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Almost safe

Safety margins are challenged!

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Preface

This thesis ends my studies at NTNU (for now!). It has been challenging years, but I would not have been without it, because it has been extremely interesting and I have learned a lot. I really have appreciated this opportunity.

I have always been interested in safety, and during my years at NTNU, my knowledge and respect for this field has increased. I would like to thank my supervisor at the Department of Psychology at NTNU, Professor Britt-Marie Drottz-Sjöberg, for her guidance and inspiring discussions throughout this process. Special thanks to my informants. Without you, this study could not have been conducted. I have learned a lot from you!

Last, but not least, I have to thank my wife, Trude. Thank you for your everlasting support!

Rune Pedersen
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Abstract

This thesis is a qualitative empirical case-study. The central themes to be elucidated were factors that can avoid a negative decrease in safety margins in risky work. Data for this study was collected from individual semi-structured interviews at various locations in Norway and from discussions in a focus group abroad during 2016. The respondents were a firefighter, a military leader, a helicopter pilot, a safety manager, an entrepreneur and a counterterrorism police unit. The study comprises relatively few respondents so the results are not expected to provide essential theoretical or methodical contributions to the field of safety, but it offers an empirical contribution which tests and challenges available theoretical hypotheses related to safety margins. The data analysis identified the following factors which all six (the unit is regarded as one in this case) of the respondents in general regarded as most important for avoiding a negative decrease in safety margins in risky work: The importance of leadership, end state, experience transfer by communication, training, exercises, learning and deviations, risk analysis, procedures and sharp-end involvement, decision making and management of complexity and safety cultures. The findings from the case study was compared to the principles and explanations found in the literature.

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1. INTRODUCTION TO RESEARCH QUESTION

In this century we have experienced a rapid development of both technological and organizational systems worldwide. The focus on safety has increased and we can see a growth in system size and complexity. The nature of large accidents is changing. We now have system accidents and sociotechnical failures (Dekker 2015, p. vii).

Resource scarcity and competition mean that system constructions incrementally push their operations toward the edges of their safety envelopes. They have to do this in order to remain successful in their dynamic environment. Commercial returns at the boundaries are greater, but the difference between having and not having an accident is up to stochastics more than available margins. Open systems are continually adrift within their safety envelopes, and the processes that drive such migration are not easy to recognize or control, nor is the exact location of the boundaries (Rasmussen, 1997).

The importance of certifications, like ISO, can cause a managing by numbers situation, and that can create a false impression of rationality and managerial control. Media coverage regarding safety is focused on the cause of the accident. In complex organizational systems it can often be difficult to establish true causality between cause and effect.

Because of the increasing use of social media, news travel fast and without the editorial responsibility. People can be wrongly accused of being the cause of an accident and the consequences can be enormous. To avoid loss of trust in the community, organizations will do a lot to avoid accidents. Because of that, there is growing evidence that focusing on safety margins can be a good strategy in today's society.

In this thesis the researcher will discuss how we can avoid a negative decrease in safety margins in risky work and the aim of this master thesis is to add more knowledge about safety margins.

Sidney Dekker has actualized the subject during the last ten years and he is known for his expression "drift into failure" (Dekker, 2015). He says that drift into failure is a gradual, incremental decline into disaster driven by environmental pressure, unruly technology and social processes that normalize growing risk (Dekker, 2015, p. 11). He also adds that no organization is exempt from drifting into failure, and the reason is that routes to failure trace through the structures, processes and tasks that are necessary to make an organization successful. He explains that failure does not come from the

occasional, abnormal dysfunction or breakdown of these structures, processes and tasks, but is an inevitable by-product of their normal functioning. He states that the same characteristics that guarantee the fulfillment of an organization`s mandate will turn out to be "responsible for undermining the mandate" (Dekker, 2015, p. 11). In addition to reviewing relevant literature, the researcher will present results from a case study. The researcher wants to find out how managers and employees with different work experience and background in hazardous sectors, think about safety margins, and how they believe an organization can avoid a negative decrease in safety margins. Therefore the difference between the selected participant's background, and how it frames the answers, will be of interest.

To answer the main research question of this thesis "How to avoid a negative decrease in safety margins in risky work?" the researcher will especially investigate the following research topics stated below as research hypotheses, which are correlated to safety margins.

1) A good safety culture is necessary to avoid decrease in safety margins.
2) Leadership is important to avoid decrease in safety margins.
3) Lack of a unified end state causes negative consequences to safety margins.
4) Involvement of employees in the sharp-end is necessary to secure acceptable safety margins.
5) Following procedures is essential to ensure acceptable safety margins.
6) Experience transfer by communication and learning is necessary to avoid decrease in safety margins.
7) Understanding complexity is necessary to avoid decrease in safety margins.

These research hypotheses have been extracted from the safety literature and their bases will be further described in the theory section.

The central concepts involved and additional factors gathered from the respondents of the case study will be explained in the theory part. The theoretical part is selected to focus on issues that are relevant to safety margins. The results are not expected to provide essential theoretical or methodical contributions to the field of safety, but the study offers an empirical contribution which tests and challenges available theoretical hypotheses related to safety margins.

1.1 Structure

This thesis is structured in five main sections. The next section will explain the thesis theoretical framework and describe previous research on the topic.

