challenging than other activities in both the investigation process and the action process. This is also stated in the previously mentioned report to Tinmannsvik and Øien (2010). This report states that the organizations experience evaluation of safety interventions as challenging and that the work on interventions has the greatest potential for improvement as opposed to the investigation process.

DNV GL and NOROG (unknown year) provide a more detailed explanation of what factors can be said to make it difficult to evaluate safety interventions. They have examined how Norwegian oil and gas companies practices the learning from incident process, focusing on especially the intervention phase as this term is understood in this thesis. Among other, they found several factors that can hinder and/or stimulate evaluating safety intervention. Based on their research, good Key Performance Indicators (KPIs) are essential for evaluating the effectiveness of safety intervention. Bad or non-existing KPIs or also called measurement parameters will hinder a successful evaluation, because the evaluator would not be able to see if there is any statistically significant change. Next, motivated and engaged leadership is crucial and will according to DNV and NOROG stimulate to oil and gas companies evaluating. Finally, they suggest companies having no formalized system for evaluating safety intervention will perform less evaluations.

Another example is Hatletveit and Helledal (2018), which examined the implementation of safety interventions in Statoil (current Equinor). In their study, many interesting findings emerged regarding the evaluation of interventions after they have been implemented. Among other things, it is mentioned that the informants from Statoil claim the formulation of interventions is important for the company's follow-up of safety interventions. They have written that - translated into English - "…. how the interventions are formulated has a great impact on both the understanding of the importance, execution and the need for follow-up." Their informants were told that they could be better at defining the safety interventions they implement, which according to the informants means that specific goals are made clear, how to achieve this goal and who is the target group. Further, they write that the informants believe there is often a kind of "overproduction" of interventions. Too many safety interventions are implemented and according to the informants, and therefore, the learning is drowning.

1.4 FURTHER STRUCTURE

Including this introduction, the master thesis consists of seven chapters. Next chapter will provide the reader with a context and background information considered to be useful in order to understand the total image. Chapter Three explains central theoretical concepts and models with regard to the problem. Here we explain the purpose of investigations of incidents, what a safety intervention one is, what it means to learn from events based on an organizational learning perspective, where evaluation comes into this learning picture, as well as various factors that theoretically can be claimed to influence both learning and evaluation. In Chapter Four, the reader gets to know how the researcher has followed a specific research design to achieve the goals of the thesis and answer the research problem, as well as the three research questions. Later, in Chapter Five, the results from the collection of data are presented. These results are further analyzed in Chapter Six. It is discussed what the empirical results means in terms of answering the problem statement and research question presented in this introduction chapter. Here, my theory suggestions are matched with the theories from both the literature review and theoretical framework. The reader is finally provided with a conclusion in Chapter Seven. To make sure the reader properly understands how the study is structured, the researcher has provided the reader with an overview of every chapter at the beginning of each one of them.

Chapter Two

Context

About this chapter:

This part of the thesis places the problem and research questions that are examined in a larger context. Although this paper is not directly about the actual investigation of undesirable incidents, it is considered sensible to say something about what it means to investigate an incident in the Norwegian petroleum industry, as well as who conducts such investigations. I think it will help to create a clearer picture of what kind of context this task is based on. In addition, this part of the thesis describes how the companies in the industry in question go from experiencing an incident and this is being investigated, until they initiate follow-up activities.

2 CONTEXT

As mentioned, this thesis focuses on oil and gas companies involved in the Norwegian petroleum industry, where this is understood as an umbrella term for several different organizations. The various organizations are small and large oil and gas companies, where many of them operate internationally (Okstad, Jersin and Tinmannsvik, 2012). Together, they constitute a very hazardous industry, where this refers to a high level of activity of various operations with a probability of devastating consequences on both humans, assets and the environment (Margaryan, Littlejohn and Stanton, 2017). When an undesirable event occurs, an investigation will be initiated to find out exactly what went wrong and what conditions contributed to its occurrence (Tinmannsvik and Kjellén, 2018).

2.1 WHO CONDUCT THE INCIDENT INVESTIGATIONS?

Based on the existing literature on incident investigations in most sectors, three levels of investigations can be distinguished (Kjellén, 2000; Tinmannsvik and Kjellén, 2018). The incident that occurs determines the level at which the investigation is conducted. The figure below illustrates these levels (see Figure 4).

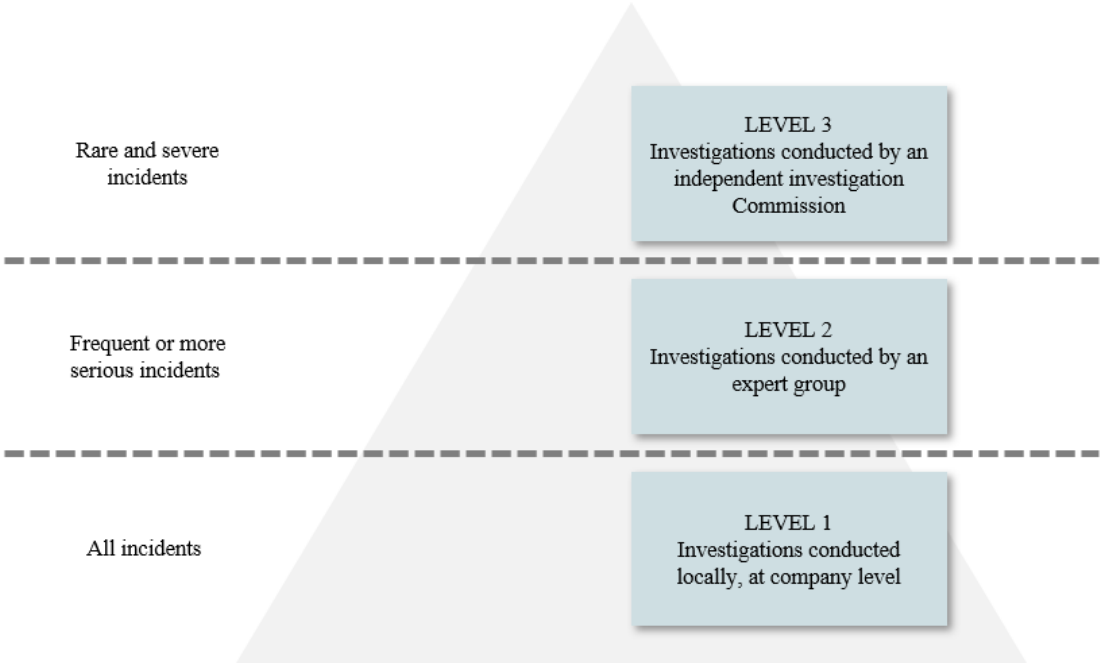


Figure 4: Three levels of incident investigation (Based on Tinmannsvik and Kjellén, 2018)

According to Kjellén (2000), all reported adverse events will most often be investigated immediately by the person (s) responsible for the business or involved in the accident, typically by a department head and a safety representative. This is referred to as level one investigations. Some selected serious incidents may also be investigated by an expert group, which is referred to as level two investigations. Events that are examined at level two are normally undesirable events that often recur over and over again or are considered to have high potential for severe damage. When it comes to those rare or serious incidents, where the actual or potential extent of damage is severe, the incidents are investigated at level three. This is investigations conducted by an independent commission.

The point is that depending on the type of incident that has occurred, a number of different investigations are being conducted. An even more relevant and detailed description of who carries out the different investigations within the Norwegian petroleum industry is described in the table below (see Table 1). The information in the table is obtained from a report about learning after incidents, from Safety Forum (2019).

Table 1: Who investigates, originally written in Norwegian, but translated to English (Based on Safety Forum 2019)

Who investigate?	**Description**
Internal investigation within the company	The investigation reports are not usually published but are in some cases distributed to other companies to achieve learning across the different parties.
Investigation by contractors	This type of investigation may be relevant in cases where the contractor has been involved during events. The client is usually represented in the investigation team.
Investigation by the Norwegian Petroleum Safety Authority	The Norwegian Petroleum Safety Authority (PSA) conducts about eight to ten investigations annually. This activity forms an important part of the supervision practice and the follow-up of the business. The purpose is to develop knowledge that contributes to

	learning and experience transfer to the industry to prevent similar incidents from happening again. The results of the investigations contribute, among other things, to prioritize supervision activities, inform the industry and provide input to the assessment of the need for regulatory development. The investigation reports are made public.
Investigation by the police	Police investigations are carried out in accordance with The Criminal Procedure Act and the prosecution instructions. The purpose is to investigate and evaluate the basis for any criminal offences.
Independent investigation commissions	The legislation allows for special commissions of inquiry to be appointed to investigate major individual incidents and major accidents. Since the oil industry was established on the Norwegian continental shelf, four such independent commissions of inquiry have been appointed in the wake of the following incidents: • Bravo blowout in 1977, ref. Meyer et al (1977). • Aleksander L. Kielland accident in 1980, ref. NOU 1981:11 (1981). • The diving accident at Byford Dolphin in 1983, ref. NOU 1984:11 (1984). • West Vanguard, blowout in 1985, ref. NOU 1986:16 (1986).

2.2 THE INCIDENT INVESTIGATIONS PROCESS

The incident investigation process is described in various ways in the literature (Sklet, 2004). In most of the literature, the term investigation process is used for describing the actual activities associated with the actual investigation that are conducted to obtain an overview of the incident and the conditions that led to it (Tinmannsvik and Kjellén, 2018).

In this part of the thesis, the reader is presented with a process figure that illustrates how most companies involved in the Norwegian petroleum industry typically work with investigations of both small and large undesirable incidents. The figure illustrates not only the investigation of incidents, but also among other phases such as the notification and registration of incidents (Okstad, Jersin and Tinmannsvik, 2012). See Figure 5.

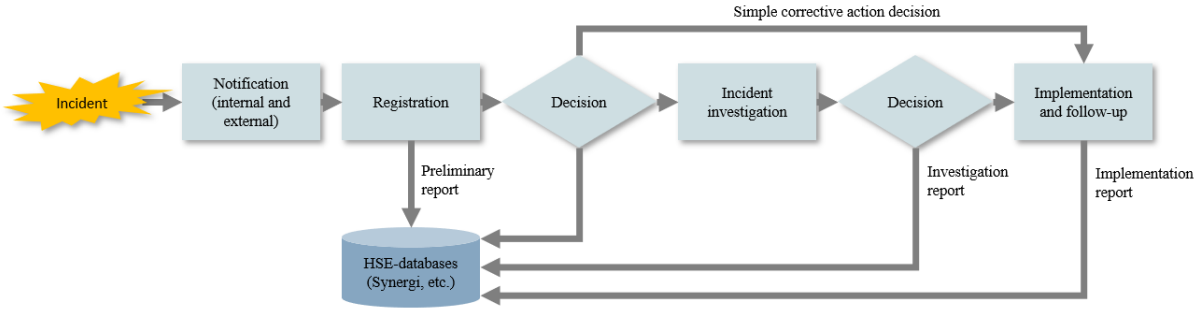


Figure 5: Flowchart describing the companies accident registration and incident investigation process (Based on Okstad, Jersin and Tinmannsvik, 2012)

According to Okstad, Jersin and Tinmannsvik (2012) it is also important to note that the companies and the PSA can follow different processes for registering incidents and conducting investigations than this figure have illustrated, because most have developed their own systems for this. In this context, it can also be noted that the various actors who potentially follow up on the investigations are likely to do so in different ways (Tinmannsvik and Øien, 2010).

2.2.1 Notification and registration

The first step is notification, where the companies notify both internally, to the PSA and possibly other relevant actors and / or authorities depending on the type of event. According to the PSA (Eriksson, 2010, page 12), all hazard and accident situations should be registered and classified to determine whether they should be investigated. Then, facts about the incident and who was involved are documented in a preliminary report, which is registered in an HSE database. According to Jacobsson, Ek and Akselsson (2011) most organizations use formal systems such as an HSE database for learning from incidents, which apply especially for the petroleum sector. Such systems are often referred to as security information systems, which are further explained in Chapter Three, Section 3.3.6. One system that many companies use to keep records of the incident investigation and work with safety interventions, is Synergy. The PSA defines Synergi as a «System for registration, analyzing, processing and monitoring accidents, incidents and adverse events". In this system, a new case is created for each incident.

2.2.2 Deciding whether to investigate or not

After the incident has been registered in the database, the companies decide on whether they will investigate the incident. This decision will be based on a classification of the incidents, which is based on an assessment of actual and potential consequences as well as the likelihood of recurrence or escalation to potential consequences (Eriksson, 2010). In addition, according to Okstad, Jersin and Tinmannsvik (2012), this decision will be influenced by an evaluation of the potential learning effects.

At the same time, the in-real-life classification may take place in different ways across the organizations within the petroleum industry (Eriksson, 2010). The reason for this is that the organizations rely on their own specific principles for classifications. It is the management of the company who decides whether to conduct an internal investigation. Then a mandate is drawn up for the investigation (SFS, 2014).

For incidents that are classified as less serious, one will usually not conduct an investigation of the incident nor make a decision about which interventions should potentially be taken with regard to preventing consequences and preventing the same incident from happening again.

For the PSA to investigate, the incident must meet one or more of the criteria in table 2 below. At the same time, it will be up to their investigative officer on duty to decide whether or not to notify a notified incident. Further, it can be added that the PSA has the opportunity to conduct its own investigations of selected incidents even where the companies have decided not to investigate themselves (Okstad, Jersin and Tinmannsvik, 2012).

Table 2: Criteria for PSA to investigate (Based on Eriksson, 2010, page 13)

Criteria for initiating investigation in the PSA
Call for major accident (the term major accident here refers to an accident involving 3-5 serious injuries or deaths, or an accident that jeopardizes the integrity of the facility).
Serious personal injury with the potential for death.
Serious loss of safety and/or impairment of barriers that jeopardize the integrity.
Cases that the police are investigating, where the PSA provides police assistance

2.2.3 Incident investigation

According to Tinmannsvik and Kjellén (2018), the actual investigation of incidents refers to a sequence of activities carried out with the intention of describing what has happened, uncovering the causes of the incident, and proposing appropriate interventions that can prevent something similar from happening again. Depending on the incident type, how detailed one wants to analyze it and its causes, such as how much resources one wants to spend on it, this sequence or process can take place in different ways. Nevertheless, based on the existing literature, one usually divides the examination itself into the following three phases:

1. Data collection: Collection of facts and evidence
2. Analysis: Analysis of data and formulation of conclusions
3. Improvement suggestions: Suggesting safety interventions and writing the final investigation report.

Various investigative methods are used in the analysis of undesirable incidents to analyze the incident and its causes. Without going into all types of details, since this is not a thesis about investigations, these methods are based on various accident models, which represent different perspectives on what kind of phenomenon an incident is and what factors typically causes an incident (Hovden et al. 2004). The results of this analysis will then be summarized in an investigation report, which normally also will be registered in the database.

2.2.4 Deciding on corrective measures (safety interventions)

According to Okstad, Jersin and Tinmannsvik (2012), the incident investigation report will form the basis for a decision related to the implementation of interventions and any follow-up activities thereafter.

2.2.5 Implementation and follow-up

Following investigations, then comes the follow-up process. It refers to the process from safety interventions being planned until it is approved and closed. Figure 5 does not mention anything further about safety interventions and or how the activities called "follow-up" actually takes place. According to Sklet (2002), it is important to include an implementation or follow-up process where safety interventions must be implemented in order to have a learning effect and

hopefully prevent new incidents from happening. Therefore, one cannot think that one is finished when the final investigation report has been written, published and distributed.

2.3 THE REGULATIONS ON EVALUATION

The petroleum industry is governed by regulations that are function-based and goal-driven. This means that the regulations set requirements for some overall goals the companies must achieve, without laying down very specific guidelines for how the companies can achieve these goals. In other words, it is up to the companies themselves how to manage to comply with the descriptions in the regulations. The Norwegian Government suggests the following reason for having this kind of regulations:

> The objective of the function-based approach is e.g. to avoid detailed provisions and to focus on the player's responsibility to find solutions, and through this, to facilitate flexibility in the selection of methods, approaches and technology development.

In this part of the thesis I will refer to the regulations that say something about examinations of undesirable incidents, follow-up of investigations and including special evaluation, as well as learning after incidents. I have chosen to focus on legally binding regulations.

The Management Regulations state that deviations must be corrected, that the causes of an incident must be mapped out, and that safety interventions must be implemented to prevent the same deviations from recurring. In addition, interventions shall be implemented to prevent the occurrence of other possible deviations. Furthermore, it is emphasized that the responsible person must have an overview of the status of non-conformity in the company. Further, according to Section 22 of the Management Regulations, safety interventions must be followed up and the effect evaluated.

Chapter Three

Theoretical Framework

About this chapter:

In this chapter, a theoretical framework is presented which presents the introduction of key theoretical concepts with regard to the problem and the three research questions initially. Explain which events the term incidents refer to, and what the purpose of these investigations is. In addition, account is given of what organizational learning is and how organizations learn after unwanted events. At the same time, it is described which conditions can have an impact on this learning. Furthermore, an account is also given of what it means to evaluate a safety intervention, different methods for implementing this, as well as criteria for successful evaluation. Theoretical contributions were selected based on their relevance as to elucidate one or several aspects of the issue addressed in this master thesis.

3 THEORETICAL FRAMEWORK

3.1 INCIDENT INVESTIGATIONS

An important element of the incident prevention work of organizations is to make use of experiences from incidents to prevent similar events from recurring. It is claimed that the reason why we choose to use resources on analyzes of incidents is because we have faith in learning something, and that through insight into accident mechanisms and causing factors, we can prevent new unwanted incidents (Hovden, Sklet and Tinmannsvik, 2004; Drupsteen-Sint, 2014; Parker et al. 2018).

In order to learn from incidents and prevent them from happening again, the incidents are often investigated afterwards. In this thesis, incident investigation is used as an umbrella term for all examinations and analyzes carried out after an undesirable event. In such analyses, it is important to find out *what* happened and *why* it went wrong at the time of the incident (Kjellén, 2000; Hovden, Sklet and Tinmannsvik, 2004; NOU, 2015: 11).

This perspective on incidents and the possibility of preventing them differs from previous assumptions about causing factors. Prior to the industrial revolution, incidents were understood as a phenomenon beyond human control (Albrechtsen and Hovden, 2013). Some were just so unlucky that from time to time they were hit by an unwanted event, and there was little that could be done to prevent them. Today, incident investigations are considered to be an important part of organizations safety management (Kjellén and Albrechtsen, 2017). Experiences from incidents and their investigations are used to develop safety regulations and regulations. It can still be argued that it is not possible to prevent absolutely all incidents from happening, but most people believe that by systematically gathering information on the causes of accidents and assessing them to some extent can control the probability of incidents and their consequences.

Following incident investigations there are several potential barriers to learning. Smith and Roles (2015) describe evaluation as a potential barrier to post-incident learning and present the following model to illustrate how evaluation can lead to loss of learning potential (see Figure

6). They call it the “LFI barrier model” for which LFI is an abbreviation for the learning from incidents process.

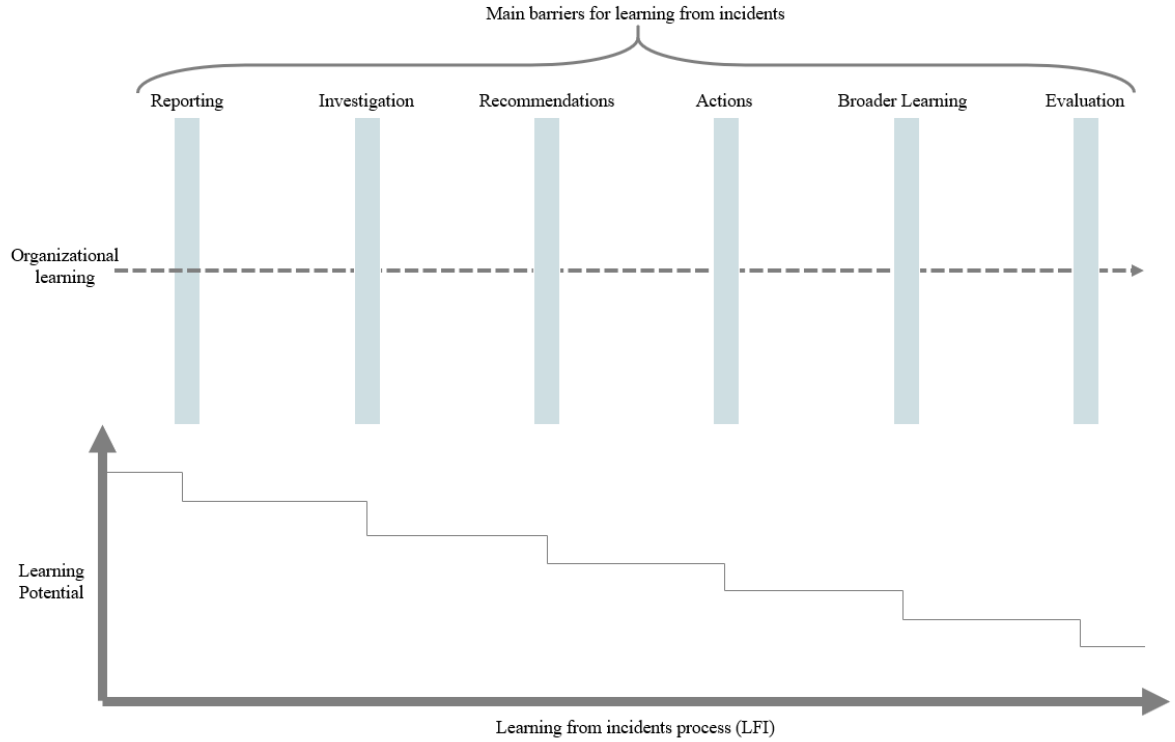


Figure 6: LFI Barrier Model (Modified after Smith and Roels, 2015)

3.2 SAFETY INTERVENTIONS

Before an explanation of learning from incidents and what it means to evaluate safety interventions, it maked sense to first explain what safety interventions means in terms of being a theoretical concept.

In general, the term intervention refers to different types of actions taken to achieve a specific goal or requirement. For example, this could be investments in new technological solutions, changes in operations and behavior or adjustments in activity level (DNV GL, 2015). A safety intervention can be understood as a sub-category of this concept, based on the intention behind the intervention. Robson and others (2001, page 16) define a safety intervention as “…. An attempt to change how things are done in order to improve safety. Within the workplace it could be any new program, practice, or initiative intended to improve safety (e.g. engineering intervention, training program, administrative procedure).”

Otherwise, abbreviations as M-T-O are typically used across the Norwegian petroleum industry, used for describing different safety interventions. M = H (human), T = T (technical), and O = O (organization). They refer to which parts of the organization a safety intervention is intended to influence.

3.3 LEARNING

Questions about how organizations learn after events have been of great interest for many years (Crossan, Lane and White, 2008; Jacobsson, Ek and Akselsson 2011; Drupsteen, Groeneweg and Zwetsloot, 2013). Different disciplines have in each way studied and drawn conclusions about whether organizations in a wide range of different sectors / industries manage to bring out as much learning potential as they should after experiencing minor and major undesirable events (Drupsteen-Sint, 2014). All these theories in different ways say something about who is learning, how to learn, what conditions should be present to optimize learning, and what conditions to avoid in a learning situation. Because of this, learning has evolved to become a very comprehensive topic on which many different theories exist.

First of all, it has been noteworthy to mention that learning can be viewed in both an individual and organizational perspective (Argyris, 1993; Argyris and Schön, 1996; Jacobsen and Thorsvik, 2007). Usually, most of us think that learning is something that has happened when individuals have acquired new knowledge or developed new skills (Jacobsen and Thorsvik, 2007). This is not wrong, because one can say that learning takes place on both levels. It is primarily individuals who acquire new knowledge (Senge, 1990). Nevertheless, it can be argued that the starting point for organizational learning is that the organization as a whole develop and learn. This thesis focuses on learning in organizations, a more collective form of learning.