The third section presents the case study and its methodology. That includes a description of the study design, data collection, data analysis and reliability and validity. The ethical consideration will also be addressed. The section also presents the empirical results generated through the interviews and focus group. The last part of section three includes the case discussion. The forth section addresses the general discussion and suggestions for further research. The fifth section presents the conclusions related to the main research question and the specified research hypotheses and implications for further research.

2. THEORY

This section will present perspectives related to the main research question and the research hypotheses, and theories which are central to the scrutiny of safety margins. These perspectives will in the end of this section subsequently be framed by theoretical contributions related to handling of deviations and complexity. In the discussion section in the case of this thesis, I will elaborate on the validity of the theoretical contributions based on the empirical input from the data collection.

2.1 Safety culture

Safety culture as a concept first appeared in the investigation report after the Chernobyl nuclear accident in 1986 (Antonsen, 2009). It was developed with the purpose to gain an overview, and to develop an indicator, of the safety level in an organization. The concept illuminated the social and subjective factors affecting safety, for example management commitment towards safety and general attitudes toward safety (Reiman and Oedewald, 2004).

Safety culture can be described as the employers and employees understanding of the hazards in their workplace, and the rules and norms governing safe working (Pidgeon, 1991). The concept is often seen as a subset of organizational culture, where the beliefs and values refer specifically to matters of health and safety (Clarke, 1999). Safety culture has been, according to Dekker, "increasingly deployed to fill the social-organizational complexity vacuum left by sequence of events models (Dekker, 2015, p. 245).

Batteau (2001) has criticized the functionalist approach to safety culture. He suggests that safety culture results from a decomposition of culture. When you decompose habits of the heart into elements sized to the checklist of a designer, one eliminates from view the ineffable impulses that distinguish cultures from commands. He also says that in a list focusing on special items in a check list mode, there is no space for a dialogue, a dialogue or conversation that might construct other versions or

perceptions of operational risks. The approach will turn culture away from the emergent phenomena and subtle connections within human contexts, and develop into a branch of engineering.

Bailey (1997) listed three factors regarding safety culture that demonstrated a positive result on safety outcomes: employee's perceptions of management's commitment to safety, employee's perceptions of fellow employees' participation in safety, and the effectiveness and quality of education and training efforts. The employees' perceptions of these factors influenced the possibility to comply with health and safety policies and rules (Bailey, 1997).

Toole (2001) asserted that to build a safety and learning culture, it requires an organizational commitment to both learning and change. This will most likely take place in an environment where fear is minimized. A positive safety culture is created by recognizing those employees who actively attempt to contribute to improve the work processes that reduce the likelihood of accidents. A positive safety culture is also supported by treating accident and incidents as system problems, not opportunities to fix blame and by treating employees as thinking, knowledgeable, and important players whose opinions and suggestions are solicited and frequently acted upon.

Components such as giving safety first priority at all levels of the organizational hierarchy, a commitment to safety at the managerial level, providing the resources needed to achieve quality and safety, the open and constructive handling of errors, organizational learning, and focusing on improving systems rather than individual blame are commonly acknowledged as essential to a safety culture (Pidgeon, 1998; Singer et al., 2003).

Reason (1998) emphasizes the importance of management receiving information on errors made and defines this "reporting culture" as an early step in creating a safety culture. The reporting culture will affect the ability of managers to gather information and compile knowledge about the environmental, organizational, personnel and other factors determining the safety of the system as a whole. Reason explains that a satisfactory safety culture involves the employees having the ability to deal with risks or hazards in the workplace in such a way as to avoid damage or loss, and still be able to achieve their goals.

2.2 Migration towards the boundaries

The safety margins are challenged by what Rasmussen (1997) calls "migration towards the boundaries". He explains that many degrees of freedom are left open at work and that the individual employee has to close it. Normal changes which happen in a work environment lead to modifications of strategies and the subsequent activity will differ based on that. Rasmussen holds that during the

search for the modifications employees identify an "effort gradient" and the employer will supply a "cost gradient". The combination of the "effort gradient" and "cost gradient" can lead to migration towards the boundaries of safe zones. If they exceed the safety margins and the event is irreversible, an accident or error occurs. Every organization has their own safe zone of operations, and those zones could be different from an employer's point of view compared to the employees' point of view (Rasmussen, 1997). Factors that can push the boundaries are pressure from competition, the market and regulation (Hale, Borys and Else, 2012).

Rasmussen (1997) says that if you work in complex systems, you are bounded by three types of constraints. The first one is an economic boundary, when the organization cannot sustain itself financially. The second boundary is related to workload, which means that the employees are exposed to too high expectations regarding workload and the result will be that they cannot successfully perform the tasks that they are supposed to do. The last constraint is the safety boundary, beyond which the organization will eventually fail in their tasks. Rasmussen explains that organizations have to deal with these boundaries, and the demands of efficiency will gradually push the operations closer to the non- accepted limits of boundaries (Rasmussen, 1997).

2.3 Models of different perspectives

In this section there will be a presentation of "model 1" and "model 2", introduced by Hale et al. (2012) and the relevance to safety margins. These models explain factors regarding procedures (Hale et al., 2012).