3.3.1 Organizational learning

Based on a review of the literature on organizational learning and what this is, it seemed that many thinks about organizational learning as acquiring knew knowledge. This theory is based on an assumption that investigations lead to learning.

Others have claimed that learning is not a result of just acquiring new knowledge, but also that this knowledge must be put to life and lead to actual change in behavior (Tharaldsen, 2013). According to Chevreau, Wybo and Cauchois (2006), organizational learning depends on the

organization initiating incident investigation processes to find out what happened and why. At the same time, it is also pointed out that investigations are not enough to achieve learning and for experiences to remain in the organizational memory. It is necessary that they apply the knowledge they have acquired through the investigation and put it into practice in the form of, for example, a changed work routine. Organizational learning takes place when differences are observed between expected and actual results of interventions implemented after the investigations (Kirkpatric, 2007). For an example, Argyris (1993, page 3) say that "Learning is not simply having a new insight or a new idea. Learning occurs when we take effective action, when we detect and correct error." It can be said that knowledge must be brought to life.

This means there are several perquisites for organizational learning. One prerequisite for learning in organizations according to this perspective, is that some or more of the organizational members experience something of relevance to the business in question. Incidents can serve as a type of input to this process. However, another important prerequisite for learning in an organization is that new knowledge is shared with the rest of the organization to which you belong. If the new knowledge is disseminated to the rest of the organization, what Jacobsen and Thorsvik (2007, page 320) call "collective learning" will arise.

This corresponds, among other things, to the statements in Jacobsson, Ek and Akselsson (2011). They argue that it is important to follow up on interventions that have been implemented on the basis of creating change in behavior, because it helps to ensure that information from undesirable events remains in the organizational memory. They have also suggested that information is likely to stay longer in organizational memory the more times one follows up.

In this thesis, organizational learning has been about acquiring new knowledge *and* transforming this into actions. According to Jacobsen and Thorsvik (2007), this can be defined as a process in which people and organizations acquire new knowledge and change their behavior on the basis of this knowledge. In other words, learning is understood as a change in behavior, based on new experiences. This type of learning can be referred to as a form of *learning by doing*, or experimental learning (Drupsteen, Groeneweg and Zwetsloot, 2013). It may also be pointed out that this refers to continual long-lasting changes, including *potential* long-lasting changes (Kaufmann & Kaufmann, 2009).

A fairly modern view of organizational learning is the theory of the *learning organizations*. A pioneer in this is Senge (1990). According to Senge, the concept learning organization describes an ideal organization with the important capacity to learn effectively. This is important as it leads to progress and competitiveness.

3.3.2 Levels of learning

The literature on learning have often referred to different levels of learning, which means the depth or breadth of learning (Hovden, Størseth and Tinmannsvik, 2011). A well-known theory that is often referred to when thinking about levels of learning is the theory of single and double loop learning by Argaryis and Schön (1996).

Single loop learning is understood as the ability of organizations to make simple adjustments or small changes to prevent errors. According to Freitag and Hale (1997), this is an elementary form of learning. Double loop learning describes pervasive reflections on practices and actions in which organizations examine their own goals and values and make changes to routines on this basis. Double loop learning occurs when organizations have changed their goals or actions based on the experience they have gained (Argyris & Schön, 1996). According to Argyris and Schön (1996), much of the learning that typically takes place in most organizations is single-circuit learning. They say it is important that organizations achieve both forms of learning.

In addition, Argaryis and Schön (1996) have presented a third type of learning called deutero learning. This is a form of organizational learning in which members of the organization discover and adjust the learning systems that underlie current practice regarding for example the incident investigations the organizations carry out or evaluation of safety interventions (Argyris and Schön (1996). With the help of deutero learning, one will know if something is learned or not learned. Deutero therefore means that the organization has the necessary knowledge of how they are actually learning. This requires reflection, which can be achieved by especially evaluation (Drupsteen, Groeneweg and Zwetsloot, 2013).

In the literature on learning from incidents, deutero learning is referred to as a higher order of learning and is often called third order learning (Drupsteen, Groeneweg and Zwetsloot, 2013). This is based on another well-known theoretical contribution on different degrees of learning (Rosness, Nesheim and Tinmannsvik, 2013). First-order learning, for example, is achieved by simply correcting the error that has been revealed in an investigation, e.g. fixing a broken

machine. In second-order learning, more organizational safety interventions are taken, e.g. plans and routines related to the deviation observed in the incident investigation are changed. According to Rosness, Nesheim and Tinmannsvik (2013), the goal is still to correct error, but the business procedures are changed as well. They have written (in own translation) that "For example, one may find that the maintenance of the machine is inadequate, which in turn leads to changes in maintenance plans, supervision, etc." (Page 20). Third-order learning is the most pervasive form of learning, where the organization invests in renewal and long-lasting improvement (Freitag and Hale (1997). According to Rosness, Nesheim and Tinmannsvik (2013) the organizations does not settle with simply correcting a error, but try to fix the more guiding principles.

3.3.3 Learning from incidents

Learning from incidents (often abbreviated to LFI in the literature) is considered to be an organizational learning process and key mechanism for improving the safety level of organizations (Lukic, Margaryan, and Littlejohn, 2013). According to Stemn et al. (2018) and Jacobsson, Ek and Akselsson (2011) the theoretical concept of learning from incidents can be defined as: "…. The ability of a business to obtain useful experiences and understanding from past incidents and transfer them into practices and behaviours that prevent future events, contributing to the overall improvement in safety." To put it into perspective, it can also be said that the process of learning after incidents is normally part of a larger management system for safety (S), health (H) and environment I (Jacobsson, Ek and Akselsson, 2011).

Lukic et al (2013) claims learning after incidents requires that employees in the organization actively take systematic actions. The point is that learning after incidents does not happen automatically and that organizations must initiate conscious and systematic safety interventions to ensure that they are learning.

In the literature on learning from incidents, there are many examples of attempts to illustrate the learning process in organizations. A relevant model is the Learning from Incidents Model presented by Parker et al. (2018) (See figure 7), but originally developed by researcher Drupsteen-Sint and her colleagues (Drupsteen, Groeneweg and Zwetsloot, 2013). It is important to remember that this act as a kind of ideal picture of the process.

As the figure illustrates, the learning from incidents process consists of four stages, also called "sub-processes" and phases. Based on this model, learning from incidents is about moving from

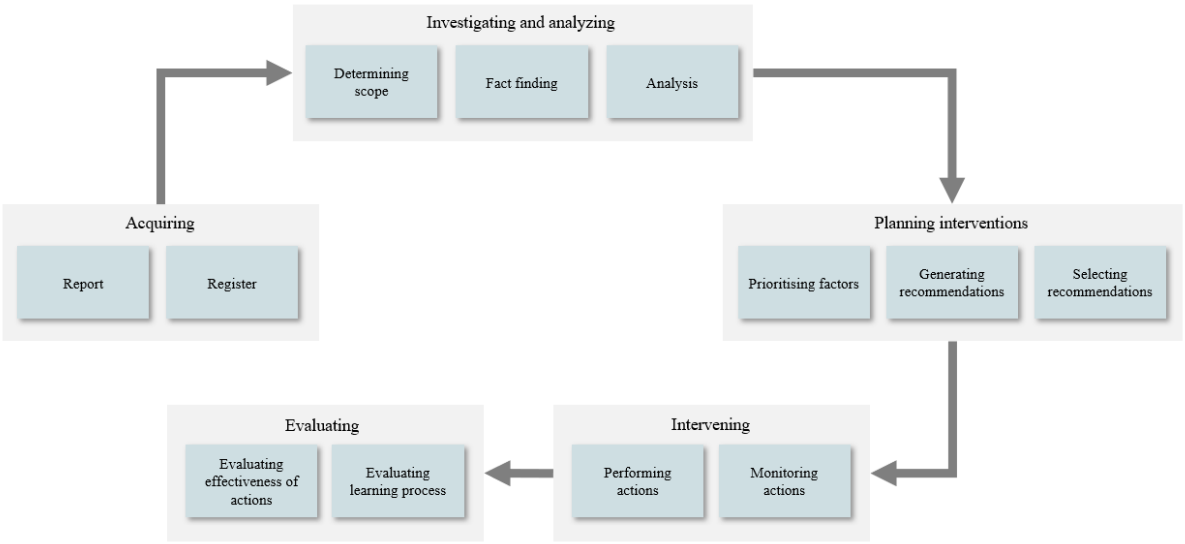


Figure 7: Learning from Incidents (LFI) process (Based on Parker et al. 2018)

acquiring information about the incident and analyzing underlying causes to this, using these defined areas of improvement to take corrective actions (safety interventions), and then evaluate the implemented interventions. Each phase leads to a result which is important for the next step in the learning process. Each result is necessary but not sufficient for effective learning. If a result is missing or not optimal, the next phase will be less effective.

According to Drupsteen, Groeneweg and Zwetsloot (2013), all steps in the process must be completed in order to successfully learn from incidents. Concerning the evaluation phase, they believe an optimal evaluation of safety interventions involves an evaluation of both the effects of a safety intervention and the implementation of the intervention. They have argued one will not be able to determine whether the knowledge from the investigation has resulted in actual changes if one does not evaluate the safety interventions one is implementing. Evaluations, according to them, act as a kind of control mechanism where one checks whether the implemented interventions actually works or not. Based on the results from an evaluation, you will be able to make corrections if necessary. According to them, evaluation is the key to improving the learning capacity of organizations.

The process illustrated above (Figure 7) can according to Drupsteen, Groeneweg and Zwetsloot (2013) and Parker et al. (2018) be compared to Demings (1993) plan-do-check-act cycle

(PDSA), formerly called PDCA (Deming, 1982). See Figre 8 on the next page. In Norwegian, some may know this as «PUKK-hjulet» (planlegging, utførelse, kontroll og korrigering). The PDSA process is often seen as a core element in organizations' work towards continual improvement, which has been argued is very important in a constantly changing world (Dalane, 2015). Learning and evaluation (study) is viewed as crucial to the survival of organizations (Parker et al. 2018). Accordin to Jacobsson, Ek and Akselsson (2011), evaluation will ensure that organizations "closes" this cycle or wheel at follow-up.

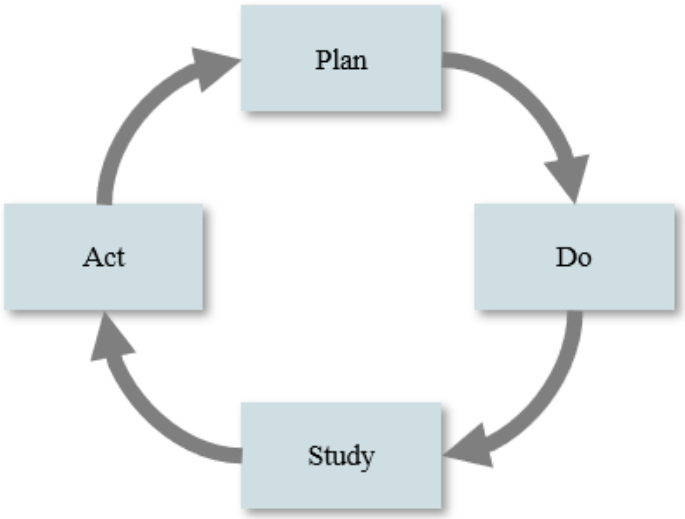


Figure 8: The PDSA cycle (Based on The W. Edwards Deming Institute, 2020)

According to Meidell (2005), it is equally important to ensure quality assurance regarding safety as with all other tasks, and that one should think of quality assurance as a continuous task all organizations have. Looking at this as a continuous task, it would be natural to think of this work as a wheel that rolls forward.

3.3.4 Safety culture

According to some researchers, there is a mutual dependence between organizational learning and safety culture (Filstad, 2010; Rosness, Nesheim and Tinmannsvik, 2013). It has been argued that the reason why some organizations are unable to carry out activities that will lead to learning is because they among other aspects have established a safety culture where employees think of learning as achieving new knowledge. Characteristics of organizational culture may therefore function as a barrier to learning. In other words, culture can influence

learning and is thus an important part of the learning picture. It is therefore necessary to explain the theoretical concept of safety culture as well.

In general, organizational culture can be understood as the set of shared norms, values and perceptions of reality that has emerged within an organization when its members interact with each other and their environment (Bang, 2013). Schein (1998) has defined this as a pattern of shared assumptions about how things are done in a group of individuals, because these individuals over time have learned that their way of doing things is the right way to perceive, think and feel about different aspects of their reality.

Safety culture can be understood as one dimension and integral part of the overall organizational culture. The concept came strongly from the late 1980s, especially in the oil and gas industry (Haukelid, 2008). It can be understood as the common set of norms and values that revolve around safety. Reason (1997) say the safety culture within an organization is a product of both the individual's and the group's values and attitudes, competence and behavioral patterns that show commitment to the organization's health and safety programs.

3.3.5 The need to prioritize

Another factor that can influence learning and thus also forms part of the learning picture is conflict of interest and that in certain situations one has to prioritize among different work tasks (Andersen & Abrahamsson, 1996). Due to lack of resources to implement what one wants; one has to prioritize only certain interests. According to Hovden, Sklet and Tinmannsvik (2004), conditions like this could have an impact on several decisions that are made and can thus potentially explain the learning difficulties clarified at the outset in this assignment.

3.3.6 Safety Information System (SIS)

As mentioned in chapter two, most oil and gas companies use the database Synergi for working with incident investigations and safety interventions. In the scholarly literature, a database like this can be understood as a safety information systems (SIS). The term refers to a system or database that records and analyzes experience-based information on adverse events and then uses this as a basis for developing and implementing preventive safety interventions. The system is described as a good aid in the safety management work, if it meets some specific criteria in Table 3 below (Aven et al. 2004).

Table 3: Criteria for optimal functioning SIS (Based on descriptions in Aven et al. 2004)

Criteria	Description
Reliability	The information has a high degree of consistency and accuracy.
Validity	The information gives a true and real-life picture of the safety level.
Relevance	The information is relevant to the decision-makers at different levels in the organization, which means unnecessary/irrelevant information is eliminated.
Availability	The information system is able to generate information that is clear and easily understandable, and available for the decision-makers.
Time optimality	The information is accessible when needed and not too late.
Cost effective	The information system is perceived as a positive contribution to safety work, compared to other alternatives. This means it provide "more safety per cent" than the alternatives.
Understanding and acceptance	The information system is understandable and accepted by all parties involved. Everyone is informed of the purpose of using the system, and data collection, analysis and interventions s is carried out in a way that everyone can accept.

3.4 EVALUATION

An important part of safety management is to demonstrate the presence of safety (SSM, 2010; Hollnagel, 2014). Evaluation is considered to be an effective tool for achieving this, as it

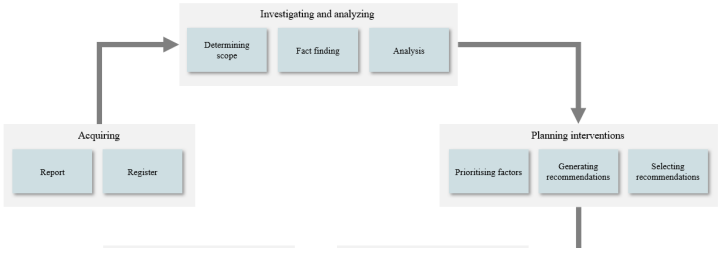


Figure 9:Learning from Incidents (LFI) process, highlighting evaluation (Based on Parker et al. 2018)

involves acquiring overview and in-depth knowledge about implemented safety interventions. This in-depth knowledge will serve as feedback and management information for organizations. It is known as the last phase of the learning from incidents process (Drupsteen, Groeneweg and Zwetsloot, 2013). See Figure 9.

Like Baklien (1987) have stated, evaluations are something we do every day and perhaps without further thought about what it entails as a theoretical concept. Mertens (2010) defines evaluation as following:

> Evaluation is an applied inquiry process for collecting and synthesizing evidence that culminates in conclusions about the state of affairs, value, merit, worth, significance, or quality of a program, product, person, policy, proposal, or plan. Conclusions made in evaluations encompass both an empirical aspect (that something is the case) and a normative aspect (judgment about the value of something) (page 49).

Almås (1990) offers a somewhat simpler definition when he says that an evaluation is a systematic collection of data to distinguish and analyze the impact of an attempt to create change in a given area. At the same time, it can be argued that both definitions presented are fundamentally about the same thing; Evaluation refers to a process of purpose in obtaining information that can be used to say something about something. It can be argued that evaluation is what Green and South (2006) refers to as a form of evidence-based practice.

3.4.1 Different types of evaluation

Some evaluations of safety interventions are about assessing whether goals have been achieved. The purpose of other evaluations is to analyze the actual process of implementing inventions. In summary, as Green and South (2006) and Sverdrup (2002) write, it can be argued that there are many ways of thinking about evaluating safety interventions. These differ from one another in terms of the purpose of the evaluation and when they are typically used (Robson et al. 2001).

In Table 4, it has been summarized what the literature on evaluation of safety interventions (also called preventive measures and actions) writes is the most typical and used types of evaluation (Robson et al. (2001). The table include descriptions which explains both the purpose of the different types of evaluations and when they are suitable to use. As the table

indicates, different names are used for the different evaluation types. I have considered this classification as appropriate given the scope of this thesis.

In this thesis, the focus is on the evaluation types process evaluation and summative evaluation. These are evaluations that, according to Drupsteen, Groeneweg and Zwetsloot (2013), serve as the final step in an ideal process of learning after incidents.

Table 4: Types of intervention evaluations (Based on Robson et al. 2001; CDC, unknown purplish date; Dahl et al. 2017)

Evaluation type		**Purpose**	**When to use**
1	Formative Evaluation / Needs Assessment	Determining what type of intervention is needed. Assessing whether the proposed intervention is likely to be needed, understood and accepted by the target group.	Planning phase, when deciding which interventions to implement.
2	Process Evaluation	Monitoring how well a safety intervention works in the extent to which the program is being implemented as designed. Identifies areas for improvement. Highly relevant when the goal is to collect information on how a given intervention could be implemented successfully and has been recommended within the nuclear power industry as well.	During implementation and operation. Should be used as soon as the implementation phase begins.
3	Outcome Evaluation / Impact Evaluation / Effectiveness Evaluation / Summative Evaluation	Assessing the quality of the intervention. Determining whether an intervention has had the effect intended on outcomes and estimates the size of the effects. Assessing whether the implemented intervention meets its goals.	Normally after implementation phase, at the end of the process. Should be used during the implementation at appropriate intervals.

4	Economic Evaluations / Cost-outcome Analysis / Cost-effectiveness Analysis / Cost-benefit analysis	Assessing cost relative effects. Comparing resources and costs with outcomes.	Both in the planning phase and during implementation.

Effectiveness, often associated with "doing the right thing", normally refer to the quality of a process or the result of a process, and the extent to which the actual output meets the desired objective (Jacobsson, Ek and Akselsson 2011, page 4). Kirkpatrick (2007) says the difference in results before and after a program is implemented indicates that learning has occurred, in other words that a safety intervention has had an effect.

According to Green and South (2006), a trend can be seen where many thinks about the evaluation of safety interventions and other programs as only the assessment of whether specific goals have been achieved or not. She further writes that definitions that think about evaluation in this way will assume that goals have been formally predetermined and planned, and that appropriate indicators of goal achievement have already been developed. All will find what they are looking for and at the same time is not open to discovering the unexpected effects of a safety intervention. This, according to Green and South (2006), is unfortunate. Rather, she proposes to think of evaluation as monitoring the effects of interventions, because this instead refers to a systematic and continuous follow-up of safety interventions to ensure that they function as planned. With such a perspective, according to Green and South (2006), one will be more open to observing potential side effects of implemented safety interventions, also called unintended effects. Such effects can be both positive and negative.

Further, Green and South (2006) have argued that it is important to keep in mind that evaluating safety interventions is not just about checking that something works or not, but also evaluating *why* specific interventions are either successful or unsuccessful. In other words, it is important that both the effect of safety interventions (summative evaluation) and the process of implementing the interventions are considered (process evaluations). This could offer important explanations as to why safety interventions may not have had the desired effect (Baklien, 1987).

3.4.2 Methods for evaluating safety interventions

To collect data for the evaluation, different methods can be used. These can be placed in two categories: quantitative and qualitative methods. Quantitative methods refer to methods that collect data that can be quantified, using quantitative indicators. This type of data usually answers questions such as “How much did the safety intervention affect the target group” and “Was the effect statistically significant?”. Qualitative methods, on the other hand, refer to methods whose purpose is to collect data that cannot be quantified and can be collected by, for example, interviews, observations and document analyzes. This type of data can help answer questions such as “In what way did the intervention have an effect?” and “What were the reactions of the target audience when the intervention was implemented?” (Robson et al. 2001).

Table 5 describes Robson et al. (2001) have argued are the most widely used methods to retrieve data to evaluate the impact safety interventions have had. It may be pointed out that this table indicates which of the methods are considered quantitative or qualitative. This is a modification of the table presented in Robson et al. (2001).

Table 5: Common evaluation methods (Modified from Robson et al, 2001, Page 54)

Common methods for collecting data for evaluations		
1	Quantitative	Administrative data collection – injury statistics
2	Quantitative	Administrative data collection – other statistics
3	Qualitative	Behavioral and work-site observations
4	Qualitative	Employee surveys
5	Qualitative	Analytical equipment measurement
6	Qualitative	Workplace audits

Kirkpatrick (2007) suggests using qualitative methods. He says a written test or questionnaire can measure changes in the knowledge and attitudes of individual individuals. Another suggestion is a physical test, which will be able to measure any increases in skills. Qualitative methods will offer more in-depth knowledge of the interventions and thus more nuances in the evaluation. According to Kirkpatrick, quantitative methods will only provide some simple indicators of whether something has had an effect or not, and possibly the breadth of effect. That is, for example, how many safety interventions have had an impact. In other words, it is claimed that the qualitative methods will be able to offer information that quantitative methods cannot.

Robson claims et al. (2001) claims the ideal or optimal evaluation of safety interventions is achieved by combining two or more of the methods in Table 5. This corresponds with the ideal evaluation phase in the learning from incidents process by Parker et al. (2018). At the same time, Robson et al. (2001) said the choice of which of these to use, depends on several factors. First and foremost, one must consider what data is potentially available and the quality that it will potentially have. Then, an assessment of available resources must be made to conduct the desired evaluation.

3.4.3 Using performance indicators

In order to support the evaluation of whether a goal has been met, one could use performance indicators (DSB, 2016). But, after experiencing an incident, a debate about the use of performance indicators often arises. This debate is normally about what performance indicators are, what kind of information they provide us with and how to develop indicators that can be useful (PSA, 2019).

A performance indicator, also called safety indicators, is a description of the activities, interventions, decisions and/or time factors that must be completed or fulfilled for the goal to be met (DSB,2016). What they point to is usually the state, level or status of something. In this context, an indicator will say something about the current level of learning, or the level of safety achieved after the implementation of specific safety interventions. Performance indicators therefore play a vital role in providing information about the safety performance in an organization.

Indicators can be both qualitative and quantitative, or a combination of these two. Quantitative indicators mean measurable data in terms of times, numbers or percentages. Qualitative indicators are more about describing and characterizing (DSB, 2016; PSA, 2019). Robson et al. (2001) says quantitative and qualitative data are important in different ways. They say: "…numbers are necessary to prove effectiveness, qualitative methods can yield information with a breadth and depth not possible with quantitative approaches."

According to WHO, which have developed a manual for evaluating among others road traffic programs, the performance indicators should relate directly to the objectives of an intervention. A clearly defined goal requires fewer indicators, while a comprehensive goal requires more indicators (DSB, 2016).

3.4.4 Criteria for a successful evaluation

The literature on evaluation argues that some specific criteria must be met in order for a successful evaluation of the effect of safety interventions to be carried out. In this master thesis I will present some selected ones. If these criteria are not met, it is argued that evaluation can be challenging to carry out. This can lead to evaluations being inadequate or evaluations not being carried out, and this is said to have an impact on organizational learning.