2.3.1 Model 1 – top-down view of procedures

Model 1 is based on the rationalist view of procedures as constraints on the behavior of the employees at the sharp end of operations, imposed by experts and management situated higher in the hierarchy. The experts and management are almost always removed from the day-to-day work (Hale et al., 2012). In model 1, following procedures in operations is regarded as the best way of behaving in all situations that needs procedures in order to keep satisfying safety margins. This is a top–down view of procedures that should not be violated under any circumstances. Model 1 states that if you do not follow procedures there is need for correction from supervisors (Hale et al., 2012).

A study by O'Dea and Flin (2001) among offshore installations managers in the British North Sea shows that failure to follow procedures is the third most important perceived cause of accidents, after "not thinking the job through" and "carelessness" (O'Dea and Flin, 2001). Thus, indicating that the model 1 view is rather frequent among managers.

However, Hale et al. (2012) concluded that interventions with the best success rates for increasing safety and procedure-following, emphasized the significance of feedback and learning systems. This would lead to better dialogue between employers and employees (Hale et al., 2012). Becker (2005) explains that it is not possible just from knowing the written procedure, to deduce what behavior will be shown by the persons involved in practice, nor to induce the written procedure from the enacted behavior. He states that they are related, but it requires a trigger to activate the routine to practical use. Becker is also critical to model 1 because he says that procedures need to be embedded in the situational context (Becker, 2005).

2.3.2 Model 2 – bottom-up view of procedures

Model 2, described by Hale et al. (2012), comes from ethnographic and sociological studies and also from management science. It focuses on predominantly complex, high-technology operations, but can be used on other operations as well. Procedures are, according to model 2, "socially constructed patterns of behavior, deriving from experience with the diversity of reality" (Hale et al., 2012, p. 8). Procedures are described as local and have many exceptions. The people who are regarded as experts in this model 2 paradigm are the operators at the sharp end. This paradigm reflects essentially bottom–up perspective (Hale et al., 2012).

Model 2 do not see written procedures as holy, but more as necessarily abstractions of a complex reality. Procedures should be used as guidance and be adaptable to situations. The imposition of externally derived procedures, especially from top-management, is normally seen by the expert operators at the front line as limitations on their autonomy of choice and that it questions their competence. Violations of procedures are seen as inevitable and the way to know how to violate safely without any negative outcome is regarded as a badge of mastery of the activity (Hale et al., 2012).

Expert operators are important in developing procedures according to Hale et al. (2012). The authors stress the need for involvement of sharp end experts. Their opinion of sharp end experts include both operators and supervisors, and by bringing in experts in processes regarding procedures, the "monitoring can lead in appropriate cases to changes in existing rules, and not just to reinforcement and discipline" (Hale et al., 2012, p. 28). When involving the sharp end experts in developing of procedures, there is use of the principle from High Reliability Organizations (HRO) called "deference to expertise" (Weick and Sutcliffe, 2007). Weick and Sutcliffe say that we should also be aware of experts because "experience by itself is no guarantee of expertise; since all too often people have the same experience over and over and do little to elaborate those repetitions" (p. 16).

2.4 Leadership

The involvement of leadership in daily work has proved a link to role clarity, worker competence and safety involvement (Dahl and Olsen, 2013), and the presence of leadership also demonstrates positive results on employee performance (Schein, 1992; Bass, Avolio, Jung and Bearson, 2003). Authenticity is regarded as important in the RISCOM model which describes communication regarding risk and safety. When there is authenticity present, there are no hidden agendas, everyone is true to the persons involved, and the leadership "walk the talk" and creates trust (Andersson, Drottz-Sjöberg, Espejo, Fleming and Wene, 2006). When employees experience that the employer does what she or he promised, the employer performs the part of the transformational leadership style called idealized influence (Bass et al., 2003). These leaders are respected and trusted, and they "share risks with followers and is consistent in conduct with underlying ethics, principles and values" (Bass et al., 2003, p. 208).

Too much trust in leadership and the importance of leadership can also be discussed. Meindl, Ehrlich and Dukerich (1985) introduced "Romance of Leadership" which states that if a new leader starts in an organization and things like safety margins improve, no matter what the cause; the leader gets the credit anyhow.

2.4.1 The importance of unified end state

Dekker (2015) explains that a major driver behind routine divergence from written guidance is the need to pursue multiple goals simultaneously. Multiple goals mean goal conflicts, and these goal conflicts can affect safety margins (Dekker, 2011). He describes the link between macro-level forces that operate on an entire organization or system, and the micro-level cognitions and decisions of individual people in it, as important explanatory factors regarding goal conflicts. He explains that the link between macro-level and micro-level forces is not straightforward. It is important to trace an organization´s goals and how they might conflict. An organization that tries to reach multiple goals at the same time or which has not unified its goals can create goal conflicts for those working inside it. Dörner (1989) states that contradictory goals are the rule almost all the time and not the exception in complex situations. Dekker (2011) explains that goal conflicts are left to emerge from multiple irreconcilable directives from different levels and sources, from subtle and tacit pressures, from management or customer reactions to particular trade-offs. Organizations often resort to "conceptual integration, or plainly put, doublespeak" (p. 101), that result in threats to safety.

Literature on High Reliability Organizations introduces the principle of "sensitivity to operations" (Weick and Sutcliffe, 2007). The principle explains how the employer should have knowledge about

the operations that take place in the organization, the goal of the operation, and also pay attention to real-time information in order to avoid a negative decrease in safety margins (Sutcliffe, 2011).