First and foremost, it is argued that successful evaluation depends on the planning done prior to implementation of safety interventions. Green and South (2006) claims evaluation – like all other activities – benefits from being well-planned. According to her, a more structured process for evaluation involves both careful planning of the evaluation and the evaluation itself. A structured form of evaluation requires structured evaluation planning. Dyvik (2008) claims that inadequate evaluations so far have often been the result of little planning.

Related to this, it is argued that it is crucial that the planning phase is well documented. Jacobsson, Ek and Akselsson (2011) argues that one of the most important things that must be in place in order to be able to follow up experiences from events and learn from these is good information. According to Green and South (2006), it will be challenging for someone to evaluate the effect of interventions if the thoughts of planning the action are not well documented. In this planning phase, it is argued that it is important, among other things, to document what expectations one has of the effect of the safety interventions. It will be extremely difficult for anyone to evaluate to actually figure out what kind of change to look for.

There will always be several parallel changes in an organization, and in order to be able to eliminate what in the current evaluation is only background noise, it may be helpful to clarify what expectations those planning the safety interventions have in terms of impact.

The Norwegian Directorate for Social Security and Emergency Preparedness (DSB, 2016), which has among other things prepared a guiding manual for the evaluation of emergency preparedness exercises (an example of a safety intervention), has tried to summarize what should be documented in the planning process in order to get to an evaluation. They say the following three factors are important to a successful evaluation:

1. The purpose av the safety intervention
2. The objective(s) of the safety intervention
3. Leading indicators to track change

Another criterion is that the person who is to evaluate a safety intervention should be familiar with the purpose of the interventions to be evaluated. Thus, they should know the background of the interventions, or in other words the intention to implement the relevant safety intervention. This is particularly important if the person involved in the evaluation was not involved in the planning and implementation phase of the action process.

Third, those who evaluate safety interventions should be informed of general principles of evaluation and what methods can be used to control the effect of different types of safety interventions (Robson et al, 2001; Baklien, 1987). An important principle is that one must consider which actors are affected by the intervention. This includes an assessment of all actors that are assumed to be affected (DNV GL, 2015). This applies irrespective of whether the person to be evaluated has been involved in the planning of the intervention(s), is employed internally in the organization or has been brought in for the evaluation (Green and South, 2006).

Finally, it can be added that Kirkpatrick (2007) argues it is important to measure the safety condition or what should be corrected *before* implementing safety interventions, in other words to have something to compare the results from an ex-post evaluation with. For an example, he claims it will be difficult to measure changes in human behavior if one does not know how the target population behaved before the intervention was implemented. This is about measuring an end state against a pre-condition. Whether the safety interventions have had an effect can be reflected in a change from a pre-state to now-state. Another way to achieve this is to evaluate

the target group with the intervention and another similar group that has not been exposed to the intervention, and then compare these results.

3.5 SUMMARY: WHAT SHOULD WE BRING FROM THIS?

Because the purpose of this master's thesis has been, among other things, to suggest how organizations can be better at evaluation, this chapter has included some descriptions that will not be used to analyze the empirical later. In other words, it has been a desire to develop a theoretical framework that companies can find inspiration in. Therefore, it makes sense to clarify exactly what the reader should include from this chapter.

The theoretical framework outlined in this chapter explained how organizations successfully can learn something from incidents. According to several, evaluation is an important part of the learning picture. Further, there are several types of evaluation, but the most important point is that an evaluation of safety interventions after incident investigations should include both an evaluation of the actual process of implementing safety interventions (process evaluation) and an evaluation of the effect of safety interventions (summative evaluation). The combination of these evaluations represents the final step in the process of learning after events. If this last step is not completed, important learning potential will be lost. Based on this, inadequate evaluation may function as a barrier for organizational learning. Evaluation of safety interventions leads to a greater level of learning that organizations miss out on in the absence of evaluation. At the same time, several criteria are mentioned in order to carry out an evaluation of safety interventions. If these are not met, evaluation can be difficult to perform in real-life.

Chapter Four

Research Design (Methods)

About this chapter:

This part of the thesis describes how I proceeded to answer the problem and the research questions introduced initially. First, it describes the research strategies followed that are related to the objectives of the master's thesis. Second, it describes how the literature review was conducted. The methods used for collecting, processing and analyzing the data collected are then explained. Furthermore, several research ethical dimensions that I have considered during the work on the thesis are explained, as well as what I think about being able to generalize the results. Finally, the study's weaknesses and strengths, as well as assessments related to validity and reliability, are described.

4 METHODOLOGY AND RESEARCH DESIGN

A research design is a detailed plan that says something about how one has progressed to answer one or more research questions (Blaikie, 2010). It is a plan that says something about how to get from A to Z and involves descriptions of the choices one has made throughout the research process. In this thesis, this refers to the research process that were undertaken to obtain information that could offer possible answers to both the problem statement and the three research questions introduced initially. The process is illustrated in Figure 10.

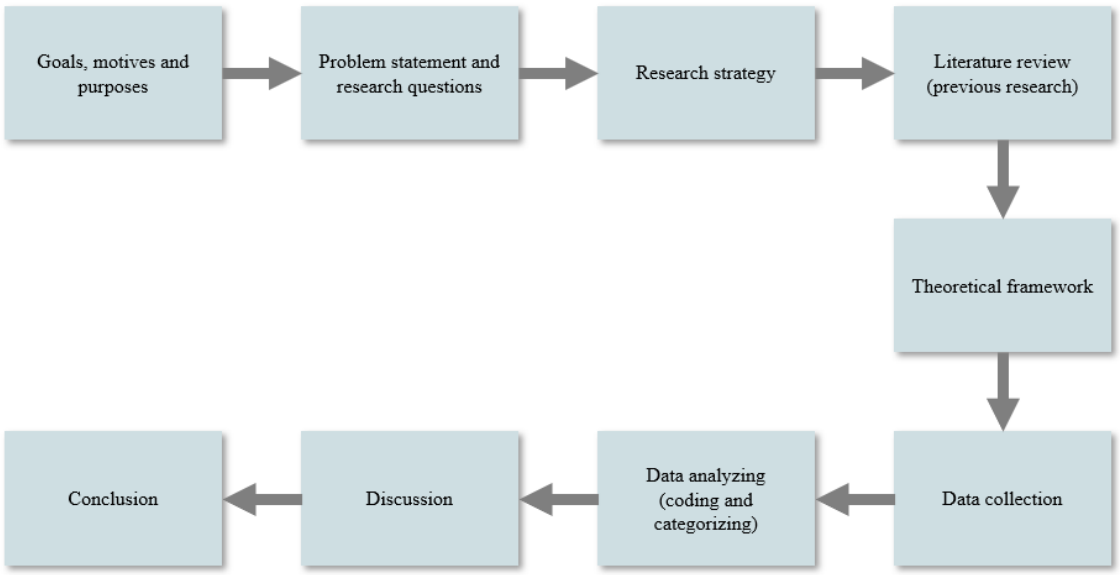


Figure 10: The research process undertaken

The research design and process that underlies this master's thesis can primarily be described as an exploratory design, based on Saunders, Lewis and Thornhill's (2012) division of exploratory, descriptive and explanatory studies. An exploratory study like this is based on the fact that there was limited knowledge about the issue addressed in this thesis. The phenomenon in question therefore needed to be explored.

Second, this study can be described as an intensive research design, based on Jacobsen's (2005) distinction between intensive and extensive designs. An intensive design refers to studies that have gathered in-depth knowledge of the phenomenon investigated, while extensive designs is studies that have gathered width knowledge. As the purpose of this study has been to gather in-depth knowledge of how companies evaluate the safety interventions they are taking and possible reasons why they do not evaluate, this study can be referred to as intensive. Like Aase

and Fossåskaret (2014) argues, an intensive design is necessary where there is no exhaustive information about the issue addressed before. It seeks explanation by going into the depth of the phenomenon itself and thus you get a comprehensive description of this.

Third, the study can be referred to as a cross-sectional study. This description is based on Bryman's (2012) distinction between five types of research design: cross-sectional, longitudinal, experimental, case and comparative design. Without going into all types of details, a cross-sectional design can be said to be about taking a still image of the phenomenon under study. A snapshot. As the first research question in this paper in particular makes clear, the purpose of this study has been to gain insight into the current practice of evaluation, i.e. a still picture that explains how this is done today.

Finally, it can be added that this master's thesis has become a mixture of both empirical and normative, even though one has often distinguished these different types of research projects in the past (Grønmo, 2004). It can be understood as empirical because I intended to explore and reveal selected organizations' current practices for evaluating safety interventions following incident investigations. At the same time, the thesis became somewhat normative, as it builds on an assumption that organizations in the Norwegian petroleum industry does not learn as much as they can from incidents by their current evaluation practices; how can *better* practices result in greater organizational learning.

4.1 RESEARCH STRATEGY

A central part of this research design was the choice to follow one specific research strategy to answer the questions I introduced initially. A research strategy can be understood as a logic or procedure for how to answer different types of research questions. According to Blaikie (2010), different research strategies will offer different ways to answer different types of questions. In this thesis, an abductive research strategy was followed.

Abduction, also called abductive logic, is, according to Thagaard (2013) about using both theory and empiricism to gain extended knowledge about a specific phenomenon. By following such a logic, one alternates between empiricism and theory to uncover understandable patterns along the way. Therefore, it is said that there is a dialectical relationship between theory and empiricism. Figure 11 illustrates this logic. As the figure shows, the starting point for all

research based on abduction is empirical observations of irregularities. Thereafter, empirical data will be collected for the purpose of arriving at a theory or explanation of the irregularities that have been observed, which are done by matching and discussing own theories with previous theoretical proposals from the literature review and the theoretical framework in Chapter Three. The figure was inspired by a similar figure presented by Kovacs and Spence (2005).

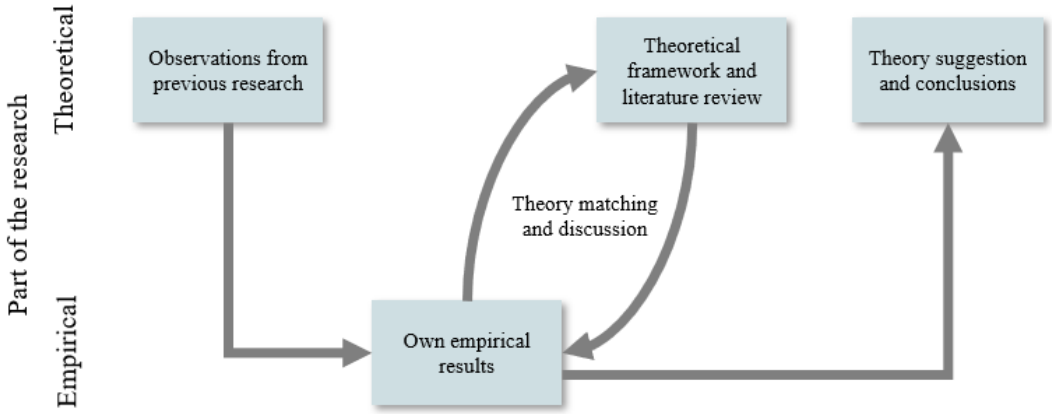


Figure 11: The abductive logic (Inspired by Kovacs and Spence, 2005)

It has been argued that the abductive strategy combines both an inductive and deductive logic. The inductive component was that the research project started by collecting data that would offer empirical explanations of the problem being investigated. The deductive component was about using pre-existing explanations for one or more parts of the research problem. Finally, by matching these explanations (theories) I could offer a possible conclusion about the learning difficulties of the organizations involved in the Norwegian petroleum industry. Together, it would be possible to answer both what- and why-questions.

Social science studies based on an abductive research strategy will often take the form of interactive processes (Jacobsen, 2005). They are often adjusted during the project, because one is more open to the fact that the data will reveal underlying patterns that you did not foresee when you started the project. New knowledge of the phenomenon emerges in the light of both empiricism and theory throughout the project (Blaikie, 2010). This apply for this master's thesis. When I started this project, I questioned companies' practices for evaluating the effectiveness of safety interventions, i.e. only summative evaluations. After the data collection was finished, I wanted to open up for a discussion about companies' current practices for

evaluating interventions at a more general level. In retrospect, this may have contributed to a more nuanced picture of the Norwegian petroleum industry.

An important point when following an abductive strategy is also that, according to Danermark (1997), only so-called reasonable conclusions are achieved at the end of a research project. It is argued that abduction can help to broaden the knowledge of the phenomenon under study and not offer a definitive explanation or truth. This applied to the conclusions of this master's thesis. The conclusion is only one possible explanation of the phenomenon being investigated. This means that other researchers may come to a different conclusion.

The reason for choosing this strategy was, among other things, that there was as previously mentioned limited preexisting empirical evidence that could answer the questions introduced initially (Drupsteen-Sint, 2014). According to Kvale and Brinkmann (2015), the abductive research strategy represents a type of reasoning that is well suited for projects where the purpose is to understand or explain something that has not been written much about before.

4.1.1 Ontological and epistemological assumptions

The choice to follow an abductive logic was also based on my ontological and epistemological assumptions about how the world is interconnected and how to obtain information about it. Blaikie (2010) say he have seen a tendency for researchers today to think very little about ontology and epistemology when choosing a research project and claims this is unfortunate. It is unfortunate because it is crucial for good research that it is documented which basic assumptions the choice of methods for data collection and analysis are based on. Therefore, it is devoted space to this in this thesis.

Ontology refers to our assumptions of how we view and understand the world. Ontological assumptions say something about how different phenomena exist, the conditions under which phenomena exist, and how these are related to each other. This study is based on an ontological assumption that reality is created by humans and that the phenomenon being investigated exists in the form of the individuals' understanding of it. According to Blaikie (2010), if one bases the study on this assumption of how the world is connected, one is an "idealist".

Epistemology refers to our assumptions of the best way to study the world and produce new knowledge about it. Epistemological assumptions say something about how we can know

different things, and what criteria must be met to determine which knowledge is right and legitimate. According to Blaikie (2010), the epistemological assumption I have based belongs to a scientific tradition called “constructionism”. According to this tradition, theories of a phenomenon are produced in the interaction between two or more people. The theory is based on human interpretations of reality. According to this perspective, there is not *one* universal reality, but rather several subjective interpretations. It is in line with what others call the interpretive approach to reality.

This is also known as a hermeneutic approach and scientific paradigm (Malterud, 2011; Kvale and Brinkmann, 2009). A paradigm refers to a scientific conception of what is to be studied, what questions should be asked to produce knowledge of what is being studied, how these questions should be asked, and further what rules should be observed when interpreting the answers obtained. In short, data is collected from individuals, were these are asked to report on their own interpretation of the phenomenon in question. Further, the empirical data is also the results of the researcher’s interpretation of what the participants have said or what is stated in written documents (Blaikie, 2010).

4.2 LITERATURE REVIEW

After having chosen a research strategy, a literature was conducted. I started the literature review by looking through the academic literature we had been presented to in various subjects during the two years at the University. The purpose was to base this thesis on relevant literature my professors had suggested throughout the master’s program. This gave some results, mostly about incident investigations, organizational learning and safety culture, but not the interventions process after incident investigations.

Then I started to search for literature beyond this by using various internet-based search engines. These were Academic Search Premier, Google Scholar, Springer, Scopus and Web of Science. In short, it was challenging to find literature that had both academic weight and good relevance to the problem. To enable a verification of the literature review, it has been considered as sensible to also describe the keywords that were used in the searches. See table 6.

Table 6: Search words in literature review

Key word	Search words
Learning	Learning from incidents, learning from incidents, learning from incident investigation, organizational learning, learning organizations
Safety intervention	Safety measure, corrective measure, corrective action, remedial action
Evaluation	Evaluation, evaluating the effectiveness of safety interventions, effectiveness evaluation, summative evaluation, outcome evaluation

Further, to make sure not to miss out on valuable information, I also had an individual tutoring session with one of the University librarians. This person said that one way to find literature that met my requirements was to check in particular how many times they were cited. This became a fairly effective procedure to follow and underlies this thesis. At the same time, the person could confirm limited results on the issue addressed in this study.

4.3 DATA COLLECTION

There are many different ways to obtain information that can answer one or more of the research questions. In this master's thesis, a combination of three qualitative methods for data collection were used. These were semi-structured and structured interviews, and content analysis. These are methods that, according to Blaikie (2010), are used for the purpose of providing qualitative, non-quantifiable data, which contain descriptions of characteristics and variations about the phenomenon, i.e. organizations' practices regarding the evaluation of safety interventions. As mentioned, the purpose of the thesis has been to discover whether it is common practice to evaluate the effect of safety interventions and further, whether it can be seen some trends across the sector. In addition, there has been a desire to collect data on the conditions that make it possible and / or make evaluation difficult. It can be said that quantitative methods only come a short way towards exploring such (Ringdal, 2001; Dalen, 2011).

In qualitative studies, data are usually collected from three different types: primary, secondary or tertiary data. In this study, only primary data were used. Primary data refers to raw data that has been collected by the researcher herself, in which there were made specific choices concerning the method for obtaining data. In other words, these are *new* data collected to answer the research questions in *this* master's thesis (Blaikie, 2010).

It can further be mentioned that although a combination data types (both qualitative and quantitative) according to the methodological literature can contribute to a more comprehensive picture of the phenomenon being investigated, I have considered it appropriate to use only qualitative data (Blaikie, 2010).

4.3.1 Interviews

Interview as method was chosen to gather in-depth knowledge of individuals' opinions, judgments, arguments, decisions and interventions. The purpose of the interviews was to gather comprehensive and in-depth information on how selected individuals perceive their work situation in an oil and gas company, and what views and perspectives they have on evaluating safety interventions after investigations (Thagaard, 2013). In other words, it has been an objective to answer the problem and research questions in light of data based on the participant's perspective on the topic of this assignment (Blaikie, 2010; Malterud, 2011; Kvale and Brinkmann, 2009).

Most of the interviews were conducted as semi-structured and so-called active interviews (Andersen, 2006). This method is characterized by the researcher actively involved in the data production, with the intention of achieving good dialogue between the researcher and research object, or also called participants in this study. A good dialogue can avoid misunderstandings, as both interviewers and the participant can ask questions to one another along the way, in order to clarify the interpretation of what is being said (Saunders, Lewis, & Thornhill, 2012).

One of the interviews that was conducted was a so-called structured interview, using e-mail. This interview can be understood as structured because the participant received some written questions in a specific order and could choose to answer these questions in that order.

There are several reasons why I chose to conduct qualitative in-depth interviews as the main method of data collection. The individuals were asked to report on their attitudes and behaviors concerning evaluation of safety interventions implemented after incident investigations. They

were also asked to tell about their impressions of other companies' practices, with the purpose generating information that could indicate if current practices for evaluation is a repeated trend across the industry. The goal of the chosen method of data collection has been to explore reality as understood by the selected informants. When doing this, Blaikie (2010) call it collecting data from individuals in a semi-natural setting.

At the same time, it can be added that because the thesis was carried out during a global pandemic crisis and that the Norwegian authorities introduced safety interventions that prevented people from meeting each other, much of the data collection was done using digital communication tools, e.g. Skype.

In addition, the choice to conduct interviews was also based on the assumption that the interview has produced very rich data of a different quality than in, for example, the use of survey. I think the interview has motivated the participants to answer in depth all the questions that were asked. By encouraging the informants to also talk about things other than I asked questions, it can also be assumed that I gathered more information than I would have used in the use of questionnaires (Judd et al. 1991).

Another advantage of the interview is that it was possible to avoid any misunderstandings. In some cases, several of the participants felt that some of the questions I asked were challenging to answer. Then, I had the opportunity to rephrase the questions so that the participants understood what I was asking for (Judd et al 1991)

Despite the so-called semi-structured interviews, all the interviews were based on a list of predetermined questions where they were considered central in answering the research questions presented initially. The questions asked in the interviews is described in Table 7. A benefit by being flexible related to the questions asked to the participants, was that I could change the order of the questions along the way in each interview, depending on what I experienced as most appropriate. Although I tried to follow the order of the questions in Table 7, there were many times I changed the order of the questions during the interviews. In addition, it should be added that even as all interviews were based on the same list of predetermined questions, all respondents at the beginning of and during each interview were encouraged to initiate conversation topics they themselves thought were central or relevant.

Table 7: Questions in Interview guide

Questions	
1	How do you proceed from which it is decided that an incident should be investigated, to working with safety interventions (corrective measures) afterwards?
2	How do you go about evaluating the safety interventions after they are implemented?
3	Who is responsible for evaluating safety interventions after investigations?
4	Which conditions could make it challenging to evaluate safety interventions after examinations?
5	Which conditions could make it easier to evaluate interventions after examinations?
6	Are there differences in how safety interventions are evaluated depending on whether the incident investigation has been conducted internally or by the PSA?
7	What opportunities do you have for keeping records of the work on evaluation of safety interventions?
8	Do you think it is important to evaluate the effectiveness of safety interventions after they have been implemented?
9	What is your overall impression of organizations within the petroleum industry's practices of evaluating interventions after they have been implemented?

Previous research and the theoretical framework presented in chapter three served as input to the interview guide in Table 7.

In order to ensure the most accurate reproduction of the dialogue that took place between the researcher and the respondents, technical aids like a recorder were used for voice recording in several of the interviews. This was used because it was considered very necessary to maintain the somewhat complex dialogue between the two involved in each interview.

4.3.2 Content analysis

In addition to interviews, I have also collected data from two business procedures from one of the oil and gas companies, with the intention of obtaining information that may say something about the company's internal guidelines imposes some requirements for evaluation of safety interventions after investigations. In addition, it was conducted a content analysis of an electronic form in the Synergi information system.

4.3.3 The sample

As mentioned earlier, the research process that underlies this thesis has been intensive, with the aim of providing in-depth knowledge that can contribute to a holistic perspective. In such studies, it is common to obtain data from a smaller selection of units, also called study objects (Jacobsen, 2005). This also applies to this study.

As Table 8 illustrates, the sample consisted of a combination of participants who in various ways have gained knowledge of how oil and gas companies involved in the Norwegian petroleum industry typically evaluate safety interventions implemented after incident investigations. Some are directly involved in the industry in question, while others have acted as somewhat more outsiders.

First, the sample consists of both several current employees in two different oil and gas companies, as well as one person formerly employed in an oil and gas company. The person who was previously employed by an oil and gas company is still directly involved in the petroleum industry today, but in a different form of employment without being able to go into this. In addition, the sample consists of a person employed by the PSA. These form the part of the selection that I have understood as directly involved.

Secondly, the sample consists of two persons from a consulting company, several oil and gas companies involved in their work related to safety and preparedness. Among other things, this company is conducting investigation courses for employees in the petroleum industry. In addition, the selection consisted of a senior researcher from a research organization in Norway. The researcher and his/her colleagues have conducted several studies on how companies in the specific sector learn from undesirable incidents. In their studies they have looked specifically at the follow-up of safety interventions.

Table 8: Overview of data collection from different data sources

Datatype	Data source	Data collection method	Employer
Primary	Individual in semi-natural setting	Structured interview by e-mail	A research organization in Norway
	Individual in semi-natural setting	Semi-structured in-depth interview by Skype	Oil and gas company called “Company A”
	Individual in semi-natural setting	Semi-structured in-depth interview by telephone	Oil and gas company called “Company A”
	Individual in semi-natural setting	Semi-structured in-depth interview, face to face	Oil and gas company called “Company B”
	Individual in semi-natural setting	Semi-structured in-depth interview by Skype	Oil and gas company called “Company B”
	Individual in semi-natural setting	Semi-structured in-depth interview by telephone	Oil and gas company called “Company B”
	Individual in semi-natural setting	Semi-structured in-depth interview, face to face	(Former) Oil and gas company called “Company C”
	Individual in semi-natural setting	Semi-structured in-depth interview	Consultant company
	Individual in semi-natural setting	Structured interview/conversation, face to face	Consultant company
	Individual in semi-natural setting	Semi-structured in-depth interview by Skype	The Petroleum Safety Authority (PSA)
	Document; business procedure	Content analysis	Oil and gas company called “Company B”
	Document; business procedure	Content analysis	Oil and gas company called “Company B”

	Electronic scheme/form in the Synergi system	Content analysis	Oil and gas company called “Company B”

A so-called strategic selection was made of the participants for this study, which means that the participants were selected based on their characteristics or qualifications being considered strategic in relation to the issue addressed in this master thesis (Blaikie, 2010; Thagaard, 2013). The participants were selected based on their knowledge of not only their own organization’s practice in evaluating interventions, but also other organizations’ practices. In other words, they can be understood as so-called experts on the topic.