2.4.2 Risk analysis

It is considered difficult to give a good definition of risk analysis (Kaplan, 1997). Rausand (2011) describes risk analysis as a systematic use of available information to identify hazards and to estimate the risk to individuals, property, and the environment. A risk analysis is carried out to provide answers to the following three main questions: What can go wrong? What is the likelihood of that happening! What are the consequences? (Rausand, 2011).

Risk is always about what can take place in the future. A risk analysis estimates the probabilities for events to take place, in order to make strategies and action to prevent them from occurring and by so ensuring satisfying safety margins (Rausand and Utne, 2009). Dekker (2015) says that decision makers in complex systems are capable of assessing probabilities regarding risky situation, but not the certainties of particular outcomes. He explains that in retrospect we nevertheless assume that these people involved had the knowledge to predict the exact outcome.

2.4.3 Decision making

Dekker (2015) traces a new trend in the research literature in the last decade. It is a way of trying to understand the situation the way the decision maker saw it when the decision was made. Dekker calls it a move away from rationalism and toward the inversion of perspectives. This view of decision making is called naturalistic decision making (NDM), and the most applied model is the Recognition Primed Decision Making Model (RPD) (Klein, 1998). This model was a methodological reorientation, where decision making was increasingly studied in its complex, natural environments. Real decision problems resist the rationalistic format because options are not specified exhaustively and access to information is far from complete (Klein, 1998). Experts are often able to identify immediately a single sufficient alternative in two different ways. The first is via recognition where the decision maker recognizes the given situation as similar to something seen and handled with success before. The option pursued in this type of situation will be the one that replicates the previous success. The second way experts can make a good decision is applied in circumstances that are relatively novel, and the key here is "situation assessment" which is "the sense of understanding what is going on during an incident" (Klein, 1989, p. 51). Kahneman and Klein (2009) explain that in uncertain and complex contexts and if something unexpected is about to take place, expertise both from top-management or located at the sharp-end has been found to be very essential in decision making (Kahneman and Klein, 2009).

A problem according to decision making theory can occur when high level of cohesiveness is present. Janis (1972) coined the term groupthink for specific situations in which the desire to reach consensus among the group interferes with effective decision making. Studies by social psychologists suggest that decision making situations often start out as normal situations where the group tries to reach consensus, and actually end up as special instances of consensus going in the wrong way. This normally takes place when the group feels pressure to reach an agreement in order to maintain a positive view of the group when facing threats (Baron, 2005). The group will fail in their consideration of available evidence. An interesting fact is that group decisions are more likely to both ignore and under-weight external points of view (Minson and Mueller, 2012).

In situations where groups are too confident regarding their abilities and entertain norms suggesting that the group itself is infallible and morally superior, they will ignore other views and will not seek external advice, because "we know best" (De Dreu and Beersma, 2010). If a group is under threat, and the group members are very similar and share the same, strong values, it is easier to fall prey to groupthink because they also share many biases (Alderfer, 2011).

To avoid groupthink groups need to engage in open enquiry and process available information and evidence (Smith, Mackie and Clay, 2015). They also should try to encourage dissenting point of views. To ensure that consensus is not contaminated by shared biases, group membership can be intentionally selected for diversity. Members with different backgrounds and experience are likely to see problems in different ways and advocate different solutions which can then be considered (Smith et al., 2015).
The role of the leader should be minimized in favor of equally valued contributions from all members, and the voicing of doubts and objections which should make everyone consider the pros and cons of alternatives more deeply, should be encouraged. The key is to ensure that all views, and not just the majority view, are thoroughly considered when groups form a consensus. The best way to achieve this goal is to ensure that minority views are given their due (Smith et al., 2015).

High Reliability Organizations move the decision making in the organization (Roberts, 1990). It is allowed to make decisions in the sharp end, and it is preferred that the employer or employee with most expertise make the important decisions regarding safety. It differs from other organizations where decisions are based on their rank in the hierarchy (Weick and Sutcliffe, 2007). Weick and Sutcliffe (2007) say that rigid, top-down hierarchies have "a special vulnerability to error" (p. 16).

2.4.4 Sharp end involvement

Otsuka, Misawa, Noguchi and Yamaguchi (2010) showed that bottom-up approaches to the development of procedures in the healthcare industry, which followed the model 2 paradigm by Hale et. al. (2012), made the employees more adaptive towards procedures and suppressed the violations of them (Otsuka et al., 2010).
La Porte and Consolini (1991) showed that if you have overlapping tasks and competence, and eye-to-eye contact, this redundancy by the involvement of sharp end operators in operations can recover near all critical errors (La Porte and Consolini, 1991).

Studies by Embrey (1999) found that operators in the sharp end had their own personal set of information and heuristics which could end up in violation of procedures. The studies by Embrey recommend that to avoid violation of procedures the procedures should be described as support for the sharp end operators. According to Embrey it is also important that the employees are trained in how and when to adapt the procedures.

Dekker (2011) writes that "procedures are a nexus between the idea that people are a problem to control and the idea that people are a solution to harness" (p. 97). He explains that hindsight always turns complex histories laced with both uncertainty and pressure into neat, linear anecdotes with obvious choices. What looks like violations from the outside and hindsight are often actions that make sense given the pressure and trade-offs that exist on the task inside of real work (Dekker, 2011).

2.5 Experience transfer by communication

Experience transfer by communication is crucial in risk governance and to avoid a negative decrease in safety margins (Renn, Klinke, and van Asselt, 2011). Fischhoff (1995) says that "communication is like an insurance policy. It is a fixed cost that can prevent larger damage" (p. 143). There are many definitions of the word "communication" by various scholars (Losee, 1999). In this thesis communication is defined "as the process whereby one individual (or group of individuals) attempts to stimulate meaning in the mind of another individual (or group of individuals) through intentional use of verbal, nonverbal, and/or mediated messages" (Wrench, McCroskey, and Richmond, 2008, p. 10). This definition considers the complexity in communication. We can distinguish between organizational and interpersonal communication. These perspectives, together with communicational guidelines, will be explained in the following sections.

2.5.1 Organizational communication

Organizational communication can be defined as "a process through which an organization sends a signal or message over a channel to another part of the organization (intraorganizational) or to another organization (interorganizational)" (Dynes and Quarantelli, 1977, p. 2). Solem and Kongsvik (2013) showed an example of organizational communication, when they introduced a safety development program which was conducted in the period from 2001 to 2012. The program involved both offshore service vessels and the petroleum company that contracted them. During the period there was a significant decrease in serious personal injuries and collisions. The program used group facilitation as a method of improving safety. The facilitators are normally external people, and their main task is to facilitate the group to achieve the goal to increase its effectiveness by improving both communication and structure in a program. To use an external facilitator is almost the same as the external "guardian"' that the RISCOM model utilizes to guarantee an adequate process for all stakeholders in a larger project regarding risk (Andersson et al., 2006), even though the guardian in the RISCOM model was from the authorities. One of the successful approaches in the safety development program was to establish a communication arena for experience transfer, which they called Captain's forum (Solem and Kongsvik, 2013). The forum met two days a year and included captains and personnel from the petroleum company. The experience transfer was accomplished by discussing issues regarding safety. Solem and Kongsvik (2013) showed how facilitation can be used as a methodology to achieve an important dialogue between employer and employees, especially by emphasizing the building of trust between the actors. This happened through the use of facilitation principles conducted by an external party, which led to the collaboration and involvement with both representatives from the seafarers and the petroleum company.

2.5.2 Interpersonal communication

Bochner (1989) define interpersonal communication as follows: "at least two communicators; intentionally orienting toward each other; as both subject and object; whose actions embody each other's perspectives both toward self and toward other" (p. 336). When this kind of communication is regarded as good, knowledge and important information will be shared, it will lead to a sense of ownership and can increase the level of trust among the involved people (Löfstedt, 2005)

2.5.2.1 Grice´s communication guidelines

One model to describe effective communication is "the cooperative principle" by Grice (1975). The cooperative principle can be divided into four conversational maxims; the maxims of quality, quantity, relevance and manner. On the next page the descriptions of the maxims are shown in table 1:

Table 1: Conversation maxims (Cited from Grice, 1995).

Conversation maxim	
1	**Quality** (Supermaxim: Try to make your contribution one that is true). Submaxim:
a	Do not say what you believe to be false.
b	Do not say that for which you lack adequate evidence.
2	**Quantity**
a	Make your contribution as informative as is required (for the current purposes of the exchange).
b	Do not make your contribution more informative than is required.
3	**Relevance**
A	Be relevant.
4	**Manner** (Supermaxim: Be perspicacious) Submaxims:
a	Avoid obscurity of expression.
b	Avoid ambiguity.
c	Be brief (avoid unnecessary prolixity).
d	Be orderly.

2.6 Experience transfer by learning, training and exercises

In this section experience transfer by the means of learning, training and exercises will be explained.

2.6.1 Single-loop, double-loop and situated learning

In this section the perspectives of single-loop learning, double loop and situated learning will be explained. Argyris and Schön (1974) explain that for learning and experience transfer to occur, it involves the detection and correction of error. Where something goes wrong, the first instinct for many people is to look for another strategy that will address and function within the governing variables. In that sense, given or chosen goals, values and strategies are operationalized instead of questioned. This is what Argyris and Schön (1974) describes as single-loop learning. The emphasis is on "techniques and making techniques more efficient" (Usher and Bryant, 1989, p. 87).

A different approach is to question the governing variables and to subject them to critical scrutiny. This is described as double-loop learning, and this kind of learning may lead to an adjustment in the

governing variables and, thus, a change in the way in which consequences and strategies are framed (Argyris and Schön, 1974). Double-loop learning, in contrast, "involves questioning the role of the framing and learning systems which underlie actual goals and strategies…. Reflection here is more fundamental: the basic assumptions behind ideas or policies are confronted … processes are disconfirmable not self-seeking" (Argyris, 1982, pp. 103-4). Argyris argues that double-loop learning is the best way for learning and experience transfer (Argyris, 1982). Double-loop learning is more likely to be found in organizations that use shared leadership. It strives to encourage open communication, and to publicly test assumptions and beliefs, and also combine advocacy with inquiry (Bolman and Deal, 1997).