When data were obtained from all the data sources in Table 8, I reached what can be called a saturation point. According to Thagaard (2013), the saturation point for the number of participants is when multiple studies of the same phenomenon do not provide further understanding.

4.4 DATA REDUCTION AND ANALYSIS

After the data collection was completed, the researcher left with raw data in the form of voice recordings, notes with comments and the described documents. In order to transform these raw data into empirical findings, the data were processed and analyzed using a method called systematic text condensation (Malterud, 2011). This has been the case that I have sorted and systematized the data material to find common features, important points, consistent and possibly inconsistent findings across the collected material.

The first step in the analysis process was to read through all the written documents, with the goal of forming a holistic impression of the data after the complete data collection was completed. A working note was prepared with reflections on immediate main trends in the data material.

In the second phase of the analysis work, a more systematic review of the data material was carried out. The goal here was to identify meaningful entities in the data. Words, sentences and entire paragraphs representing one or more themes were selected, and these were given a code.

The codes acted as labels and briefly described what the informants had said. An important point is that the coding of the transcripts and notes from the interviews has been computer-driven, or as Tjora (2017) calls empirical-based. This means that the codes represented the informants' actual statements about what it means to evaluate the impact of safety interventions and what potentially impacts their current evaluation practices. Instead of asking the question "what is this interview about?", I asked myself "what does this participant say?". Another approach to data analysis is a theory-driven analysis, where key themes and points from the theoretical framework govern what one is looking for in the raw data material. The coding of the procedures was theory driven, which in short explains that themes or important points in the theoretical framework control how the data is coded. The raw data in these data sources were coded for the terms learning and evaluation.

In the third phase of the analysis process, it was undertaken to abstract the contents of the individual meaning-bearing units, also called condensation (Malterud, 2011). Here all the codes were sorted and categorized by theme. Categories or themes were created by merging codes that were about the same. These themes were labelled based on the descriptions the participants had given.

Finally, for information, no digital tools were used to analyze the data. An example of a digital tool is NVIVO, which I have used in previous research projects. To ensure complete information security, I chose to exclude this in this master's thesis.

4.5 RESEARCH ETHICS

Like most research projects, ethical challenges were encountered during this research project. These must be addressed because they potentially can create negative effects for the participants (Jacobsen, 2005). According to Dalland (2014), research ethics is about planning, conducting and reporting research, as well as protecting privacy and ensuring the credibility of research results. In this section, I will explain three basic ethical considerations that I have made during this project. These were informed consent, anonymity, data verification and my role as a researcher.

4.5.1 Informed consent

The thesis meets the research ethical norm of informed consent. This means that all participants agreed to participate in this study based on detailed description about the purpose and background of the study, as well as what it meant to participate in the project. Each participant where sent an information letter, in this information letter it was stated that the participation is voluntary and that the participants can choose at any time to withdraw their consent to participate in the study. In addition, information about themselves and their employer have been treated confidential throughout the entire project, which was also described in the information letter. A recorder was used in some of the interviews. In those cases, were the recorder were used, the responder was informed about this.

4.5.2 Confidentiality (anonymity)

All data collected in this project has been stored and treated confidential. This means I have made sure information that could reveal the participants identity have been protected and hidden from others not involved in this project. I had great focus on protecting the participants' privacy throughout the entire research process. The researcher created a codebook at the beginning of the project, where the information about the different participants was stored. This codebook was not stored digitally but in a personal notepad. The codebook works in such a way that all participants are given their own code (number) from one to ten. Only I had access to the codebook. In addition, any information that could be used to recognize the participants were left out from being described in the final thesis report. For example, it has not been specified which companies have participated.

All participants were asked whether they wanted to be anonym or not. Some were not clear about this in the interviews, so the researcher sent an email to the relevant participants later and asked if it was OK to mention their employers name or if they wanted to be anonym. Eventually, all participants wanted to remain anonymous.

Furthermore, it can be added that the master's thesis was reported to and registered with the Norwegian Center for Research Data (NSD). The project was approved.

4.5.3 Data verification

To make sure the participants agreed with the way the data is presented in this master's thesis, as well as give them a chance to object to any changes I might had to make to properly reproduce their statements and intentions behind the statements, I sent the thesis to all participants two weeks before final submission. It was stated to the participants that they could comment on exactly whatever they wanted to, and that they could choose to withdraw their consent to participate in the study after reading the thesis if they desired to do so. I pointed out that I would be willing to make any possible changes they wanted with the purpose to keep them as participants.

4.5.4 My role as a researcher

The researcher plays a major role in ethical issues during the research work. In qualitative research projects such as this thesis, it can be said that the researcher is the most important research instrument for the research work (Kvale & Brinkmann, 2009; Postholm, 2010). Several claim the independence of the researcher plays an important role in an ethical perspective. The reason for this is that it is claimed that the researcher's involvement in the production of knowledge has much to say for the results of the study. In this assignment I have had a role as a "faithful reporter" (Blaikie, 2010, page 51). In short, this means that I have tried to reproduce the participants' statements in the most correct way possible, without revealing their identity.

4.6 GENERALIZATION, VALIDITY AND RELIABILITY

All scientific projects impose strict requirements in regard to validity and reliability (Kvale and Brinkmann (2009). In line with the norm of humility, it is stated that a researcher should show humility in his studies and explain any limitations. So far in this thesis, mostly advantages of the chosen strategy and methods have been mentioned. Despite this, there can also be mentioned several weaknesses associated with the research process that underlie this thesis. According to Kvale & Brinkmann (2009), it is common in the social sciences that the strength and credibility of the findings are discussed with the concepts of generalization, validity and reliability. Therefore, I have described various factors that may threaten both the validity and reliability of this study. At the same time, I have described how I have tried to solve these problems and thus strengthen the validity and reliability of the task.

4.6.1 Validity

Validity is about whether the chosen methods for collecting and analyzing data are suitable for producing the right type of knowledge to explain the research problem and answer the research questions (Blaikie, 2010). Further, validity can be divided into internal and external validity. The internal validity of a study is about the extent to which the results of this master's thesis are valid for the sample and phenomenon studied (Blaikie, 2010). External validity is about whether the findings from this master's thesis can be generalized to other samples and populations (Jacobsen, 2005).

In this study, the internal validity of the master's thesis depends, among other things, on whether the participants have given the researcher honest answers. Interviewing as a method of data collection may have made the participants not feel comfortable and therefore not respond as honest as they potentially could have by using other methods. One of the factors that can make participants uncomfortable is voice recording. It may be that several of the participants were more comfortable in an interview situation where the interview took place on email, where one has more opportunity to think more through the questions being asked and the answers to these. To reduce this threat, I tried to create a safe environment around the interview. I did not feel that any of the participants stated that they experienced the interview as uncomfortable, and based on several feedback that it was okay to participate in the study I am sure this is not a particularly salient weakness of this study. However, I wanted to shed light on this issue, to show that I have been aware of this aspect when I have collected data myself.

Another potential threat to internal validity is that participants have misunderstood the questions I asked them, or maybe answered what they thought I wanted to hear. In studies using qualitative methods for obtaining data, such as this master's thesis, the researcher is often much more involved than using quantitative methods. As an interviewer, I may have influenced the participants' answers to the questions I asked them by asking leading questions. Therefore, in all the interviews, I tried to be conscious of my role as a researcher. To reduce the danger of influencing the answers to the informants, I tried as far as possible to ask open-ended questions.

At the same time, according to Dalland (2014), it can be argued that the challenge with studies like this is that there are no "right" or "wrong" answers. Therefore, the internal validity rests more on the researcher's interpretation of the data collected. In other words, a third potential

threat to the study's internal validity is rather that I may have misunderstood what the participants told in the interviews. To avoid this, I conducted a double validation of the findings from the interviews. First, most of the participants during the interviews were asked follow-up questions to what they told, where these questions revolved around whether I had understood the informants correctly. Respondent validation such as this can be important means to avoid misunderstanding or misinterpreting the information provided by the informant or situation. In order to reduce the likelihood that I have misunderstood the informants, I have also asked myself whether the data can be interpreted in a different way than I have done. In other words, I have tried to be critical of my own interpretation of the findings.

Another threat to the internal validity of this study is that participants' statements were translated into English from Norwegian. An English translation may have changed material nuances in the statements of the participants so that the meaning is presented incorrectly or similarly. To reduce the risk of this, I sent the task to the informants before handing in, so that they could verify that their statements translated to English, accurately represented their opinions and attitudes.

Concerning the external validity, the researcher has obviously aimed to generalize the findings from this study, which is about the researcher having a desire to produce knowledge that can be transferred beyond the sample studied in this thesis. In other words, it has been a goal to be able to say that the results of this project can be argued to apply to the entire petroleum industry, not just the few oil and gas companies interviewed in this paper. In this context, it should be said that the researcher has had a purpose for being able to make so-called theoretical generalization of the results. Another type of generalization is referred to as statistical generalization. Due to the chosen method of data collection, where the units studied are based on a strategic selection based on the individuals' experiences with investigations and practices for evaluating safety interventions, this type of generalization has not been possible. At the same time, it has not been a goal to achieve this. In order to be able to make a theoretical generalization, the researcher has been particularly concerned with collecting data from several individuals with a great deal of knowledge of how most organizations in the specific industry follow up investigations. Therefore, the researcher has ended up with a composite group of data sources.

4.6.2 Reliability

Reliability is about whether the findings presented are credible or not. The researcher's involvement in data production may have much to say about the reliability (credibility) of the study. In qualitative methods for obtaining data, the researcher is often much more involved than using quantitative methods. The reason for this is that the researcher herself will interpret what is being said, and it is this interpretation that will be presented in the thesis. If the researcher is involved, the credibility will diminish, because the results presented are often a product of the researcher's interpretation of what has been said. This is a disadvantage of using the data retrieval method I want to use.

Another possible weakness of this study is that the researcher's prior knowledge of the oil and gas sector may have had an impact on the content of the text. It may be that elements that had been crucial to the reader being clarified are not because I myself did not consider this to be necessary, based on my prior knowledge of the industry.

Further, a potential threat to this study's reliability is that the information about the Synergy information system may be different across the companies. It is important for the reader to know that the electronic scheme in section 5.1.1 is taken from the Synergi database for company B. The electronic form used by company A and C may not be identical. At the same time, all participants have read through the thesis before submission. None have commented on differences in Synergi.

In order to ensure the credibility or reliability (reliability) of the study, I have made several choices during the project. First, I have been very conscious of my role as an interviewer and researcher. In the interviews, I tried to influence the results as little as possible. Secondly, I have spent a lot of time making sure that the participants' statements are credible, that is if they have told the truth and been honest when they have spoken. I also consider the secondary sources credible, that they are not tampered with. They were brought straight out of the management system of the organization in question. This also concern the electronic scheme extracted from the Synergi System, presented in section 5.1.1. Thirdly, I have focused on documenting the research process and the participants involved in the study as detailed as possible. The purpose has been to make it possible to test the study.

Chapter Five

Empirical Results

About this chapter:

In this chapter, the empirical results of the data collection are presented in the previous chapter. The descriptions represent participants' statements related to evaluation of implemented safety interventions. First, the reader is presented with an overview of the main topics of the interviews. Subsequently, a typical intervention phase after incident investigations of oil and gas companies involved in the Norwegian petroleum industry are reported. Furthermore, I describe various conditions that the participants in this study have told make evaluation of safety interventions either difficult or easy.

5 EMPIRICAL RESULTS

After the process of coding and categorizing the data from the interviews was completed, the researcher was able to list seven main themes that were repeated in all the interviews. Central sub-themes are also listed. Se table 9 below.

Table 9: Main themes and sub-themes after data analysis

THEMES		SUB-THEMES
1	The transition from incident investigation to the intervention process	• Planning safety interventions • Follow-up meeting with the PSA • Implementing safety interventions • Closing safety interventions • Closing the case (incident)
2	The ideal intervention process vs. reality	
3	The Synergi system does not support evaluation of safety interventions	
4	Evaluating safety interventions is challenging	• Lack of information • Uncertainty associated with evaluation methods • Some interventions are more challenging to evaluate than others • Uncertainty related to timing
5	Evaluation of interventions is not a priority	• The companies are more concerned about "closing deviations" than controlling the impact from implemented interventions • Evaluation of interventions is too resource-demanding • When interventions are implemented you “feel done"
6	Evaluating interventions could be easier if you could look to others for examples	
7	Closing criteria should be set	

5.1 THE TRANSITION FROM INCIDENT INVESTIGATION TO THE INTERVENTION PROCESS

All the semi-structured interviews that were conducted were initiated with a conversation about how the companies typically go from investigating an incident to working with safety interventions. In other words, how they transition from the incident investigation process to the intervention process. After all the interviews and content analysis, it became possible to outline what the participants referred to as a typical intervention process after an incident investigation within the Norwegian petroleum industry. This process describes the transition from investigation both when the companies themselves have investigated an incident and when the investigation was conducted by the PSA. See Figure 12.

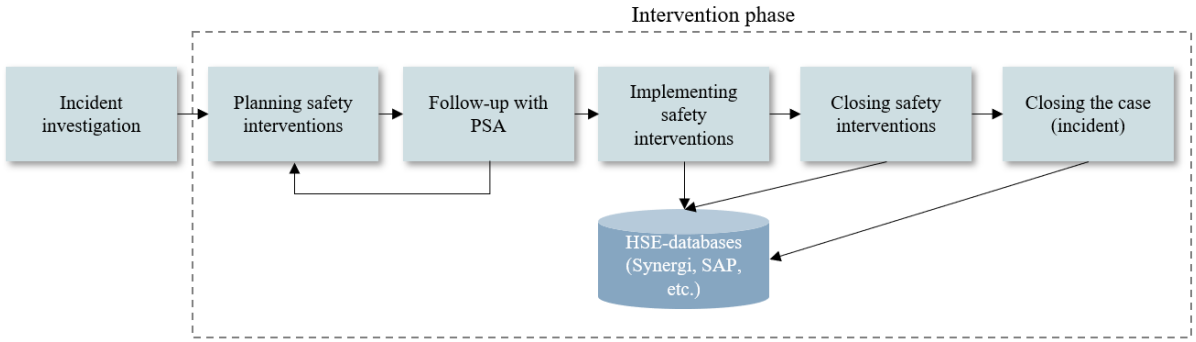
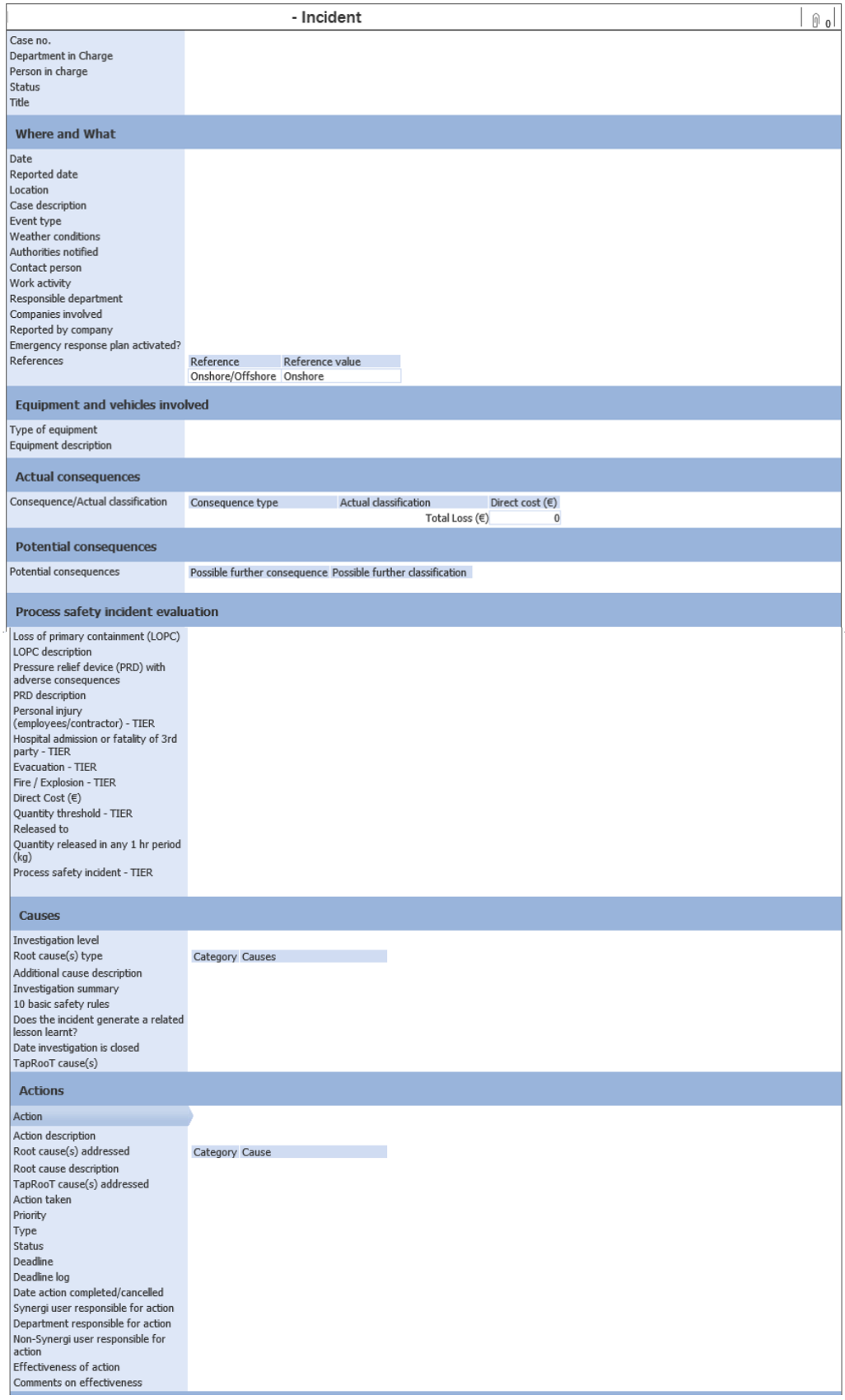


Figure 12: A typical intervention phase in the petroleum industry

Almost all the participants stated that the process illustrated in Figure 12 takes place in the same way regardless of who has conducted an investigation. On the other hand, the participant from the PSA mentioned that the intervention process will take place in different ways depending on the level of the investigation or the incidents potential for consequences. Among other things, it is stated that if the PSA has carried out the investigation, the companies will have one or more follow-up meetings with the PSA about what safety interventions they plan to implement and how they will follow up. Each step in the process illustrated above is further explained in the following.

5.1.1 Planning safety interventions

According to all participants, a planning phase starts when the companies receive the final investigation report from the investigation group. This is stored in the Synergy system, attached to the relevant case (incident). The following picture (Figure 13) shows the electronic scheme/form the companies fill out.



- Incident

Case no.
Department in Charge
Person in charge
Status
Title

Where and What

Date
Reported date
Location
Case description
Event type
Weather conditions
Authorities notified
Contact person
Work activity
Responsible department
Companies involved
Reported by company
Emergency response plan activated?
References

Reference	Reference value
Onshore/Offshore	Onshore

Equipment and vehicles involved

Type of equipment
Equipment description

Actual consequences

Consequence/Actual classification

Consequence type	Actual classification	Direct cost (€)
	Total Loss (€)	0

Potential consequences

Potential consequences

Possible further consequence	Possible further classification

Process safety incident evaluation

Loss of primary containment (LOPC)
LOPC description
Pressure relief device (PRD) with adverse consequences
PRD description
Personal injury (employees/contractor) - TIER
Hospital admission or fatality of 3rd party - TIER
Evacuation - TIER
Fire / Explosion - TIER
Direct Cost (€)
Quantity threshold - TIER
Released to
Quantity released in any 1 hr period (kg)
Process safety incident - TIER

Causes

Investigation level
Root cause(s) type

Category	Causes

Additional cause description
Investigation summary
10 basic safety rules
Does the incident generate a related lesson learnt?
Date investigation is closed
TapRooT cause(s)

Actions

Action
Action description
Root cause(s) addressed

Category	Cause

Root cause description
TapRooT cause(s) addressed
Action taken
Priority
Type
Status
Deadline
Deadline log
Date action completed/cancelled
Synergi user responsible for action
Department responsible for action
Non-Synergi user responsible for action
Effectiveness of action
Comments on effectiveness

Figure 13: Synergi scheme

In case of internal incident investigations, the planning phase starts when the individual or group of individuals who decided that a local incident investigation should be conducted, receives the investigation report from the company's internal investigation group. In this report, according to all participants, the course of the event and what direct triggering and underlying causes is described. In addition, according to the participants from companies A, B and C, the investigation report will usually also contain the investigation group's recommendations for safety interventions.

When the PSA has investigated, the planning phase starts with the company receiving the final investigation report from them. Contrary to the typical investigation report from the companies' internal incident investigation group, the PSA's reports do not contain recommendations for interventions. The participant from the PSA said the following:

> We would rather say that there are many different ways to go with this. It is up to each individual company. The companies must solve this based on their organization, management system, equipment, etc. We therefore do not make recommendations for safety interventions. We point out deviations and improvement points, related to requirements in the regulations. We only point out mistakes, no solutions.

After receiving the incident investigation report, the companies normally put together a group of employees who will decide on what interventions to implement. Normally, this group will set up a meeting with the investigation team, which will present their findings and recommendations for safety interventions. According to most of the participants from the three companies, this group will often decide to implement the same interventions that the investigation team has recommended. At the same time, they may decide to make some adjustments depending on what they think will be the most successful interventions. The most successful interventions refer to those actions believed to have the most impact on selected parts of the organization. The participants mentioned that they spend much time on finding the most effective safety intervention because it is important that not too many interventions are implemented. One of the participants from company B stated that they want to implement those few interventions that will have the best effect on several parts of the organization. They do not want to implement many different safety interventions that will have an impact on only a small part of the organization.

Further, both of the participants from Company A told that during the planning phase they try to define the target group for every safety intervention. As an example, one of these participants said the following about what it means to define the target group:

> Who will learn from this incident or change anything? Is there a single platform that is expected to learn something, or does this apply for all platforms in the North Sea? So, you must try to define the target group for the intervention, because sometimes it applies to equipment only a few have or a working method only a few have.

In addition, the participants from Company A said that they have developed what they call an "Intervention Manual", which they use when planning which safety interventions to implement. According to both participants, this manual is intended to serve as a kind of "guide" or "cookbook" for planning safety interventions. The intervention manual contains descriptions of different types of interventions and their expected effect on different parts of the organization if implemented. The participants explained that the manual is based on a systematic work where several employees in Company A have gone back in time and looked at various earlier implemented interventions and what effect these have had over time.

5.1.2 Follow-up meeting with the PSA

The participant from the PSA stated that in addition to the internal process taking place at company level, the companies often have one or more follow-up meetings with the PSA. The degree of follow-up from the PSA will be based on their assessment of the potential of the incident. In these follow-up meetings, the companies are asked to explain how they work with safety interventions and to document this process. The participant said the following:

> We will get a response from the companies about how they intend to follow up the deviations and the improvement points. In the first place, this happens in the form of meetings, where the companies come and explain and elaborate on what they have done. Then they submit documentation on what analyzes they have done or e.g. what pictures they have used in terms of what has happened and how they understand it. Say it was something cultural, then they will present documentation on e.g. all the safety meetings they have had or employee surveys they have done. There may be one meeting, or there may be five meetings.