For organizational learning and experience transfer to occur, "learning agents, discoveries, inventions, and evaluations must be embedded in organizational memory" (Argyris and Schön, 1978, p. 19). If it is not encoded in the images that individuals have, and the maps they construct with others, then "the individual will have learned but the organization will not have done so" (p. 19). When succeeding with double-loop learning the organization is "setting new priorities and weightings of norms, or by restructuring the norms themselves together with associated strategies and assumptions" (Argyris and Schön, 1978, p. 18). Argyris (1990) argues that double-loop learning is necessary regarding experience transfer and if practitioners and organizations are to make informed decisions in rapidly changing and often uncertain context. Documentation of tacit knowledge is also a prerequisite for experience transfer in an organization.

Lave and Wenger (1991) introduced a learning model called situated learning. Instead of looking at learning as the addition of certain kinds of knowledge, they have placed it in a social context where learning involves participation in a community of practice. They explain that the mastery of knowledge and skill requires newcomers to participate in the sociocultural practices of a community. These apprenticeships provide a way to speak about the relations between inexperienced and more experienced people, and about activities, identities and communities of knowledge and practice. The intentions to learn are engaged and the meaning of learning is understood through the process of becoming a full participant in a sociocultural practice. This social process includes, indeed it subsumes, the learning of knowledgeable skills (Lave and Wenger, 1991).

2.6.2 A learning organization

A learning organization can be defined as "an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights" (Garvin, 1993, p. 80). Argyris (1977) writes that organizational learning is "a process of detecting and correcting error" (p. 116). These organizations are competent at five main activities: systematic

problem solving, experimentation with new approaches, learning from their own experience and past history, learning from the experiences and best practices of others, and transferring knowledge quickly and efficiently throughout the organization (Garvin, 1993).

2.6.3 Training and exercises

Training and exercises which is as close to real events as possible is preferable to give maximum training transfer to increase performance and avoid a decrease in safety margins (Dahlstrøm et. al., 2009). Dekker (2015) points out that there are limits for our ability to prepare ourselves for the problems we may encounter. He states that "These limits stem from the intersection between our finite knowledge and the infinite configurations of problems-to-be-solved in any complex, dynamic domain" (p. 269). Dekker criticizes that the training simulation is often technology-driven. He questions whether the photorealistic environment improves training quality or greater validity of that which is trained in the simulator.

HROs train on how to be sensitive to operations by being responsive to the messy reality inside organizational systems (Weick and Sutcliffe, 2007). The training lead to discussions about "what we are actually doing regardless of what we were supposed to do based on intentions, designs and plans" (p. 59).

2.7 Handling of deviations and complexity

High reliability organizations are preoccupied with failure. It means that they track small failures and deviations, because they see small failures as a symptom of system failure. The reasoning is that these small errors can have large consequences if they happen close in time (Weick and Sutcliffe, 2007)

One example of many small failures leading to a complete disaster took place on December 3, 1984, in Bhopal, India. More than 40 tons of methyl isocyanate gas used in the manufacturing of pesticides was released, and the release killed three thousand people. The small errors contributing to the disaster were failure to reinsert a water isolation plate, inoperative alarms, malfunctioning storage tanks, manuals that could not be read and understood by the plant personnel because of English-language instructions, and loss of important experience due to high turnover among personnel (Shrivastava, 1992).

HROs want deviations and near misses to be reported, because they want a culture of learning from both episodes that went wrong and near misses that could have gone wrong. HROs are also familiar

with the potential liabilities of success. That includes complacency and the temptation to reduce safety margins. These organizations are dealing with a continuous process where they are proactive and analyze and discuss possible vulnerabilities and treats which can potentially end up in major problems (Sutcliffe, 2011).

Vaughan introduced an expression called normalization of deviance (Vaughan, 1999). She related that to the Challenger accident where production pressure and resource limitation became institutionalized in the organization. This social-technical dynamic, where risk is constructed and reconstructed and renegotiated, will gradually normalize deviations. Both weak signals and clear signals of potential danger, can be normalized, and can also lead to repeat itself under quite similar circumstances.

Dekker (2011) says that "The key to normalization of deviance is that this process, this algorithm, repeats itself. And that successful outcome keeps giving the impression that risk is under control" (p. 106). He explains that: "Each step away from the previous norm that meets with empirical success (and no obvious sacrifice of safety) is used as the next basis from which to depart just that little bit more again" (p. 106). The solution to succeed in not normalizing deviances is to ensure that the organization continually reflects critically on and challenges its own definition of "normal" operations, and finds ways to prioritize chronic safety concerns over acute production pressures (Dekker, 2011).

Dekker (2015) states that many of the things that would, after the fact, be constructed as "incidents" and worthy of reporting are the normal, everyday workarounds, frustrations, and improvisations needed to get the job done, however they are not report-worthy. They do not qualify as incidents. Even if the organization has a reporting culture, even if it has a learning culture, even if it has a just culture so that people would feel secure in sending in their reports without fear of retribution, such "incidents" would not turn up in the system. This is the banality-of-accidents thesis.

Dekker introduces a concept about complexity called "Scarcity and competition" (Dekker, 2011). He explains that every organization is influenced by features outside of the organization, and these organizations are in continuous, complex interaction with the surroundings. Dekker (2011) says that industries that are strongly regulated do not by all means have a better safety record. He writes:

> Complexity theory can easily predict that changing the number of agents will change the dynamics of any complex system; it will affect the speed at which feedback about agents´ actions travels and the pattern along which it reverberates. It might even change the way in which success is defined and assured, and also the way in which failure is bred and perhaps no longer recognizes (p. 37).