Furthermore, the participant from the PSA stated that they can convene the companies for a new meeting when the companies have said that safety interventions should be closed.

5.1.3 Implementing safety interventions

Based on the information that emerged in the interviews with several of the participants from all companies, it seemed that the implementation phase starts when each intervention is registering in Synergi. This applies to all companies. When the interventions are registered in Synergi, it is registered who is responsible for each intervention and a deadline for when the various interventions will be implemented. The participants from all companies said they will try to add a detailed description of each safety intervention, but that it is not mandatory to fill in all the fields. The following image shows the last part of the electronic form presented earlier where the companies fill out information about safety interventions (See figure 14).

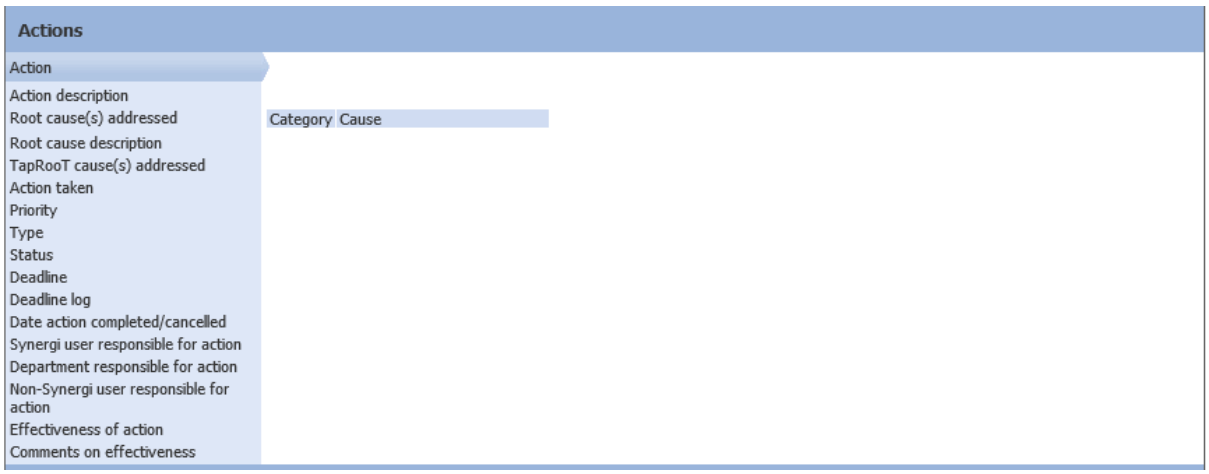


Figure 14: Part of the Synergi scheme regarding safety interventions

All in all, the information in Synergi will according to all participants from the three different companies, serve as an overview of the interventions to be implemented, as well as information about when these interventions will be implemented and who is responsible for this. The actual implementation of safety interventions will normally take place in other systems than Synergy. As an example, one of the participants from Company B said:

> But then it may be that in order to implement the safety intervention, you may use other tools. It is very common to write that you should, for example, buy an equipment, that is if the intervention involves changing an equipment. Then you write in Synergi what you intend to do. The very process of switching equipment, you write what is called a

notification in SAP. There you can place orders for equipment and describe how to install it, etc.

5.1.4 Closing safety interventions

After the implementation phase, the safety interventions will eventually be "closed" in Synergi. According to several of the participants, the person responsible for an action will receive an e-mail from the system that the deadline for implementing one or more safety interventions will soon expire.

In the interviews with the participants from the various companies I asked what it means to close a safety intervention in Synergi. Most participants stated that this means checking if a safety intervention has been implemented or not. It seemed that most participants were unanimous about this. At the same time, some of the participants said that it ideally also involves an evaluation of the safety intervention. According to the participants who said this, conducting an evaluation of safety interventions means that you have to evaluate whether you have succeeded in what you wanted to achieve, whether you have achieved your goals. One of the participants from company A and B also said that the effect of each intervention should be evaluated at this stage of the intervention process. According to several of the participants, the person responsible for implementing a safety intervention is also responsible for evaluating the intervention *after* implementation. At the same time, the participants said that they do not believe that the person who is responsible for implementing a safety intervention, feel a responsibility to evaluate the effect of the interventions and whether goal(s) are achieved or not. One of the participants from Company B said one reason for this may be that their work procedures state that an evaluation *should* be conducted. In other words, this is not something you have to do if you do not want to. Because of this, the interventions that are registered in Synergi are usually closed when they are considered implemented.

I addition, one of the participants from company B said that they have recently initiated a internal project where they check whether interventions have been implemented as they were intended, half a year after one has closed the safety interventions in Synergi. The informant told the following:

> We have started to register a separate intervention in Synergi, in addition to the other interventions, where we decide that we will come together within six months and

> consider both the degree of implementation of the various interventions and a little about what effect they had. That is the way we follow up on interventions.

5.1.5 Closing the case (incident)

Several participants stated that the final step in the interventions process is to close the "case" in Synergi. Closing a case, according to the participants, means ending the work related to the specific incident in the system. The person responsible for the entire case will in theory evaluate the quality the interventions and implementation process. To close the case, this person must describe the quality of what has been done. One of the informants from Company A said: “They should read through and see if its good enough.”

At the same time, an informant from company B said that he / she believes that this person rarely feel having an overall responsibility to go through all the safety interventions, assess whether these have been implemented and then check what effects they have had. This were also mentioned by the participant from the PSA, who said the following:

> There is one case manager in Synergi, who owns the entire case, but there are different people on all the interventions. The caseworker does not necessarily go in and assess how each individual has followed up on his or her interventions.

Because of this pattern, where the person responsible for closing the Synergy case does not necessarily check whether interventions are actually implemented or evaluating their effect, two of Company B participants said they have recently initiated a process where they check on everyone closed interventions in Synergi have actually been completed as intended. According to these participants, they will do so six months after the interventions were closed.

The participant from the PSA stated that he / she imagine that there is a difference in the degree of follow-up of incident investigations and interventions depending on the potential of the incident and level of the investigation. This participant stated that he / she imagine that an investigation that has been carried out either by the companies’ head office or by the PSA, will be followed up to a greater extent than investigations conducted at a lower level, because the companies will perceive this as more serious. The participant said that he / she believes that the higher the level of investigation performed, the higher the likelihood that the companies will follow up. The reason for this is, according to one of these participants, that the investigations

at the two highest levels are taken more seriously, because there may be a lot of external interest in these. Both participants from the consulting firm expressed that they share the same perspective on the degree of follow-up as the participant from the PSA.

5.2 THE IDEAL INTERVENTION PROCESS VS. REALITY

In several of the interviews, the participants talked about what I have interpreted to be the ideal intervention process, i.e. how the participants think this process should ideally be carried out. Furthermore, they compared this ideal picture to what they referred to as normal practice in reality. As an example, one of the participants from Company A said the following:

> First, you have to plan the safety intervention, and then do it. Then, you should check to see if it has worked. And then you may have to correct it, in order to keep getting better. It should really go about as a kind of circle. The common practice is rather that you plan and implement but stop when this is done.

All participants claimed that the ideal intervention process involves an evaluation of the interventions they have implemented. Nevertheless, all participants claim that they rarely conduct an evaluation. As an example, one of the participants from Company B said:

> There we are not good. Frankly, we do very little there. We have just started with this project of going back in after six months. And we do not have that many investigations.

As another example, the informant from company C said the following:

> We are good at investigations but may not be as good at safety interventions. Or I know we are not very good at interventions. And then it gets even worse, when we are actually going to check exactly that bit if they are actually done. Overall, I actually think the investigation phase is very good, but the evaluation, it is both difficult and resource intensive.

According to all the participants I interviewed, this is a trend that is continuing across the sector. In other words, most oil and gas companies rarely evaluate the interventions they implement. Among others, the senior researcher said that based on his/her own experience from various

projects in the petroleum industry, an overall impression is that most organizations could be more thorough in following up on investigations. This participant wrote:

> What we see is that the companies, at least the large ones, have good routines for investigations, and they put a lot of work into this, while struggling with taking out the learning potential in the form of concrete safety interventions and improvement work. We have had several projects for operating companies and other organizations, where we have looked at learning after incidents, and the same pattern repeats itself; a lot of good work is done regarding incident investigations, while there is far less focus and systematic work associated with ensuring learning after the events (i.e. the process of planning, implementing, evaluating interventions; this can also be referred to as the "action process").

Also, both informants from the consulting companies said they have the impression that in general, the entire industry rarely evaluates interventions after they are implemented. One of these informants said that they believe companies are not good enough at following up interventions, and that this applies to safety interventions implemented independently of investigations as well. In other words, according to this informant, it seems that this is a problem regardless of whether an investigation has been conducted. In general, according to the informant, few seem to have good, structured routines for follow-up activities.

In addition, this one informant from the consulting company said that they have the impression that the companies know that one should evaluate the effect of safety interventions, but that this is still not done. The informant said they find it interesting that companies rarely evaluate the effect of interventions when they know the importance of doing so.

On the other hand, one of the participants from company A mentioned an example where they were successful in evaluating implemented interventions. The company had experienced an incident where a ship collided with one of their platforms. The participant explained the following:

> It ran straight into the platform. A very dangerous situation. At that time, we had maybe 150 ships on collision course with the platform every single year. Sometimes they did not turn around until they were almost completely at the platform’s feet. A whole series of interventions were implemented to avoid this. Then we measured it. We measured the

number of ships heading for the platform. We implemented several different interventions. We said for example that the vessels should not be allowed to use the position of the platforms as a target for coordination, because then they will run on autopilot. They should not be allowed to use the platform as such an autopilot waypoint. It had a certain effect, but we still had too many ships on collision course. Then other steps were taken to reduce the number of boats on collision course. We had meetings with the shipping companies, and we had meetings with ... or we created a captain's forum. We made checklists for the vessels, and checklists for when to contact the platforms before they came with cargo and stuff. Together, these safety interventions had a very good effect. So now we are down to ten or less than five ships on collision course each year. Last year there were maybe just two. So, this is one way to measure impact. Find a parameter that tells you something about the risk, and then keep track of that parameter.

5.3 THE *SYNERGI* SYSTEM DOES NOT SUPPORT EVALUATION OF INTERVENTIONS

When it became clear that oil and gas companies rarely evaluate safety interventions, all participants were asked what they believe is the reason for this. Several responses emerged, one of which was that Synergi is not designed to evaluate the impact of safety interventions after they have been implemented. Several claimed that the electronic scheme in Synergi does not contain fields where information on the evaluation of safety interventions should be filled in. Therefore, according to most participants, this system has great potential for improvement when it comes to facilitating evaluation of safety interventions. As an example, the participant from the PSA said the following:

> The system does not plan for evaluating whether the interventions have achieved what one wanted or not. It is just about whether it is done or not done. When the interventions are completed, you just "tick". Then you are done. So that evaluation part, the last step, is not added to Synergy as I have ever worked with this system.

The reason why it is important that the electronic form in Synergi contains fields in which to fill in information from an evaluation of safety interventions is because the individuals who are responsible for each intervention do not think this is important. The individuals will follow the schematic in Synergi, and if evaluation is not part of this schematic, it will not be done.

Because there are no separate fields to describe how to evaluate a safety intervention and then the outcome of an evaluation, two of the participants from Company B told that it has become common practice for them to register a separate action to evaluate the effect of safety interventions, in Synergy. They record this in the same way as all other interventions.

On the other hand, one of the informants from company B told that it is actually possible to describe something about evaluation in Synergi, which means that the system is set up so that one should evaluate. In the interview with this participant, I was shown several cases in Synergi, where these had several registered safety interventions. When we took a closer look at the electronic scheme, the participant said there are fields where you can say something about the effect of interventions. The form is designed to first check whether the intervention has had an effect or not (yes or no), and then can describe what kind of effect the safety intervention may have had. In the picture below I have marked these two fields (see Figure 15).

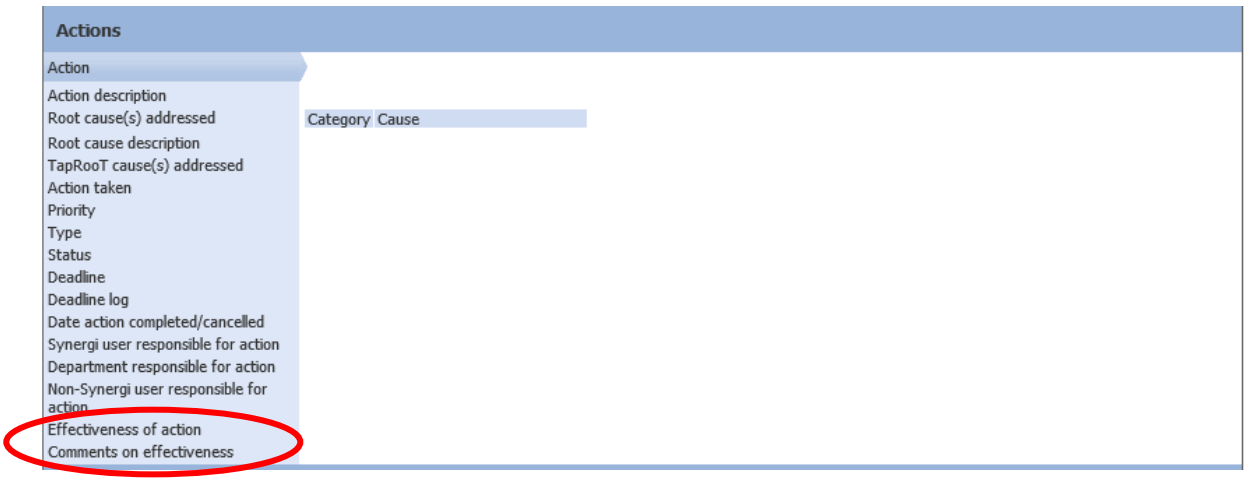


Figure 15: Synergi scheme, possibility for describing effects of safety interventions

Furthermore, the informant said that despite the possibility of describing something related to the effect of safety interventions, most of their employee do not. Prior to the interview, the participant had gone through all the investigations they had conducted "world wide", and concluded that in all cases there were only 75 cases where they had chosen "yes" for interventions to have had an effect. In only a few of these cases, something had been written about the effect of the intervention.

When I asked the participant what he / she thought could be the reason for not filling in these fields, the participants offered several potential explanations. First, according to the participant, it is not mandatory to fill in all the fields in the electronic form in Synergi. The participant said

that it is therefore up to individuals what they want to add of information to this database, and it is therefore conceivable that few will do so. Second, one explanation for this may be that the individuals responsible for each intervention do not know the system that they might need to do. This may be because they have not received sufficient training, or that they have not spent much time to familiarize themselves with the schematic.

Furthermore, I asked for a third reason why in the cases the participant had shown me had not written very much about what kind of effect the safety interventions had and how they had come to this, could be that there is limited how much can be written. Maybe it is not be possible to write more, I thought. The participant therefore opened a new form to test how much information can be filled in. It turned out that there is no limit to how much you can write about evaluation and measured effect.

5.4 EVALUATING INTERVENTIONS IS CHALLENGING

In addition to deficiencies in the Synergi system, several of the participants mentioned that another main reason why evaluation is rarely carried out is that evaluation of safety interventions is perceived as challenging in practice. When the participants who mentioned this were asked to elaborate on what conditions they think make it difficult to evaluate, several factors were mentioned.

5.4.1 Lack of information

Several of the participants revealed that one reason why evaluation of safety interventions is perceived as difficult, is lack of information. With a lack of information, some of the participants talked about missing information about the purpose behind each safety intervention. Some also mentioned that there is often a lack of information about the pre-condition, i.e. the conditions that led to specific interventions being implemented. This was mentioned in just about all the interviews.

Then, when the participants were asked *why* it is important to have enough information about the purpose of the interventions to be evaluated, as well as a description of the pre-condition before the safety interventions were implemented, several of the participants replied that it would be almost impossible to measure potential change in safety if do not have this information. According to the participants, this information can be used to formulate

performance indicators, which will make it easier to measure whether there has been a change in the target group. As an example, one of the participants from company A answered the following:

> The safety interventions can be interpreted in so many ways. If you have an understanding of what you really want to achieve, then you can more easily evaluate. You must have some criteria to evaluate in relation to. One must know what the purpose or objective of each intervention was.

As another example, the participant from company C said:

> That would be hard to do. Often this will be offshore, and then the responsibility often falls on some of the leaders out there, and on the HSE adviser. Then you might ask: Where are they at this place? Did they agree with the intervention in the first place? Do they know the whole background behind, or are they a bit more like "yeah, they're doing this right now" and just 'tick'? How good is that kind of a job?

The informant from the PSA stated that descriptions of goals and pre-conditions are crucial for measuring the effect of safety interventions. The person in question also used the word "picture" and "frame" about the safety state before safety interventions are implemented, and said it is about "having something to measure up against". In addition, the informant said the following:

> You have to understand the context of the situation when the safety interventions were made. The frame can change after all. Then the effect of the safety interventions will also change and may not be relevant anymore, right. There are things that can happen to the framework that mean that the whole interventions will no longer have an effect or is no longer relevant.

According to several of the participants, when a person is set as responsible for both implementing and evaluating a safety intervention, this individual is rarely given detailed information about the target group for the intervention they are responsible for. The information available to the persons responsible for the intervention is the descriptions in Synergi, and according to the participants this is often not very detailed. In addition, one of the participants from Company A mentioned that the language used in Synergi often can be difficult to understand. The participant said they had recently completed an internal project in which they

investigated how structured employees were when working on safety interventions in Synergi. They had, among other things, gone through several cases in Synergi and seen that it was generally difficult to get a good picture of both the incident and the safety interventions that were registered. To understand everything, they had to contact other employees who had been involved in registering the case and / or the synergy interventions. In summary, it was said in the interviews that the only information available to those who *should* evaluate safety interventions is insufficient.

Further, several of the participants from all companies and the PSA also mentioned that the reason for insufficient information in Synergi is that when planning safety interventions, it is not planned for an evaluation of the interventions afterwards. It is not planned whether they should be evaluated, how this can be done or when they should be evaluated. Because one does not plan to carry out an evaluation later, the group of individuals who decide on which safety interventions to implement probably do not think that it is important to document all information from the planning phase.

The participant from Company C told me that he / she believes a solution to this problem is to involve those who are put in charge of an action in the planning phase. The participant said that it would be easier to evaluate a safety intervention if one knew the background to implement the intervention. In addition, the participant claimed that the person responsible for a intervention will feel more ownership of the safety intervention if he or she becomes involved in the planning. According to the participant, this could possibly help the responsible person to experience it as more important to follow up the intervention in a systematic way. Among other things, the participant said the following:

> Then they are the ones who own them. I think they will be better implemented. I think there will be implemented better interventions too. They will follow up and test themselves. It is themselves who will also test whether the intervention they themselves invented actually works in their department. It gets much closer, and it becomes much easier to observe for the individuals. It's much easier to do what you have come up with yourself, than if you are required to take action in a process that says "you have to do this and that".

5.4.2 Uncertainty associated with evaluation methods

In several of the interviews, there were also mentioned that the reason why evaluation of safety interventions is perceived as difficult, is lack of knowledge or insight into different methods that can be used to measure the effect of different types of safety interventions. According to the participants, the most difficult is to measure the effectiveness of a safety intervention. The participant from company B said that it is relatively "straight forward" to evaluate whether one has implemented the safety interventions one should, but that it is challenging to evaluate whether one has achieved the desired effect. As another example, one of the company A said:

> When you talk about effectiveness measurement, you often come across indicators that can say something about the effect. But we really have no recipe or tips for users on how to measure the effect of some interventions. The problem is that you often only implement the first and best safety intervention and then hope that it works. The reason why it is done this way is that it may not be so easy to find ways to do it, that is, to measure effect.

Nevertheless, most of the participants mentioned several different methods for evaluating the exact effect of safety interventions. They all mentioned qualitative methods such as individual interviews, questionnaires and observations. According to the participants, the result of an evaluation using such methods would be the employees' subjective opinions about the effect of a safety intervention. One of the participants from company B said the following:

> You have to talk to people and ask them, "How did this intervention work?". One must talk to those who will use it in practice, those who may or may not use or use a new equipment or procedure. They have to talk to them. The best thing would be if you first observed those who do the job according to the new method.

As another example, the participant from company C said the following:

> Of course, you do follow up on specific things that are often easier to check up, but there are quite a few activities that are a bit tricky simply. Say you are implementing a new procedure. Then you can test whether it is actually used, but you never get to test if they follow it to 100 percent out in the field. Then you have to sort out and observe. So, you have to be so down to the details sometimes. If there are organizational things, it looks

> fine on the surface, but then it is not followed in practice. And it is difficult to follow up. Then you almost have to be out and walk around.

At the same time, some of the participants also mentioned more quantitative methods for measuring effect. As an example, one of the participants from Company A said the following:

> We do have some effectiveness measurement, at a very general level. For example, the number of leaks. We measure that on an annual basis. We measure the number of injuries. The number of breaches of security barriers, we measure that. Or also how good the safety barriers are, we can measure that.

5.4.3 Some interventions are more challenging to evaluate than others

Another reason why it is difficult to evaluate safety interventions is according to the participants that some interventions simply are more difficult to evaluate than others. As an example, one of the participants from company A said the following:

> Everything that has to do with people or the organization, i.e. interventions around it, is difficult to measure. It is easy to measure the effect of technical safety interventions. Or it is relatively easy. Once you talk about human and organizational safety interventions, it is usually much more difficult. (…) You can always check if people have done something or done something else, or mentioned something at the security meeting, but what is the effect of, for example, mentioning something at a safety meeting? What is the effect of conducting training? What exactly is the effect of taking technical safety interventions? There is often uncertainty connected to this.

Based on an overall impression, it seems that just about all participants in this study argue that evaluation is difficult because it is simply very challenging to evaluate the safety interventions that are going on at the organizational and human level. The participant from company C elucidated this with the fact that some interventions are more difficult to measure the effect of than others:

> There is one challenge in relation to follow-up, that there are simply things that are difficult to follow up. Technical improvements are relatively straightforward, because you can go out and see. And you can take a test of them to see if they work on purpose

> and things like that. If you divide it by such MTO, where you have technical safety interventions, which are surprisingly few compared to the findings, but that's another thing. They think I actually get followed up so reasonably well, because it's relatively easy to do and there are few of them. Then you get more into the organizational and the human. On the organizational side, you can see in a way that "yes, there have been changes in procedures and things", but you have to go one step further, because you actually have to check if this has been used and it is difficult.

Then the same participant gave an example:

> This was just when a new NORSOK standard came up for lifting, for example. We had just started a new training program and people had gained access to this new lifting directive, which we called it. As the PSA pointed out; "Well, they are not guaranteed to understand that." So, we started a verification program (…) Then we simply had an assessor, i.e. a person who goes out and verifies; "Now do this job and show me you can do it." Then you have at least seen that they can do it in practice and that they have got the expertise, that they can do the job. So far the best thing to come is that you have given the training, that you have seen that they understand it, that they can do it in the field, but then they may not do it next time. You just have to occasionally have someone out there checking that "okay, they've got a competency". The intervention was that we must raise the competence of those who work with strapping for example, or those who handle flanges, or yours and that. And then you have follow-up, and then you actually have to see that they can do what they have learned. And that is a pretty demanding case.

The participant from the PSA also said that it would be more challenging to evaluate the effect of organizational and human safety interventions than interventions that are of a more technical nature. Among other things, the participant explained this in the following way:

> The simple ones are the technical ones. Here, you just have to fix it. When it is technically fixed, then it is fixed in a way. But what goes on in leadership or everything really goes on in culture, leadership and organization, how do you know that you have met your goal? It is hard to measure. And it is hard to know what is going on. Organizational learning is not easy to me. If it is a technical discovery it is easy to tick

> off for "yes, it is done, we have bought a new crane". But if it is a cultural discovery, it is harder to just tick off. It requires more of both the company and us in terms of follow-up.

The participant from the PSA stated that one reason that especially organizational and human safety interventions are more difficult to measure the effect of than technical safety interventions is that these types of changes often take a long time to have any effect at all. Among other things, the informant said: "This is not something you can implement overnight. It takes years to make that change. It's demanding."

5.4.4 Uncertainty related to timing

Another reason that several of the participants from all companies mentioned may lead to more people finding it difficult to evaluate the effectiveness of safety interventions is that one cannot say with certainty what you are actually measuring the effects of. The participants talked about the fact that safety interventions are constantly being implemented, and that therefore it is not given that one intervention the effect of only one intervention when, for example, going out to an installation to observe the employees working. The measured effect might be the total impact of many interventions and other contributing factors. In connection with this, among other things, the participant from company C said: "You are influenced by so many things. What else is going on in that business at that time? If they are running a downsizing program or there is some quarreling, you can just forget about such things."

In several interviews it was said that because you are aware that it is uncertain whether the effect you are measuring is actually the effect of the safety interventions you are evaluating, you are uncertain at what time it is really right to try to evaluate the effect of different types of safety interventions. Some of the participants mentioned this as uncertainty related to timing. Several of the participants questioned whether it is good enough to evaluate only once, once a safety intervention has been implemented. It was also questioned whether more evaluations should be carried out, in order to have control over the effect that participants think may change along the way. According to the participants, there is no cookbook that says which method is the best, and because of this, most people will choose not to carry out an evaluation.

On the other hand, the participant from the PSA talked about when he or she believes it is appropriate to evaluate the effect of interventions. He/she said the following:

> You should actually measure it and see along the way if you are moving. Is something happening here? Is there a process or change going on here? If you wait until the end, it can be 1.5-2 years ahead, and then you can have spent a whole bunch of resources on something that may prove to move organizations only small steps. One should not just evaluate in the end. It should really come in pretty early and be there all the way, as part of the intervention.

5.5 EVALUATION OF INTERVENTIONS IS NOT A PRIORITY

In addition to evaluation of safety interventions being challenging, it was mentioned in the interviews that another main reason why companies rarely evaluate safety interventions is because such evaluations are not prioritized. As an example, one of the participants from Company B stated the following:

> I think everyone thinks it makes sense to follow up on safety interventions, but I also think that no one can put it high enough on their priority list. When we talk about it, everyone agrees that we have to, but ... No, not difficult, but it requires a lot of effort. At least you have to have a baseline, or you have to have before and after. Rather, that is the challenge.

Like the other main reason why evaluation is not carried out, several potential explanations were mentioned as to why evaluation is not prioritized as of today. These are described as following.

5.5.1 The companies are more concerned about "closing deviations" than controlling the impact of safety interventions

In almost all the interviews, several of the participants claimed that the down-prioritization of evaluation of safety interventions is due to the fact that a culture has emerged where they are more concerned about "closing deviations" than actually controlling whether the safety interventions the companies have implemented have a positive effect on safety. According to the participants, the closure of nonconformities is about closing safety interventions, as previously described is about determining whether a safety intervention is implemented or not. Some of the participants said they were more concerned with implementing the first and best safety interventions, and could show that they were actually implemented, than evaluating

whether the implemented safety interventions were "correct". Participants claim this culture is prominent throughout the sector and that it is a negative or “bad” culture in terms of safety.

Furthermore, several of the participants from the various companies claimed that this culture is the result of strong pressure from the PSA to show that they have implemented safety interventions after PSA’s incident investigations. Several of the participants say they perceive the supervisory authority as strict and demanding. According to the participants, the PSA requires that the companies can demonstrate that safety interventions have been implemented, that it is almost most important that interventions are implemented rather than evaluated as well.

According to the participant from the PSA, it is equally important for them that the companies can document how they plan to evaluate or have evaluated the effect of safety interventions. He / she mentioned several examples in which, in meeting with companies, they have questioned how the companies evaluate the effect of the safety interventions they implement. PSA also have orders (in Norwegian: pålegg) that specifically order the companies to evaluate why earlier interventions potentially did not have effect. Among other things, the participant told about an example where they had a follow-up meeting with a specific company that had been asked to evaluate the safety interventions they had implemented after an investigation of an undesirable event, where, however, representatives from that company had said that they had not been able to evaluate because they were too busy implementing all the safety interventions they wanted.

Further, the participant from the PSA said he/she thinks this issue is about the companies not prioritizing properly and that they might “be better at evaluating safety intervention" if they manage to choose some interventions to evaluate. The participant stated that he/she believes the companies "are too concerned with details and that they must raise their eyesight and focus on the total". Among other things, the informant from the PSA said the following:

> I also think the companies dare not prioritize and say what is important and what is not important. If one had become stricter in prioritizing, one could have followed up those things properly. One could at least prioritize the safety interventions that it is really important that we sit down and evaluate the effect of. Not all safety interventions need to be reviewed and evaluated. It is a bit about how to prioritize the interventions. The safety interventions that you consider to be very important or difficult to implement,

they should be high on a priority list. One should be aware of it right from the start and think "we should at least consider whether we have achieved what we should achieve or not". You have to think a bit like "it's very important, so we should at least get there".

5.5.2 Evaluation of interventions is too resource-demanding

Then it was said that another reason why evaluation is not prioritized is that it is too resource demanding. The participant from company C described the petroleum industry as a hectic industry and said that he / she does not think it has gotten any better after a long and tough period of downsizing. A hectic industry refers to an industry that has a high level of activity where a great number of safety interventions are being implemented all the time, regardless of incident investigations. According to several of the participants from the different companies, a trend could be seen in the past where all companies implemented very many safety interventions. One of the participants from Company A told that they sometimes implemented anything from 20-40 interventions after an investigation. Today, they try not to implement too many safety interventions. They try to prioritize the most important ones, that is, those that have the best possible effect and are feasible. Nevertheless, several of the participants, also from the other companies, mentioned that it still seems that too many interventions are being implemented. And according to several participants, many will think that it is almost impossible to evaluate all these safety interventions, that it is too resource demanding. As an example, one of the participants from company A said that several employees try to evaluate the effect of safety interventions, but almost give up because they experience it as unaffordable with so many different interventions. Because of this, many people «just fly on».

The informant from the PSA also said that he or she has the impression that the companies rarely evaluate the effect of safety interventions because they feel it is too resource intensive. The participant also said that the companies are implementing a lot of safety interventions, and that this may be why you experience it as too resourceful to evaluate them after they have been implemented. At the same time, he / she still believed that this was about company priorities. The participant said:

> So, I really think it is about being aware of the priorities and choices we make. I think that if you had become better at evaluating safety interventions or at least sorting out which interventions are important to evaluate, then you get much better control and control over whether the safety interventions have worked. After all, it makes no sense

> that organizations spend a lot of time and resources on interventions that do not move the organization forward. Or loads of time and resources on safety interventions that just move the organization a bit forward. If you spend a lot of time and effort on it, then the effect should be in keeping with the resources you put into it. If you have to spend huge resources just to move it a step forward, then you might have to spend those resources on other things that could have a better effect on other areas.

5.5.3 When safety interventions are implemented, you “feel done"

Subsequently, several participants mentioned that another reason why evaluation is not prioritized is that they "feel done" when they have implemented safety interventions. Among others, the PSA claimed that the feeling of being finished after the implementation phase causes several people to choose not to prioritize evaluation of interventions. He /she said:

> When the safety intervention is implemented, I think many people feel done with it. We do not take the extra round where we consider “was this what we wanted with the intervention? Has it had an effect? ” I don't think it lies ... Some organizations have been better at implementing systems to follow up on whether the safety intervention have had an effect than others. But I think most people are happy when they can say "yes, we're done".

One of the informants from Company B also said that safety interventions are rarely evaluated because it is not prioritized and that the reason for this is that many feel done after they have implemented a safety intervention. Among other things, the informant said the following:

> Otherwise, I think it is a lot of people thinking that “yes, but we have learned an awful lot of the incident so far, so there must be limits to how much more we need to do. Well, that should be enough.” Perhaps they do not feel that there is so much more to gain. I believe that when you choose not to follow up on the safety interventions, it is a lot of a kind of cost-benefit feeling many have. You do not do calculations, but you may feel that we have done enough. But I think the benefit of following up is higher than maybe many others think.

5.6 EVALUATING COULD BE EASIER IF YOU COULD LOOK AT EXAMPLES FROM OTHERS

In addition to discussing the reasons for not evaluating safety interventions following investigations in the petroleum industry, in most interviews several suggestions were also suggested that informants think could potentially make evaluation of interventions easier. One informant from the consultancy mentioned this with experience sharing, and that the companies could benefit from being better at sharing experiences related to safety interventions and impact measurements. The informant said that it should be possible to see what others are doing, for an example to check the interventions they have implemented. One should be able to check if anyone else has figured out what are the "best" safety interventions with the most impact for different types of events, but this does not exist today.

Furthermore, the same informant mentioned that he / she believes there may be more focus on evaluating safety interventions among the companies if it were to be easier to find suggestions on what are "effective" safety interventions for specific types of events. The informant told me that he / she knows that there are several collaborative forums where the companies share their experiences. At the same time, the informant pointed out that his or her overall impression of the experience sharing is grouped, that there are some selected who have access to different information.

One of the informants from company A also mentioned that evaluation of safety interventions could be easier if you could look at some examples, but stated that this is about finding it difficult to find research that can say something about what is good practice.

In contrast, one of the informants from Company B mentioned that they generally think the companies have a good exchange of experience in terms of experiences related to the effect of various safety interventions. At the same time, the same informant also mentioned that he or she believes that one could become even better at sharing experiences. The informant said:

> Very often the companies focus most on themselves in the actions and maybe share some things, but taking things further and sharing experiences is probably so much to gain. So to learn from others and not just themselves.

The participant from company C also mentioned this with experience sharing. This informant felt that the PSA could be better at sharing information about how they measure how safety in the industry potentially changes from year to year. The informant talked about the PSA presenting a report every year based on reported incidents in the RNNP system. The informant referred to RNNP as "the most important tool we have. It is the largest measurement tool in the industry, for safety work." Furthermore, this participant told by the PSA uses various methods to both collect data and measure how the security state of the industry develops over time. He / she believed that the PSA therefore had valuable experience in evaluating particular effects, and that the companies could benefit from building on their experience.

5.7 CLOSING CRITERIA SHOULD BE SET

In several of the interviews, the informants said that stricter requirements should be set for evaluating the effect of safety interventions. The informants stated that they doubt that there will be more focus on evaluation of interventions before requirements are set. The requirements should contain clear guidelines for when a safety interventions can be completed. The participants called this "closing criteria". According to one of the participants from company B, a closing criteria should say something about: "What is it that you have to be able to check out before you can close the safety intervention?"

One of the informants from company B stated that the reason why closing criteria should be set for when a safety intervention can be closed in Synergy is not only to make it clearer that one must evaluate the effect of interventions after they are implemented, but also to ensure that interventions will not be closed without actually being implemented. Code 2 said as follows:

> For what we call green events, you can write that "this is further processed in SAP", and then you can close the case based on it. For more serious incidents, it is not allowed to close the case until the safety interventions have been transferred to SAP. Then one should wait to close the case in Synergi until it has actually been transferred and implemented in SAP. Because there is a risk that you transfer interventions to SAP and do nothing further anyway, even if you have written it in Synergi. For these more serious incidents, to avoid going into that trap, you have to confirm so-called execution.

According to the informants, several examples can be found in which it has been discovered that safety interventions were closed in Synergi without actually being implemented. The informant from company C said:

> We found one even then, that it was crossed out as completed and transferred to the plan. Afterwards we saw that it was gone because it was prioritized away in the context of other things. It is a bit embarrassing, you might say. Therefore, never remove it prematurely. Then you have no control over whether it was actually done or not.

According to one of the informants from company B, one should set some closing criteria while formulating the safety interventions.

In addition, closing criteria should be set so that an evaluation of safety interventions is actually carried out. According to the participants, an evaluation of safety interventions should involve an evaluation of the effect of the interventions they implemented, as well as how they may or may not succeed in implementing the interventions. Prior to the interview, one of the participants from Company B had gone through their guidelines and procedures for investigation and work on safety interventions. The informant stated that none of the documents he/she had reviewed made clear requirements for evaluating the impact of safety interventions after they were implemented. The informant said: "It says in a way that you can do it if you want to". I gained access to these documents myself, and after a separate review, the following are specified in this company's procedures:

> The "Person in charge" of the incident or of the S&E analysis will follow up on the implementation of the improvement actions, validating their effectiveness if appropriate.
>
> For certain Synergi cases, the senior manager on the installation, in collaboration with the case supervisor, must carry out an overall assessment of the quality of the actions implemented to prevent a recurrence of the event. The documentation of this review must be registered as a separate action in the Synergi case.

Despite this, both one of the consultants from the consulting company and the informant from the PSA stated that it is stated in the regulations of the PSA that the companies must evaluate the effect of safety interventions after they have been implemented.

Chapter Six

Discussion

About this chapter:

In this part of the thesis it is discussed what might be the answer to the three research questions, based on the empirical findings presented in the previous chapter. The findings are compared with previous research from the literature review and analyzed in the light of the theoretical framework. Finally, it is discussed whether the answer to these research questions represent an explanation of the problem.

6 DISCUSSION

Let us bring up the staircase in Figure 2. In discussing what the empirical results mean in light of the theoretical framework, and compared with findings from previous research, I have used this staircase as a structure (See Figure 16).

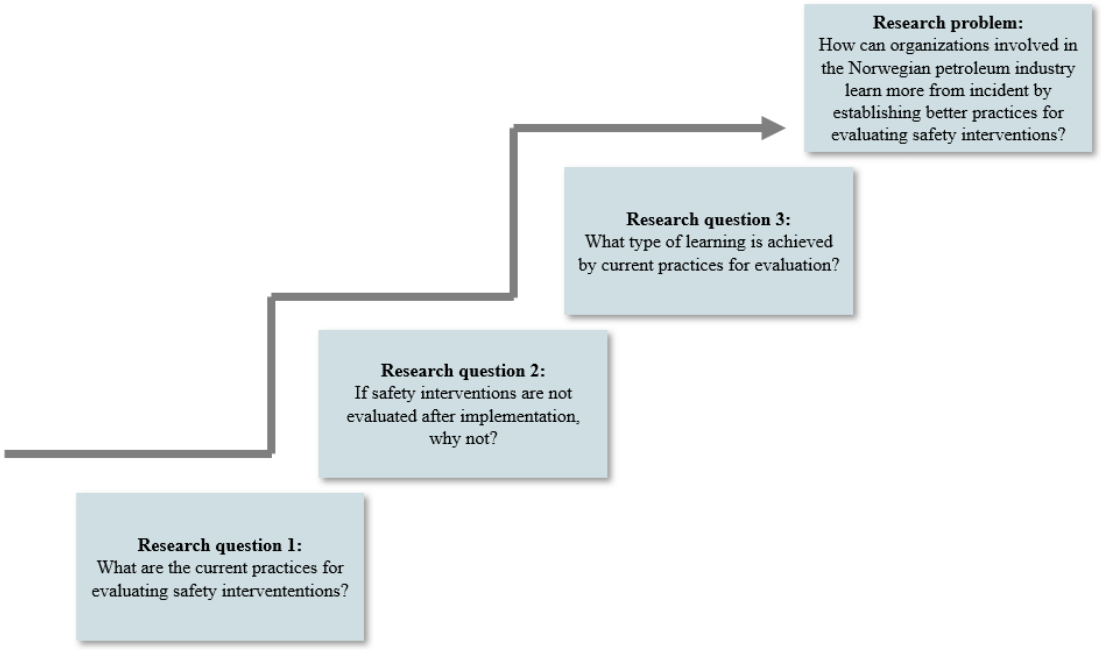


Figure 16: Steps to answer all the questions (same as Figure 1)

6.1 WHAT ARE THE CURRENT PRACTICES FOR EVALUATING SAFETY INTERVENTIONS?

The first step towards achieving an explanation of the research problem was to gain insight in the oil and gas companies' current practices for evaluation. Based on an overall impression, it can be argued that the oil and gas companies involved in the Norwegian petroleum industry have great potential for improvement when it comes to conducting evaluations of safety interventions implemented after incident investigations. Based on the theoretical framework, an evaluation of safety interventions, as the final step in the process of learning from incidents (Drupsteen, Groeneweg and Zwetsloot, 2013), should include an evaluation of both the effect of safety interventions and the process of implementing interventions (Green and South, 2006). The findings in this thesis suggest that there is no well-established current practice for these evaluation types at all. The arguments for this are discussed below.

Several of the participants in this study claimed that most oil and gas companies spend a lot of resources on incident investigations and pay less attention to activities in the intervention phase, which include evaluation of safety interventions. Based on an interpretation of what the participants said, it is believed that there is an uneven distribution of resources on these processes. This is in line with one of the key points from the literature review presented in Chapter 1, that most organizations have tended to focus more on investigations than on the intervention process following an investigation (Rollenhagen et al. 2010; Drupsteen, Groeneweg and Zwetsloot, 2013; Stemn et al. 2018). At the same time, according to some participants, it seems that most oil and gas companies spend a lot of time on both planning and implementing safety interventions. They put together a group of individuals who will try to implement what they expect will be the most effective safety interventions. Typically, the companies will choose to implement the same interventions as recommended in the investigation report. According to several of the participants, even too many safety interventions are sometimes implemented, i.e. an overload, like Hatletveit and Helledal (2018) have observed earlier. Therefore, it is incorrect to claim that the companies do not focus on the intervention process at all.

On the other hand, the companies' practices concerning the evaluation of safety interventions that is referred to as the final step in the Learning from incidents process in the theoretical framework (Drupsteen, Groeneweg, Zwetsloot, 2013) has great potential for improvement. Based on the empirical results presented in chapter five, it can be argued that safety interventions are rarely evaluated after they have been implemented. All the participants I spoke to confirmed this, and according to them this is a pattern that is repeated among the vast majority of companies involved in the Norwegian petroleum industry. It therefore seems that the evaluation phase is *the* part of the whole process of learning from incidents that is given the least attention by all of them.

This is corresponding with one of the findings from the literature review, about that it has previously been observed that several organizations do very little when it comes to particular the evaluation of safety interventions. As an example, Kjellén (2000) has stated that organizations should ideally evaluate the interventions they implement, but that few actually do so in reality.

Nevertheless, it may be noted that some of the participants from one of the companies (B) stated that they have recently initiated an internal project where they will evaluate whether the safety interventions that has a status as "closed" in the Synergi system (meaning implemented), are actually implemented. Based on Almås' (1990) definition of evaluation as any systematic collection of data to analyze an attempt to create change in a given area, this company conducts an evaluation. In addition, this can be said to be a form of process evaluation (Robson et al. 2001; CDC, unknown publish date; Dahl et al. 2017). Despite this, a complete process evaluation based on the theoretical framework should include an assessment of *how* the implementation took place (Green and South, 2006). The result of a process evaluation like this could offer valuable information about why a safety intervention, for example, did not have the desired effect (Baklien, 1987). Thus, the evaluation this company have started doing becomes incomplete because it will only provide the companies with the answer yes / no to whether the intervention was implemented. The important point of this is that although some of the participants in this study indicate that they are trying to evaluate safety interventions, based on the descriptions in the theoretical framework it can be argued that this effort is inadequate (Green and South, 2006).

When it comes to evaluating the impact or effectiveness of safety interventions, it would be reasonable to argue that oil and gas companies are rarely doing anything. In the theoretical framework, this is referred to as summative evaluation, or also outcome evaluation (Robson et al. 2001; Green and South; 2006). Contrary to the section above, which described that several of the participants express that they are trying to evaluate whether the interventions are being implemented or not, it almost seemed that the companies today are not even trying to evaluate possible effects of the interventions they are implementing. This is due to many different reasons, among other things that they find this extremely difficult, which will be elaborated in section 6.2.

In Chapter Three, it was referred to among others Green and South (2006) who has claimed they has seen a trend were many think of evaluation of safety interventions as only the assessment of whether specific goals have been achieved or not, and that this is a problem because then one will only find what one is looking for, not potential unintended effects. The empiricism in this thesis indicates this is not a relevant problem within the Norwegian petroleum industry, because rarely any evaluation is carried out.

Nevertheless, the participants in this study mentioned some examples of successful impact evaluations. For example, one of the participants from company A mentioned that they were able to measure the effect of many different safety interventions they implemented to reduce the risk of ships on collision course towards one of their platforms. They managed to reduce the number of ships on collision course from 150 to two ships a year. Still, examples like this only represent a few individual cases that disappear a bit if we look at the entirety of the evaluations being done, i.e. the big picture. Based on these findings, the PDSA model presented in Chapter Three can be modified as in Figure 17.

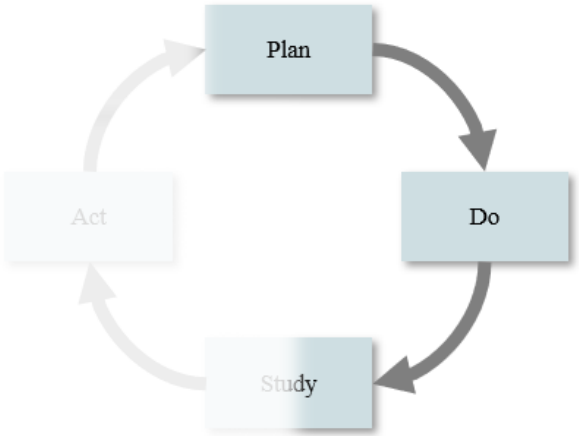


Figure 17: A modified PDSA-cycle indicating oil and gas companies' practices for evaluating safety interventions

This modified version of the PDSA cycle Deming (1993) is intended to illustrate current practices for evaluating safety interventions within the Norwegian Petroleum industry. Because the participants in this study claimed that they are trying to evaluate the interventions they implement, but that this is not complete because they do not evaluate how the process of implementing the interventions functioned or the effect the interventions had, the "study" phase in this supposed-to-be cycle is only halfway finished. Furthermore, it can be argued that because the companies rarely evaluate the safety interventions that are implemented, the companies will also rarely experience a need to correct any interventions (act). In other words, the first two phases are completed, but not the last two phases of this process. It can therefore be argued that the steering wheel does not close (Jacobsson, Ek and Akselsson, 2011), and that no wheels are rolling forward towards continual improvement (Meidell, 2005).

One of the participants in this study, the senior researcher, claimed that few oil and gas companies have established any formal practices or routines for evaluating interventions. Based on an overall impression of the other empirical results of the data collection, it certainly seems that the researcher's impression of the industry represents a correct picture of reality. It does not seem like there is any current, common practice for what theorists say is a proper evaluation of safety interventions (e.g. Drupsteen, Groeneweg and Zwetsloot, 2013; Parker et al. 2018; Green and South, 2006). The examples cited by some of the participants do not appear to be the result of formalized evaluation procedures. Based on this, it can be argued that the findings from this thesis suggest that the petroleum industry does not carry out the final phase of the Learning from incidents process, which corresponds to the findings in the research of Drupsteen, Groeneweg and Zwetsloot (2013), that most organizations do little or nothing in the evaluation phase of the intervention process . This is illustrated in Figure 18.