Weick (1993) points out that even though there can be a long period without accidents, that may not be the result of the decision making process of people involved, but instead a stochastic variation that is dependent of other, complex factors. Dekker (2011) takes it further by explaining that: "Borrowing more and more from safety may go well for a while, but we never know when we are going to hit" (p. 39).

Exceeding safety margins sometimes occur in small steps. It means that organizations adapt their operations continuously around goal conflicts and surroundings of complexity (Dekker, 2011). These small steps can eventually normalize deviations, and what was seen as violations can now be regarded as normal behavior. Since every deviation is only a small step away from the former accepted norm, and no accidents have happened, this is regarded as an operational success, and the small adaptations are considered normal, not affecting future safety. Dekker says that when employees expect and accept changes from the former norm "They have come to believe that things will "probably be fine" and that it will do "a good job" (p. 15).

Complex systems are sensitively dependent on initial conditions. It means that a decision made early in a situation, can cause huge effects on the process or end-result later on. Dekker (2011) suggests that there is a possibility that drift into failure "can be baked into a very small decision or event. This may have happened somewhere way back, way at the beginning, even before the system was as complex as it may be now" (p. 16).

HROs are aware of complexity by resisting oversimplification (Sutcliffe, 2011). HROs want to see as much about the environment and the risks that they face, as possible. They know that the situations they face can be complex, unpredictable and unstable, and because of that they are striving to continually create a nuanced and complete picture of both themselves and the situations they face. They welcome diverse opinions and experience and cultivate diversity because it helps them to notice more in complex environments, and also because it helps them to do more with the complexity discovered (Weick and Sutcliffe, 2007).

When HROs see very close similarities between past and possible future negative events, they are highly alert. That is because the similarities can be superficial, and that can hide profound, complex differences. The profound differences can prove fatal (Hollnagel, 2006). Dekker (2011) also points out that if an organization is doing the same thing twice, because of former success, the result will not predictably lead to the exact same result because the situation has changed.

2.8 Summary of theories

This section started with a short description of safety culture which is a basis for an organization's health and survival. Safety culture was described as involving various parties understanding of the hazards in a workplace. Such understanding affects safety margins, how they are estimated, perceived and upheld, and this understanding is shaped by organizational rules and traditions, external pressures as well as internal practices, competences and social rules. Therefore, the issue of understanding how an organization's safety culture can be affected to migrate towards, or outside, safety limits requires a closer look at organizational models, leadership, decision making, communication and transfer of experience. Furthermore, examples of approaches to detect or limit such migration or deviance have been collected from the area of research related to high reliability organizations and provide ideas of how to handle complexity. The review section is concluded with selected ideas of how complexity itself can overshadow crucial developments and affect insights as well as influence an unobtrusive sliding towards a safety limit. On the basis of the results and suggestions sampled from the research literature it was of interest to interview persons who handled risk and safety tasks in their ordinary work. The following section presents a case study with results from interviews with individuals and a work team. The respondents were selected across a broad area of hazardous work in an attempt to capture both similarities and differences in their approaches and perceptions of safety and safety limits. The findings from the case study will later on be compared to the principles and explanations found in the literature.

3. CASE STUDY

3.1 Method

To be able to get an in-depth exploration of the respondents understanding of the theme to be investigated i.e. how to avoid a negative decrease in safety margins in risky work; it was decided to conduct a qualitative case study based on individual interviews and a focus group discussion.

Data for this study were collected from individual interviews at various locations in Norway and from discussions in a focus group abroad during 2016. A semi-structured interview guide was used as a tool to systematically gather information from the respondents in the individual interviews (Appendix C) and from the focus group (Appendix D). A focus group is "a sort of collective interview, directed by the researcher (moderator), which exploits the interactive potential of the situation in order to generate rich data" (Howitt, 2013, p. 92). It can be used as an early stage of research, in order to investigate and identify the significant issues (Howitt, 2013).

In this section, the study's design, selection and recruitment process, data collection process, and data analysis process will be explained. Issues related to ethical considerations as well as reliability and validity will end the section.

3.1.1 Case study design

Blaikie (2009) explains that a study design should be able to answer three questions: What you will study, why you will study it and how this study will be done by the researcher. The first two questions have been answered in the introduction section, and the third question about how the study was done, will be presented further in this section.

Yin (2010) explains that "the distinctive need for case studies arises out of the desire to understand complex social phenomena" (p. 2). That is because the case study method allows investigators to maintain the broad, holistic and meaningful characteristics of real-life events, such as organizational and managerial processes. A case-study is characterized by focusing on specific aspects of one individual, group, organization or event (Yin, 2010). Yin explains that case studies seem to be the preferred strategy when "how" or "why" questions are being posed and in situations where the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context (Yin, 2010).

In this thesis, both leaders and employees in different organizations in Norway, and a counterterrorism police unit abroad were involved. The central themes to be elucidated are factors that can avoid a negative decrease in safety margins in risky work.

To investigate the main research question, it was essential to recruit both leaders and employees from organizations that by assumption dealt with risky work on a daily basis and less than daily. The respondents were also selected within different fields of work regarding safety, and by this selection the aim was to get different point of views relative the research question.