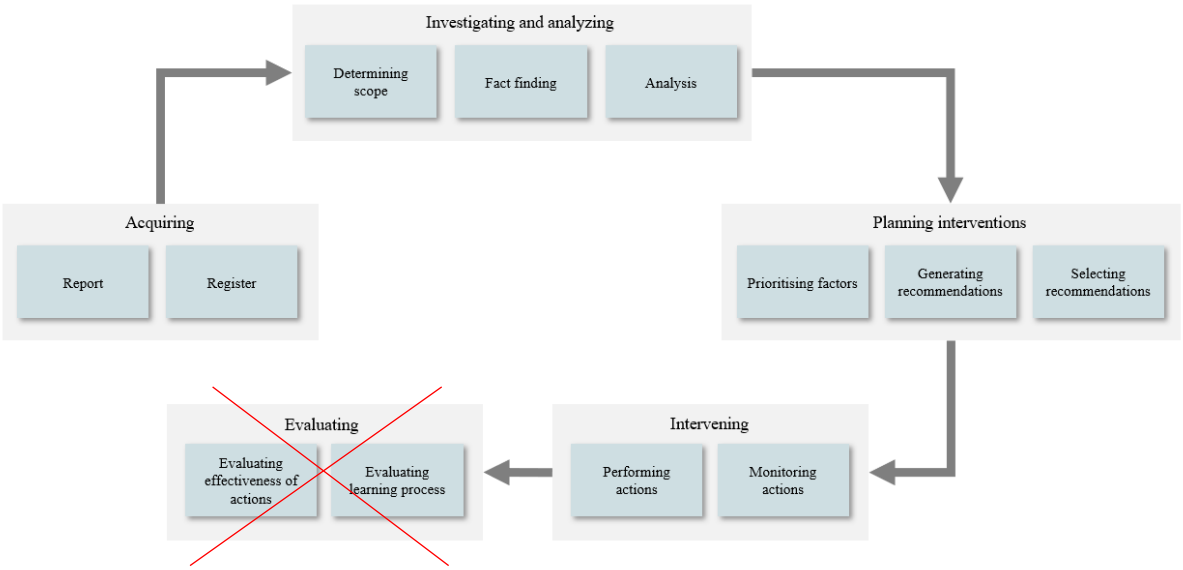


Figure 18: A modified LFI-process indicating oil and gas companies' practices for evaluating safety interventions (Modified from Parker et al. 2018)

Finally, in this section, it can be pointed out that the empirical results in Chapter Five revealed that the problem related to evaluation of safety interventions is a problem also regardless of whether there has been conducted an incident investigation. As one of the participants from the consultant company stated, it seems that interventions are generally not evaluated after implementation. It is a general, widespread problem.

6.2 IF INTERVENTIONS ARE NOT EVALUATED AFTER IMPLEMENTATION, WHY NOT?

As summarized in the previous section, most oil and gas companies involved in the Norwegian petroleum industry rarely evaluate the safety interventions they implement. To summarize the following discussion, it can be argued that there are many different factors that influence the organizations' practice of evaluation. The findings from previous research by Drupsteen, Groeneweg and Zwetsloot (2013), Tinmannsvik and Øien (2010), DNV GL and NOROG (unknown publish date) and Hatletveit and Helledal (2018) that indicate that the evaluation phase holds many bottlenecks for organizational learning, applies to the oil and gas companies. Based on the empiricism in this thesis, it can be argued that it appears to be the combination of different factors that causes safety interventions to be rarely evaluated. The participants all highlighted several factors that hinders evaluation of safety interventions. This is in line with the findings from the research of Drupsteen, Groeneweg and Zwetsloot (2013) that there are many bottlenecks concerning the evaluation phase. At the same time, it can be argued that some important bottlenecks that hinder evaluation occur during the planning phase. This is elaborated in the following.

6.2.1 Evaluation is perceived as important, but not prioritized

First and foremost, all participants in this study claimed evaluation is important. Several mentioned what they called an ideal intervention process, which includes an evaluation of the safety interventions being implemented. Almost all participants argue that it is important to evaluate safety interventions because it contributes to more learning. They also state that they believe an evaluation should include an assessment of both the process of implementing a safety intervention and the effect of the intervention. Despite this, it was argued that current practices for evaluating differ from this ideal. According to the participants, a typical intervention process at most oil and gas companies normally does not involve an evaluation, and it seems that they think this is unfortunate. In other words, the participants know that evaluation is important, but still do not evaluate safety interventions.

Nevertheless, Chapter 5 also revealed that several argued that evaluation is often prioritized in favor of other activities. One of the reasons for this could have been that evaluation is not considered as important as everything else. However, this does not seem to be the reality.

Instead, it seems that the down-prioritization of evaluation is due to somewhat demotivated employees who do not understand how they are supposed to evaluate all the safety interventions that is implemented in an otherwise busy work day where they also have other tasks than checking to see if they actually achieved what they wanted by implementing some specific interventions. According to the participants in this study, when the employees feel that they must prioritize between different tasks, they will usually choose not to evaluate because they feel the process is complete when they have implemented a safety intervention. As one of the participants stated, they “feel done”.

In the literature review, it was argued that one reason organizations do not evaluate safety interventions may be that they believe it is "just" investigations of incidents that is a prerequisite for achieving organizational learning, i.e. acquiring new knowledge. That, in a way, no systematic follow-up is required as some researchers claim. Based on the empirical results in this thesis, this does not seem to accurate in this case. Participants gave the impression that employees in most oil and gas companies know organizational learning and continuous improvement require follow-up of the results of the investigation. Among other things, as mentioned earlier, they spend a lot of time planning and implementing safety interventions. These are activities that are part of the important follow-up process after investigations (e.g. Tinmannsvik in PSA, 2019). According to participants, evaluation is also an important part of this process, but this is not prioritized because participants say employees often feel that they do not have time to evaluate.

Related to this, participants stated that over time, a common practice has been established across most companies in the Norwegian petroleum industry where employees experience pressure from the PSA to document that they have implemented x number of safety interventions. To achieve this, employees choose not to focus on evaluation. In addition, most participants argue that the PSA does not seem to be interested in companies also documenting how they try to evaluate the impact of interventions, which requires a lot of time. However, the participant from the PSA stated that they are certainly also interested in the companies being able to explain to them how they are going to evaluate the safety interventions they are implementing. In addition, it is stated in the legally binding regulations that interventions must be evaluated (see Chapter Two). Therefore, it seems that there is a unified idea across the companies that evaluation does not have to be prioritized, even though both the companies and the authorities think of evaluation as equally important as everything else. Based on the definition of organizational

culture and safety culture (Bang, 1995; Schein 1998; Reason, 1997), it may seem that a "bad" safety culture has emerged. It has become an unwritten norm and shared belief across the oil and gas companies that evaluation does not have to be prioritized. This is at the expense of safety, because in an evaluation, it could have been concluded that implemented safety interventions did not lead to improved safety and that additional corrections had to be implemented to prevent new incidents from happening (Baklien, 1987; Robson et al. 2001; Green and South, 2006; Drupsteen, Groeneweg and Zwetsloot, 2013).

This "bad" culture is also referred to in the literature review, where previous research has observed that organizations are more concerned with closing deviations from government investigations than checking whether they have had the desired effect or unintended side effects that may need to be corrected (IRIS, year; Tinmannsvik and Øien, 2010). Theories from previous research therefore match my empirical findings.

6.2.2 Evaluation is challenging to conduct in real-life

Another reason why evaluation is rarely carried out is that evaluation of safety interventions is perceived as generally challenging, with participants suggesting that the most challenging is to evaluate the effect of safety interventions. One of the reasons for this is, according to the informants, that they are uncertain about which methods they can use to evaluate particular effects. At the same time, as mentioned in Chapter Five, several of the participants mentioned several approaches that, based on the theoretical framework, are in fact typical methods for evaluating safety interventions (Robson et al. 2001; CDC, unknown publish date; Dahl, 2017). One explanation for this may be that participants need confirmation that these are methods suitable for an evaluation of safety interventions. Uncertainty as to which methods are suitable for evaluating interventions and, more specifically, evaluating the effect of safety interventions, as far as I am aware, is not something that has been emphasized in previous research. Therefore, this can be understood as a new discovery.

Another explanation that the participants consider to be difficult to evaluate in practice is a lack of information on the purpose of the various safety interventions being implemented, what their objectives are and a description of the pre-condition that led to the implementation of the interventions. In addition, some of the participants expressed that the person who is supposed to evaluate the effect of interventions lacks information about the target group for each

intervention. They lack information that several of the participants say is being reviewed during the planning phase. A possible explanation for this may therefore be that the planning work being carried out is not well documented. Another possible explanation for this may be that during the planning phase it is not thought that this is important information for the person to evaluate the safety intervention afterwards. Without this information, participants claim that it is virtually impossible to conduct an evaluation. This problem was also explained in the theoretical framework. Here, good information on these conditions is claimed to be a criterion for successfully evaluating all safety interventions (Green and South, 2006; Jacobsson, Ek and Akselsson, 2011; DSB, 2016).

6.2.3 The Synergi information system

According to the participants in this study, the information that the participants have available for evaluation is the registered descriptions in the Synergi database. Based on an overall impression of the empirical results in chapter five, it seems that this database contains limited information because one often does not focus on elaborating on different matters. According to some of the participants, it is not mandatory to fill in all the subject fields in the electronic synergy form, which often results in the failure to describe each safety intervention more than is absolutely necessary. At the same time, some of the participants mentioned that during the planning phase they try to elaborate on each individual intervention. Nevertheless, according to some participants, this information will be difficult to use for anything, because the language often can be difficult to understand. The theoretical framework outlined several criteria for a security information system (SIS) such as Synergy (Aven et al. 2004). In order for the system to function as a good tool for, among other things, evaluation, all these criteria must be met, but based on the empirical results in Chapter Five, it seems that the criterion of relevance, availability and understanding is not met. Thus, Synergy as today does not function as an optimal and effective tool for evaluation.

This has also been observed previously, by among others Jacobsson, Ek and Akselsson (2011). They have as mentioned in the literature review seen that many information system/databases that different organizations use for recording information about an incident and safety intervention are not optimal for this purpose. This theory therefore matches the empiricism in this master's thesis.

Furthermore, it can be added that based on the empiricism in chapter five it also seems that it has not only emerged an "bad" organizational culture related to closing deviations, but also the use of the Synergy system. Over time, a common belief has emerged about what kind of information is needed to fill in Synergi (Schein; 1998; Reason;1997). Subject fields that are not mandatory in the Synergy scheme/form (see section 5.1.1) are rarely filled out. However, the few times these subject fields are filled in, this information is incomplete. It can be argued that this is also a negative safety culture.

In addition, several of the informants mentioned that Synergi has not prepared an evaluation of safety interventions after they have been implemented. By this, the participants felt that the electronic form that is filled in this system does not contain subject areas where you can write something about the evaluation you plan to conduct or have completed. Based on these statements, it can be argued that Synergy is not a suitable system for following up safety interventions, which was also mentioned in the literature review. One of the key points from this literature review was that the systems or databases that organizations use are often inappropriate (Kjellén, 2000; Jacobsson, Ek and Akselsson, 2011). On the other hand, one of the participants in this study mentioned that an evaluation is actually planned. The electronic form this participant showed me contained two subject areas at the bottom of the electronic form, where you could check whether the safety intervention had an effect and describe in free text what kind of effect it had, as well as how to measure it. On the basis of this statement, it is incorrect to claim that the Synergy system does not function as a tool for monitoring and including evaluation of interventions.

6.2.4 Sharing information

Another factor that, based on the literature review, can explain why organizations do not follow up on the safety interventions they implement is that they think of learning as a product of information sharing. Based on such a perspective, one would argue that organizational learning is achieved by investigating an incident and sharing the investigation report among all organizational members. On the other hand, based on the empirical results, it does not appear that this is one of the reasons why an oil and gas company involved in the Norwegian petroleum industry rarely follows up the interventions in the form of evaluation. The participants in this study seem to indicate that most oil and gas companies have realized the importance of also planning and implementing safety interventions, that organizational learning requires follow-

up in the form of an action process. Therefore, it can be argued that this study debunks this potential explanation of the problem this master's thesis addresses.

But, also related to sharing information, the participants in this study reported that one reason why evaluation may be perceived as challenging to perform is little exchange of experience between the companies and authorities concerning how to evaluate safety interventions. This corresponds with one of the key points highlighted in the literature review, that one has previously observed that there is little sharing of information across organizations (Tinmannsvik and Øien, 2010; Kletz, 2002). The oil and gas companies in this study have reported that they think evaluation would be easier if they could look at examples from others.

6.3 WHAT TYPE OF LEARNING IS ACHIEVED BY CURRENT PRACTICES FOR EVALUATION?

As Hovden, Sklet and Tinmannsvik (2004) argue, organizations conduct investigations because they hope to learn something from these. At the same time, several point out that it is not enough to conduct an investigation to learn something from undesirable incidents (e.g. Tharaldsen, 2013; Chevreau, Wybo and Cauchoi, 2006; Kirkpatric; 2007). Organizational learning requires systematic follow-up in the organization (Jacobsson, Ek and Akselsson, 2011; Drupsteen, Groeneweg and Zwetsloot, 2013; Parker et al. 2018). One of the follow-up activities that should be carried out is evaluation, but based on the empirical results in this study, it can be argued that the oil and gas companies do not work very systematically in the follow-up of investigations and safety interventions. Does this mean that they learn nothing from the experiences of the unwanted events they experience? To assess what kind of learning the oil and gas companies are achieving through current evaluation practices, I would like to use the theoretical perspectives on organizational learning and learning following events presented in Chapter 3.

Based on the theory that investigations in themselves will lead to learning after events, it can be argued, based on the empirical results, that oil and gas companies learn much from their experiences. As mentioned earlier, several of the participants in this study claim that all oil and gas companies spend a lot of time investigating incidents.

On the other hand, assuming that learning is a result of both acquiring new knowledge *and* using it, it does not hold to just conducting investigations. With such a perspective on learning, oil and gas companies will not learn anything just by conducting investigations. Based on this perspective, organizational learning requires, among other things, that safety interventions are implemented. This is about bringing new knowledge from events and their examination to life, and according to Drupsteen, Groeneweg and Zwetsloot (2013) can be understood as a form of "learning by doing". Since the participants in this study claim that most oil and gas companies often implement many interventions after investigations, it can be argued that the companies carry out a form of learning by doing.

The purpose of the safety interventions that the companies implement seems based on an overall impression to be a desire to correct findings uncovered in an investigation and prevent the same or similar incident from happening again. It is mentioned everything from changing technical equipment to adjusting work procedures. The companies manage to transform new knowledge in the form of experience into specific safety interventions that are intended to prevent new events. This is an essential part of the concept of learning after events (e.g. Stemn et al. 2018; Jacobsson, Ek and Akselsson., 2011) According to Argyris and Schön (1996), this is achieved by this single and double loop learning, or also what the theoretical framework describes as the first and second order learning.

According to Argyris and Schön (1996), these forms of learning are important learning that all organizations should strive for. At the same time, this is understood as a very elementary or simple form of organizational learning (Freitag and Hale (1997). In order to achieve a higher level of learning, i.e. more learning than single- and double-loop learning, the organization must reflect on the process of learning after events and whether they achieve enough learning by current practices. According to Drupsteen, Groeneweg and Zwesloot (2013), this can only be achieved by evaluating the safety interventions implemented. In other words, it is not enough to just implement interventions to achieve a high degree of learning. The safety interventions you implement must also be evaluated.

Evaluation is about ensuring that new knowledge from undesirable events and their examination are preserved in the organizational memory. It is about verifying that the safety interventions implemented actually led to a change in behavior and the presence of safety (e.g. Robson et al. 2001; Baklien, 1987; SSM, 2010; Hollnagel; 2014; Green and South, 2006). Evaluation thus

contributes to the organizations achieving a more controlled form of learning. Based on the fact that this study revealed that oil and gas companies rarely evaluate interventions, the companies will not achieve a high degree of learning. The participants in this study describe an industry where one rarely systematically checks whether one has actually learned anything, i.e. whether the employees have changed behavior as a result of, for example, a changed work procedure.

According to Drupsteen, Groeneweg and Zwetsloot (2013), optimal learning outcomes after adverse events require organizations to complete the entire process illustrated by the Learning from Incidents model (see Figure 7 in section 3.3.3). If one or more of the steps in this process are not completed or are defective, the learning potential will be lost. Based on the empirical results of the data collection in this study, the final step of this process is not completed. As mentioned above, participants in this study argue that safety interventions are rarely evaluated after they are implemented and, as is evident from the discussion in Section 6.1, neither the type of effect interventions have been evaluated nor how the process of implementing the safety interventions was carried out. It is not evaluated whether one has achieved the objectives of the interventions the companies are implementing, but it can be referred to individual cases where one checks whether safety interventions were implemented or not. Whether interventions were implemented or not, based on the descriptions in the theoretical framework, does not say whether the safety interventions have actually led to a change. The current practice for evaluating safety interventions among oil and gas companies in the Norwegian petroleum industry therefore does not involve an evaluation or verification of whether any of the events the companies have experienced have actually learned. So, it seems that most oil and gas companies do not close the steering wheel (PDSA) which could lead to continuous improvement (e.g. Drupsteen, Groeneweg and Zwetsloot, 2013; Parker et al. 2018).

I would like to point out that several of the participants emphasize the importance of evaluating, while it is clear that the participants claim that most do not prioritize evaluation as much as they should. Based on an overall impression, it generally seems that the reason why evaluation is rarely carried out is because evaluation is perceived as challenging. Therefore, it can be argued that this corresponds to the findings of the literature review, that most organizations try to learn from desired events, but still fail to do so.

As mentioned initially in this paper, it has been an objective to test whether the observations of Dutch organizations' inadequate follow-up of investigations would also apply to oil and gas

companies in the Norwegian petroleum industry (Drupsteen et al. 2015). Based on the discussion so far, a graph similar to the one Drupsteen, Groeneweg and Zwetsloot (2013) presented in their research can be drawn (see Table 1, Chapter 1). Current evaluation practices help ensure that the learning that comes with undesirable events and their examination is not utilized to its full potential. At the same time, it may be added that the participants in this study suggest that more effort is put into planning and implementing safety interventions than the Dutch organizations studied by Drupsteen and her colleagues normally did. The learning curve in the graph that could have been drawn based on the findings from this thesis would therefore not have been as steep as the graph presented by these researchers.

In summary, it can be argued that the oil and gas companies involved in the Norwegian petroleum industry do not achieve optimal learning outcomes after experiencing an undesirable event that has been investigated. Failure to evaluate is a barrier to organizational learning, which match the LFI barrier model presented by Smith and Roles (2015). Further, this is in line with the findings from the literature review, where the first key point is that several organizations miss valuable learning after events. It is not the case that companies do not learn anything, but that they achieve only a very low level of learning. Based on this, it can certainly be argued that organizations in this industry have learning difficulties.

6.4 HOW CAN BETTER PRACTICES FOR EVALUATING SAFETY INTERVENTIONS CONTRIBUTE TO MORE LEARNING?

At this point, the discussion has resulted in it being argued that most oil and gas companies involved in the Norwegian petroleum industry rarely evaluate the safety interventions they implement after investigations, and that this is due to a combination of many different factors that represent areas for improvement. Thus, it can be said that they have great potential for improvement regarding evaluation of safety interventions. In addition, it can be argued that the current "non-present" evaluation practices lead to the loss of learning potential that comes with undesirable events such as incidents. It can be argued that the oil and gas companies achieve organizational learning, but that this is only a very elementary form of learning after incidents.

Failure to evaluate the impact of intervention based on the discussion in this master's thesis cannot be said to hinder organizations such as oil and gas companies learning from anything

from their experiences from incidents. The prerequisites for organizational learning are, as mentioned in the literature chapter, that the organizational members must acquire new knowledge, share it with the rest of the organization and putting it to life through safety interventions (e.g. Jacobsen and Thorsvik, 2007). If these prerequisites are met, it can theoretically be said that learning will take place. Therefore, organizational learning will happen regardless of whether or not one evaluates. Nevertheless, evaluation is important with regard to learning in organizations because, as mentioned in the theoretical framework, it serves as the only operational opportunity to check whether the safety interventions implemented have actually led to a change in practice or not (Drupsteen, Groeneweg and Zwetsloot, 2013). Evaluation can be understood as being about checking that you actually learn something (change in behavior). In a way, it can be said that evaluation contributes to a better understanding of what companies are actually doing in the big picture. If the evaluation reveals that the safety interventions did not lead to a change, one will have the opportunity to implement new interventions that can correct this outcome. These post-evaluation corrective interventions can lead to even more learning. Thus, it may be assumed that evaluation of interventions will help organizations towards more learning than they would have achieved without evaluating (e.g. Parker et al. 2018).

First, better practice of evaluation involves more formalized procedures for when one should conduct an evaluation and what this entails. As the individuals do not feel a responsibility to evaluate, a reasonable explanation may be that there are not clear enough expectations for evaluation. As several of the participants claim, so-called closing criteria should be established for closing specific actions and a case in Synergi. This is despite the fact that it is written in the legally binding regulations that an evaluation is to be carried out. This new formalized routine may not be a written routine, but it must be a unified routine, that is, everyone must agree on how to do this. Some of the participants claimed that because their internal business procedures only contain descriptions that indicate that one *can* conduct an evaluation if one wishes, safety interventions are rarely evaluated. Based on this, it can be argued that companies should set clearer, written requirements for what an evaluation is and what it means to carry out a good enough evaluation, as well as who has the responsibility to conduct this.

Second, better practice for evaluation involves better use of the Synergy information system. As previously mentioned, participants claim that it may be pointed to a trend where there is no focus on providing enough descriptions in Synergi, and that the language in this database may

be difficult to understand. This makes it difficult to evaluate, because information about the purpose of safety interventions, goals and target groups is crucial information in order to carry out an evaluation. The companies should therefore initiate a process where they set clearer expectations for the information in this system. This may lead to all the criteria for a well-functioning SIS, as described in the theoretical framework, being met (Aven et al. 2004).

Third, better practice for evaluation also involves better use of Synergy in using the opportunities to describe the impact of safety interventions and how to measure this. As one of the participants in this study stated, it is very rare that these subject fields in the electronic form are filled out by the employees of the company. One reason may be that employees do not know the entire system well enough and based on this it may be a good idea if the companies carry out more training of Synergi employees. Another reason may be that the other companies do not have this available in their version of the system. It can be an add-on module not everyone has. If this is the case, the companies involved should provide access to this and encourage their employees to use this tool.

But in order to establish a better practice for evaluating safety interventions, some other very basic conditions must be fixed. A basic factor that needs to be addressed is planning for evaluation. Based on the empirical results in this study, it seems that the companies do not plan to evaluate safety interventions after implementation. Based on the participants' statements, this may cause some employees to think they must not conduct an evaluation. Therefore, companies should also set a plan for when to evaluate and how to do this when the time comes. In relation to this, the companies must ensure that the planning work is well documented in Synergi. Based on the statements of the participants in this study, it seems that the individuals who are going to evaluate safety interventions lack essential information to be able to do this, information that according to the participants is reviewed in the planning a planning phase.

The result of better practice for evaluating interventions, which means that the above points are adhered to, will provide a higher degree of learning (e.g. Drupsteen, Groeneweg and Zwetsloot, 2013; Argaryis and Schön, 1996). Evaluating interventions will assumingly lead to the companies have much greater control of safety interventions and actual learning. Systematic evaluation of specific safety interventions provides a basis for assessing the effects of implemented interventions in terms of defined goals and needs (e.g. Kirkpatrick, 2007; Green and South, 2006). Without a systematic follow-up you risk strengthening weaknesses and

missing important opportunities for improvement. Based on this, better practices for evaluating safety interventions will lead to more learning in the form of a higher degree of organizational learning and more focused, tailored and adapted learning. This means evaluation can be a useful and effective tool for learning more from incidents.

Chapter Seven

Conclusion

About this chapter:

This chapter presents a conclusion on the problem and the research questions presented in the introductory chapter. It is the result of a comparison of the empirical results presented in Chapter Five and theoretical contributions from both the literature review in Chapter One and the theoretical framework presented in Chapter Three, as well as discussion of these findings.

7 CONCLUSION

Based on the discussion in Chapter Six, it can be argued that most oil and gas companies involved in the Norwegian petroleum industry rarely evaluate safety interventions they have implemented after incident investigations. It is a repeated pattern across all organizations withing this industry. The few examples of a successful evaluation that the participants in this study mentioned do not appear to be the result of an established, common practice or formalized routine for evaluation, and these disappear when you look at the overall picture. Therefore, the oil and gas companies have a great potential for improvement.

A noteworthy finding has been that the participants in this study have claimed they rarely evaluate any implemented safety interventions. They claimed this is a typical problem that applies not only after incident investigations, but in general.

Regarding reasons why safety interventions are rarely evaluated, findings from this master's thesis suggest that the companies believe it is important to evaluate, but that this is challenging to perform in real life and simply not prioritized. Further, compared with findings from previous research, the empiricism has showed that there are multiple factors contributing to this.

Failure to evaluate safety interventions results in companies not achieving optimal learning outcomes, which according to the theoretical framework is described as deutero learning and third-order learning. By current, almost non-present practices for evaluation, companies achieve a very basic form and low degree of organizational learning. Thus, oil and gas companies involved in the Norwegian petroleum industry do not learn as much as they could have done by better practices for evaluation of safety interventions. Further, this may indicate that they are not continuously improving.

To achieve more learning, according to well-known theories about how organizations successfully learn from experience from unwanted events like incidents, all steps in the LFI process must be completed (Drupsteen, Groeneweg and Zwetsloot, 2013; Parker et al. 2018). It is wrong to claim that companies do not achieve any learning at all, because they put a great deal of effort into both planning and implementing safety interventions, but the companies can achieve more tailored, adapted and higher degree of organizational learning by better practices for evaluation. According to the theoretical framework, a better evaluation involves both a

process evaluation and summative (effectiveness) evaluation. The results of combining these evaluation types will tell the companies if what they are doing is actually working and to what extent implemented interventions are contributing to preventing new incidents from happening. This is an important input to the organizations' safety management.

As mentioned in the introduction chapter, the background for this master's thesis was to test whether observations in selected previous research that organizations miss valuable learning by failing to conduct an evaluation of safety interventions implemented after incident investigations also would apply to organizations involved in the Norwegian petroleum industry. Based on the discussion in chapter six, this master's thesis indicates that Drupsteen, Groeneweg and Zwetsloot's (2013) observations of Dutch organizations flawed practices for evaluation of safety interventions matches current practices in oil and gas companies involved in this study.

7.1 PRACTICAL IMPLICATIONS: RECOMMENDATIONS

In order to stimulate better practice, which was one of my main goals for this task, I also wanted to clarify some important areas of improvement. Some practical implications. First of all, better practice for evaluating safety interventions involves as already stated, an evaluation of both the effect of safety interventions and the implementation process.

Secondly, a better practice also involves more systematic and structured usage of the information system Synergy. Based on the discussion in the previous chapter, the findings in this thesis showed that the Synergy system/database may be used for evaluation of safety interventions, but that this is normally not done. Several factors are hindering this, but without going into all types of details, one possible solution may be that the companies should make sure the system contains detailed descriptions of the objectives of the interventions, the reasons why they were implemented, who was the target group and potential indicators of achieved goals. This information must be available at all time, when needed (Aven et al. 2004). Lack of information about this is something the participants in this study have claimed often makes it challenging to evaluate especially the effectiveness of safety interventions. Another possible solution may be to make in mandatory to describe something about an evaluation of implemented safety interventions in Synergi. As the participants in this study said, evaluation being perceived as only an option if one has the time and motivation to so is often a reason to why employees do not prioritize evaluation. If evaluation is in fact an add-on module that not

all companies have, these companies should make sure they get this. Related to this, the companies should then make sure their employees get proper training in how to use this function, and what is expected of them when they are supposed to fill in these subject fields.

In order to achieve a better practice for evaluating safety interventions after investigations, oil and gas companies should also try to *plan* to carry out an evaluation when they plan what safety interventions to implement. If one has a plan that says you *must* evaluate safety interventions, it is harder not to prioritize this. Here, it is important that one say an evaluation should be the combination of both a summative evaluation and process evaluation.

In addition, the companies should also reformulate the wording in their governing procedures. It should be written that the employees *must* evaluate. Evaluation should not be optional as it is today, because then, as this study has shown, one will most often choose not to focus on evaluation.

7.2 CALL FOR FURTHER RESEARCH

An important task in all research is to clarify which points should be highlighted in the further research. First, it can be encouraged to further explore whether the findings from this thesis also apply to more oil and gas companies than the three examined in this thesis. Among other things, further research should use quantitative methods for data collection to count how many oil and gas companies that eventually do not evaluate implemented safety interventions. Second, as stated in this study, the empirical results of this study suggest that failure to evaluate safety interventions also applies to follow-up of interventions in general. This should be further explored. Third, it would be interesting to compare the Synergi systems across other companies, to check whether the system is the same and if there are different practices concerning the registration of information in this information system. Finally, further research should take a closer look at whether inability to effectively utilize learning outcomes means that organizations are not learning organizations (Senge, 1991).

REFERENCES

Aase, T. H., & Fossåskaret, E. (2007). *Skapte virkeligheter: kvalitativt orientert metode*. Oslo, Universitetsforlaget.

Albrechtsen, E. & Hovden, J. (2013). *Godt sikkerhetsarbeid i bedrifter*. NTNU, Institutt for industriell økonomi og teknologiledelse.

Andersen, S. (2006). Aktiv informantintervjuing. In *Norsk statsvitenskapelig tidsskrift* 03/2006, Vol. 22.

Andersen, J. A. & Abrahamsson, B. (1996). *Organisasjon: om å beskrive og forstå organisasjoner*. Oslo: Cappelen akademisk forlag

Argyris, C. & Schön, D. A. (1996): Organizational learning II, theory, method and practice. Reading, Massachusetts: Addison-Wesley Publishing company

Argyris, C. (1993). *Knowledge for action*. San Francisco: Jossy Boss.

Aven, T., Sandve, K., Olsen, K. H., Boyesen, M. and Njå, O. (2004). *Samfunnssikkerhet*. Oslo, Universitetsforlaget.

Bang, H. (2013). Organisasjonskultur: en begrepsavklaring. Tidsskrift for Norsk Psykologiforening. Obtained from: https://psykologtidsskriftet.no/fagartikkel/2013/04/organisasjonskultur-en-begrepsavklaring

Baklien, B. (1987). Evaluering i praksis. I norsk pedagogisk tidsskrift.

Blaikie, N. (2010). Designing Social Research. 2nd edition, Polity Press

Bryman, A. (2012). *Social research methods*: Oxford university press.

Bukve, O. (2016). *Forstå, forklare og forandre. Om design av samfunnsvitenskapelige forskningsprosjekt*. Universitetsforlaget.

Cedergren, A. (2013). Implementing recommendations from accident investigations: a case study of inter-organisational challenges.

Chevreau, F. R.; Wybo, J. L. & Cauchois, D. (2006). Organizing learning processes on risk by using the bow-tie representation. In Journal of Hazardous Materials.

Cristou, M. & Konstantinidou, M. (2012). Safety of offshore oil and gas operations: Lessons from past accident analysis. Ensuring EU hydracarbon supply through better control of major hazards. *JRC scientific and policy reports*, European Commission.

Crossan, M. M., Lane, H. W. & White, R. E. (2008). An organizational learning framework: From intuition to institution. *The Academy of Management Review*, Vol. 24.

Dahl, Ø., Kilskar, S.S., Aarlott, M.M. & Midthun, K. (2017). *Measures against hydrocarbon leaks: taxonomy, effect and costs*. SINTEF report A28119, Trondheim.

Dalane, S. (2015). *Styring av storulykkerisiko og rettighetshavers påseplikt. En dokumentanalyse og single case studie med utgangspunkt i retningslinjen "Major accident risk process in licenses*. Master's thesis, University of Stavanger.

Dalen, M. (2011). *Intervju som forskningsmetode: en kvalitativ tilnærming* 2nd Edition. Oslo: Universitetsforlaget.

Danermark, e. a. (1997). Generalisering, vetenskapeliga slutledningar och modeller for forklarande samhallsvetenskap. *Att forklara samhallet* (pp. 50). Lund: Studentlitteratur.

Deming, W. E. (1982). Out of the Crisis; Quality, Productivity and Competitive Position, Cambridge University Press, Cambridge, M.

DNV GL AS (2015). *Analyser av antatte konsekvenser, kostnader og nyttegevinster av HMS-krav og -tiltak i petroleumsvirksomheten*.

DNV GL & NOROG (unknown publish year*). Opportunity. Energy Management and Efficiency on the Norwegian Continental Shelf*. Obtained From: https://energiledelse.norskoljeoggass.no/en/Energiledelse/Utf%C3%B8re/Measure

Drupsteen, L., Groeneweg, J. & Zwetsloot, G.I.J.M. (2013). *Critical Steps in Learning From Incidents: Using Learning Potential in the Process From Reporting an Incident to Accident Prevention*. International Journal of Occupational Safety and Ergonomics (JOSE) 2013, Vol. 19, No. 1, 63–77.

Drupsteen-Sint, L. (2014*). Improving organizational safety through better learning from incidents and accidents*. PhD Thesis. Centre for Industrial Production, Aalborg University.

Dysvik, A. (2008). Trenings- og utviklingstiltak. I B. Kuvaas, Lønnsomhet gjennom menneskelige ressurser. Evidensbasert HRM (ss. 139-176). Bergen: Fagbokforlaget.

Engen, O.A.H., Kruke, B.I., Lindøe, P.H., Olsen, K.H., Olsen, O.E. & Pettersen, K.A. . XVII (2016). Perspektiver på Samfunnssikkerhet. Cappelen Damm Akademisk, Oslo.

Eriksson, S.A. (2015). *Hvordan vurderer Ptil hva som er gode granskingsprosesser petroleumsvirksomheten*. Presentation in the conference: Hvem lærer av ulykker og hvordan foregår læring?

Filstad, C. (2010). *Organisasjonslæring: fra kunnskap til kompetanse*. Bergen, Fagbokforlaget.

Goldenhar, L. M.; LaMontagne, A. D.; Katz, T.; Heaney, C & Landsbergis, P. (2001). *The intervention Research Process in Occupational Safety and Health: An Overview From the National Occupational Research Agenda Intervention Effectiveness Research Team*. In Journal of Occupational and Environmental Medicine. Volume 43.

Grønmo, S. (2004). *Samfunnsvitenskapelige metoder.* 2. utgave 2016. Fagbokforlaget, Bergen.

Green, J. & South, J. (2006). *Evaluation. Key Concepts for public health practice*. Open University Press.

Hatletveit, E.W. & Helledal, H. (2018). *Tiltaksimplementering i organisasjoner i etterkant av uønskede hendelser. Hemmere og fremmere i tiltaksprosessen*. Masteroppgave. NTNU.

Haukelid, K. (2008) *Theories of (safety) culture revisited—An anthropological approach.* Safety science, 46, 3, s. 413-426.

Holstein, J. & Gubrium, J. (1995). *The active interview*. Qualitative Research Methods. Volume 37. Sage Publications.

Hopkins (2008). *Failure to learn: the BP Texas City Refinery Disaster*. H Australia Limited.

Hovden, J., Sklet, S. & Tinmannsvik R.K. (2004). I etterpåklokskapens klarsyn: Gransking og læring av ulykker. In Lydersen, S. (red.): *Fra flis i fingeren til ragnarok*. Tapir Akademisk Forlag, Trondheim.

Hovden, J., Størseth, F. & Tinmannsvik, R.K. (2011). Multilevel learning from accidents – Case studies in transport. *Safety Science*, 49, pp. 98–105.

Jacobsen & Thorvik (2007). *Hvordan organisasjoner fungerer*. 3. utg. Fagbokforlaget, Bergen.

Jacobsson, A., Ek, Å. & Akselsson, R. (2011). Method for evaluating learning from incidents using the idea of "level of learning. *Journal of Loss Prevention in the Process Industries*.

Jacobsen, D. I. (2005). *Hvordan gjennomføre undersøkelser? Innføring i samfunnsvitenskapelig metode*. Høyskoleforlaget.

Judd, C. M., Smith, E. R., Kidder, L. H. (1991). Research methods in social relations. Fort Worth, Texas: Holt, Harcourt Brace Jovanovich College Publishers.

Kaufmann, G., & Kaufmann, A. (2009). *Psykologi i organisasjon og ledelse*. Bergen: Fagbokforlaget.

Kirkpatrick D.L. (2007). *The Four levels of evaluation: Tips, Tools and Intelligence for*

trainers. Info Line. American Society for training and development.

Kjellén, U. (2000). *Prevention of accidents through experience feedback*. CRC Press.

Kjellén, U. & Albrechtsen, E. (2017). *Prevention of Accidents and Unwanted Occurences: Theory, Methods, and Tools in Safety Management*. 2nd edition. CRC Press.

Kletz, T. (2002). Accident Investigation – Missed Opportunities

Kovacs, G. & Spence, K.M. (2005). Abductive Reasoning in logistics research. *Internal Journal of Physical Distribution & Logistics Management*, Vol. 35 Iss 2 pp. 132-144.

Kvale, S. og Brinkmann, S. (2015). *Interview. Det kvalitative forskningsinterview som håndværk*. 3. udg. Hans Reitzels Forlag. København.

Kvale, S., & Brinkmann, S. (2009). *Learning the craft of qualitative research interviewing*. Thousands Oaks: Sage Publications.Lindberg, Hansson og Rollenhagen, 2010

Lukic, D. Margaryan, A. & Littlejohn, A. (2013). *Individual agency in learning from incidents.* In Human Resource Development International Journal. 2013.

Malterud, K. (2011). Kvalitative metoder i medisinsk forskning: en innføring. Oslo: Universitetsforlaget.

Margaryan, A.; Littlejohn, A. & Lukic, D. (2018). The development and evaluation of a Learning from Incidents toolkit. In *Policy and Practice in Health and Safety*. Vol. 16.

Margaryan, A., Littlejohn, A. & Stanton (2017). Research and development agenda for Learning from incidents. In *Safety Science* Volume 99, Part A, November 2017, Pages 5-13.

Mertens, D. M. (2010). Research and Evaluation in Education and Psychology. Integrating Diversity With Quantitative, Qualitative, and Mixed Methods. California, USA: Sage Publications Inc.

Ministry of Labour and Social Affairs. The Norwegian government. Meld. St. 12 (2017-2018) – Health, safety and environment in the petroleum industry.

Centers for Disease Control and Prevention (CDC) (ukjent årstall). Types of Evaluation. Obtained from: https://www.cdc.gov/std/Program/pupestd/Types%20of%20Evaluation.pdf

NORSOK (2003). NORSOK standard S-006N. HMS-evaluering av leverandører.

Okstad, E. Jersin, E. & Tinmannsvik, R. K. (2012). Accident investigation in the Norwegian petroleum industry – Common features and future challenges. In Safety Science. Volume 50, Issue 6.

Parker, A., Ummels, F., Wellman, J., Whitley, D., Groeneweg, J. & Drupsteen-Sint, L.

(2018). *Taking learning to the next level.* A presentation at the SPE International Conference on Health, Safety, Security, Environment, and Social Responsibility held in Abu Dhabi, UAE. Windesheim University of Applied Sciences. Obtained from: file:///C:/Users/Oda%20Bruaset%20Brath/AppData/Local/Packages/microsoft.windowscommunicationsapps_8wekyb3d8bbwe/LocalState/Files/S0/824/Attachments/How_to_Take_Learning_from_Incidents_to_the_Next_Le[2975].pdf

Postholm, M. B. (2010*). Kvalitativ metode: En innføring med fokus på fenomenologi, etnografi og kasusstudier* (2. Utg.). Oslo: Universitetsforlaget.

PSA (unknown year) *Indicator Blues*. Obtained from: https://www.ptil.no/en/contact-us/loose-pages-contact-us/order-publications/indikatorblues/

PSA (2019). Lærevansker (Learning disabilities). Interview with Ranveig Kviseth Tinmannsvik. Dialog nr. 2, 2019. Obtained from: https://www.ptil.no/fagstoff/utforsk-fagstoff/reportasjer/2019/larevansker/

Reason, J. (1997): *Managing the Risks of Organizational Accidents*. Ashgate publishing company, England.

Ringdal, K. (2001). *Enhet og mangfold – Samfunnsvitenskapelig forskning og kvantitativ metode*. Bergen: Fagbokforlaget

Robson, L. S. Shannon, H. S. Goldenhar, L. M. & Hale, A. R. (2001). *Guide to Evaluating the Effectiveness of Strategies for Preventing Work Injuries: How to Show Whether a Safety Intervention Really Works*.

Rollenhagen, C., Westerlund, J., Lundberg, J. & Hollnagel, E. (2010). *The context and habits of accident investigation practices: A study of 108 Swedish investigators*.

Rosness, R., Nesheim, T. & Tinmannsvik, R.K. (2013). *Kultur og systemer for læring*. SINTEF rapport A24120, Trondheim.

Samarbeid for sikkerhet (Sfs) (2014). *Beste Praksis for Undersøkelse og Gransking av HMS-hendelser*. Obtained from: https://www.dnmf.no/Artikler/PublishingImages/Godkjent%20versjon%20Anbefaling%20029N%202014%20%20Beste%20Praksis%20for%20Undersøkelse%20og%20Gransking%20av%20HMS-%20hendelser.pdf

Saunders, M. N. K., Lewis P. & Thornhill A. (2012). *Research Methods for Business Students* (6 utg.). Prentice Hall

Senge, P. M. (1990): *Den femte disiplinen – kunsten å skape den lærende organisasjon*.

Nordbok AS, Oslo

Schein, E. H. (1998). *Organisasjonskultur og ledelse: er kulturendring mulig?* Oslo: Libro Forlag A.S.

Safety Forum (2019). Læring etter hendelser. Rapport fra Sikkerhetsforum 2019.

Sklet, S. (2002). *Methods for accident investigation*. Trondheim.

Sklet, S. (2004). Compariason of some selected methods for accident investigation. *Journal of Hazardous Materials 111*.

Smith, E. (2015). *Learning from incidents.* Blog post in Oil and Gas blog, blogs.dnvgl.com.

Smith, E. & Roles, E. (2015). *Guidance on Learning From Incidents, Accidents and Events*. Presented at Hazards 25, 13-15 May 2015, Edinburgh, UK. Obtained from: file:///C:/Users/Oda%20Bruaset%20Brath/AppData/Local/Packages/microsoft.windowscommunicationsapps_8wekyb3d8bbwe/LocalState/Files/S0/824/Attachments/LFI-Paper[2977].pdf

Stemn, E., Bofinger, C., Cliff, D. & Hassall, M.E. (2018). Failure to learn from safety incidents: status, challenges and opportunities. *Safety Science*

Sverdrup, S. (2002). *Evaluering. Faser, design og gjennomføring*. Bergen: Fagbokforlaget

Swedish Radiation Safety Authority (SSM) (2010). *Indicators of safety culture – selection and utilization of leading safety performance indicators*. Report number 2010:07.

Thagaard, T. (2013). Systematikk og innlevelse: En innføring i kvalitativ metode 4. utg, Bergen Fagbokforslag.

The W. Edwards Deming Institute (2020). *PDSA Cycle*. From: https://deming.org/explore/p-d-s-a

Tinmannsvik, R.K. & Øien, K. (2010). *Kartlegging av læring og oppfølging av uønskede hendelser hos vedlikeholdsentrepenørene – særlig med tanke på forebygging av storulykker*. SINTEF rapport A16717, Trondheim.

Tinmannsvik, R.K. & Størseth, F. (2013). Major accidents – what have we learned about learning? Keynote presentation at 45th *ESReDA Seminar on Dynamic Learning from Incidents and Accidents*, 23rd and 24th October 2013, Porto, Portugal.

Tinmannsvik, R.K. (2017). *Hvorfor er det så vanskelig å lære?* Presentasjon under SIBA-seminar, 27. november 2017. Hotel Park Inn Oslo Airport, Gardermoen, Oslo.

Tinmannsvik, R. K. & Kjellén (2018). *Granskning etter hendelser.* SIBA-note (Sikkerhetsstyring i BA-bransjen). SINTEF/NTNU, mars 2018.

Obtained From: https://sikkerhetba.files.wordpress.com/2018/03/siba-granskning-etter-hendelser.pdf

Tjora, A. (2017). *Kvalitative forskningsmetoder i praksis*. Oslo: Gyldendal Akademisk.

APPENDICES

APPENDIX A: INFORMATION LETTER TO THE PARTICIPANTS (IN NORWEGIAN)

Revidert informasjonsskriv:

Forespørsel om deltakelse i prosjekt

Dette informasjonsskrivet er utarbeidet i forbindelse med Oda Bruaset Brath sin avsluttende masteroppgave ved studiet Samfunnssikkerhet våren 2020, ved Universitet i Stavanger (UiS). I det følgende beskrives oppgaven, samt hva det vil si å delta i prosjektet.

Det er utarbeidet en revidert versjon av informasjonsskrivet etter innspill fra Norsk Senter for Databehandling (NSD). Revidert versjon tydeliggjør deltakers rettigheter og ble sendt til informanter 22. april 2020.

Bakgrunn og formål

Bakgrunnen for studien er blant annet at tidligere forskning på organisasjoner innen andre sektorer hevder organisasjoner ikke følger opp granskinger på en god nok måte og dermed henter ut lite av læringspotensialet etter uønskede hendelser og undersøkelsen av disse. Det hevdes blant annet at mangelfull evaluering av tiltak som blir implementert er en grunn til at læring går tapt. Formålet med dette prosjektet er å teste om observasjonene nevnt over også gjelder for organisasjoner innen petroleumsindustrien. I tillegg er det ønskelig å få svar på hvorfor de aktuelle potensielt ikke evaluerer tiltak etter implementering. Ytterligere et det et formål å skulle identifisere noen konkrete områder for forbedring, som forhåpentligvis vil kunne gjøre evalueringen enklere.

Problemstilling

Foreløpig problemstilling er: Hvordan kan en mer strukturert evaluering av implementerte tiltak etter granskinger bidra til at organisasjoner innen petroleumsindustrien lærer mer av uønskede hendelser? Det opplyses også herved at problemstillingen kan bli justert ved behov underveis i prosjektet.

Hva innebærer deltakelse i studien?

Datainnsamlingen vil foregå ved hovedsakelig ved intervju. Det er i forkant av intervjuene forberedt en liste med forhåndsdefinerte spørsmål studenten ønsker svar på (intervjuguide), men denne vil ikke være førende dersom det oppfattes passende å stille andre eller ytterligere spørsmål. Der det er behov vil informasjonen fra intervjuer i oppgaven bli supplert med data fra utvalgt litteratur. Alle informanter vil motta oppgaven for gjennomlesning og verifisering av empiri senest en uke før innlevering til sensur.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. Kun masterkandidaten og veileder Morten Sommer ved UiS, vil ha tilgang til personopplysninger og data. Navn eller andre personopplysninger som kan identifisere informanten blir anonymisert etter muntlig avtale.

Det vil bli tatt taleopptak av enkelte samtaler, dersom dette er oppgitt av studenten og tillatt av informanten. Eventuelle lydfiler blir slettet ved innlevering (15. juni 2020).

Hvis det ikke nevnes i intervjuet, tas det ikke taleopptak. I intervjuene hvor det ikke tas lydopptak, vil studenten ta notater. Disse notatene har blitt ettersendt til vedkommende det gjelder for verifisering av informasjonen. Disse notatene blir slettet ved innlevering (15. juni 2020).

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Frivillig deltakelse

Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi grunn. Dersom du vil trekke ditt samtykke, vil alle opplysninger om deg bli anonymisert og slettet. Ved spørsmål til prosjektet, ta kontakt med Oda Bruaset Brath på mobil: 91762747 eller e-post: Oda.bruaset.brath@hotmail.com.

Samtykke til deltakelse i studien

Ved signatur bekrefter deltaker å ha mottatt informasjon om studien, og samtykker til å delta i prosjektet. Det godkjennes også skriftlig samtykke per e-post.

_____

(Signert av prosjektdeltaker, dato)