3.1.2 Selection and information about the respondents

The respondents were recruited through strategic selection. Strategic selection means recruiting informants possessing specific qualifications and characteristics relevant for gathering information illuminating the research question (Thagaard, 2003). Leaders and employees were contacted through people with awareness of the field of safety, after a description of the aim of the thesis and specification of the need for respondents who had experience and knowledge within the area of the research question.

Five participants were recruited to the individual interviews. They had an average of 15 years (range = 6-30) of work experience. All of the participants were male, and their ages ranged from 28 to 57 years (M = 37). The five participants had different backgrounds regarding fields of study and work experience. Three of the participants were managers and 2 were employees. The respondents were a firefighter, a military leader, a helicopter pilot, a safety manager and an entrepreneur. The firefighter had more than 5 year of experience as a firefighter and before he started his career as a firefighter, he had worked in an administration for around two years. The Norwegian military leader had over 30 years of experience from the Norwegian armed forces. He had been in a leadership position for more than 10 years and he also had a lot of experience as a regular soldier. The helicopter pilot worked as a commercial pilot. He had more than 5 year of experience as a pilot, and he also had more than 5 years of experience from the military. The safety manager worked in the public services. He had more than 20 years of experience in a safety department, and he had been the safety manager for approximately 10 years in the same organization. The last person interviewed was a man who was a manager in the entrepreneur industry. The company specialized in building roads and bridges. He had more than 20 years of experience within the industry, and had been a manager for more than 8 years.

A focus group with a unit of five counterterrorism policemen was conducted. They did not have the opportunity to tell me, due to security reasons, their exact age but said they were approximately 30-40 years old. They had worked in the unit between 5 to 15 years. The focus group was conducted in English and even though the participants' native language was another language, they spoke English fluently. They worked together as a unit all the time and they had a unit leader who was a part of the unit and he also participated in the focus group. He had been a unit leader between 5-10 years and he also had several years of experience as a regular policeman in the counterterrorism police force.

3.1.3 Classification regarding safety level and exposure

The respondents were presented a figure, which differentiated between if you are facing safety or security threats, and if you face the threats on a daily or less than daily basis. The respondents were asked to place themselves in the figure, and the resulting classification is shown in Figure 1. This classification will be used in the interpretation of results.

Security	Counterterrorism police unit Military leader	
Safety	Helicopter pilot Firefighter Entrepreneur	Safety manager public services
	Daily	Less than daily

Figure 1: An overview of all participants own classification of their work in options given as safety vs. security threats and daily vs. less than daily exposure.

3.2 Data Collection

3.2.1 Semi-structured interviews and interview guide

Semi-structured interviews were chosen as the method to gather information about the research question, in both the individual interviews and the focus group. Semi-structured interviews are one of the best ways to gather information in case studies (Bernard, 2000). To use this type of primary data has its advantages because the data gathered are the result of direct communication between the researcher and the source. This gives the researcher a better control over the topics being researched, and it also enables the researcher to evaluate the data in a better way compared to if the data had been secondary or even tertiary data (Blaikie, 2009).

Face-to-face interviewing, which was conducted for the individual interviews in this case study, is appropriate where depth of meaning is important and the research is primarily focused on gaining insight and understanding (Ritchie and Lewis, 2003). The interviewer has to be an active listener and be able to make the respondent expand on and clarify what has just been said (Howitt, 2013).

An interview guide where questions related to the investigation of the research question was used (Appendix C; Appendix D). An interview guide is a skeletal outline of the interview with a list of questions which are prepared prior to the data collection phase (Howitt, 2013). The part of the interview guide targeting the main research question used open ended questions so that the respondents would have more options to answer without the constraint of fixed response alternatives to choose from (Howitt, 2013). Thus the interviews and focus group discussions could develop into areas that were not thought of in the interview guide preparation, but which could still illuminate the

research question. Blaikie (2009) explains that qualitative researchers "have to accept opportunities when they open up and they will want to follow leads as they occur" (p. 215).

The interview guide contained two parts. The first part included general information related to the respondent and his work and the second part focused on questions related to the main research question and research hypotheses. The initial question asked to all of the respondents was the main research question. The following questions were usually asked in the predefined order of the interview guide, but when a respondent in a natural way discussed topics which were meant to be brought up later in the interview, the researcher allowed them to do that. The nature of a semi-structured interview contains this flexibility (Howitt, 2013).

3.2.2 Interview procedures and contexts

The interviews took place between February and May, 2016. Approximately a week before the interviews the selected respondents received a letter (Appendix A) about how the interview would be conducted and how the information would be used in the thesis. All of the interviews took place at a location of a participant's choice, usually at work where they were not disturbed by colleagues etc. The interviews lasted on average 1, 5 hours (range = 1.2- 2) and the answers were written down on paper during the interviews. In addition, a summary of the information gathered was written immediately after the interviews. All of the individual interviews were conducted in Norwegian. Excerpts from the interviews used in this thesis have been translated from Norwegian to English by the researcher.

The focus group with a unit of five counterterrorism policemen was conducted during the winter 2016. Four weeks before the focus group took place, they received an e-mail (Appendix B) about how the interview was about to be conducted, how the information should be used in this thesis, and the main research question. The interview lasted 2.5 hours. The focus group was conducted in English and even though the participants' native language was another language, they spoke English fluently.

To give a better understanding of safety margins the following figure was presented to all of the respondents (Figure 2):

Daily work	Safety margins	Accident
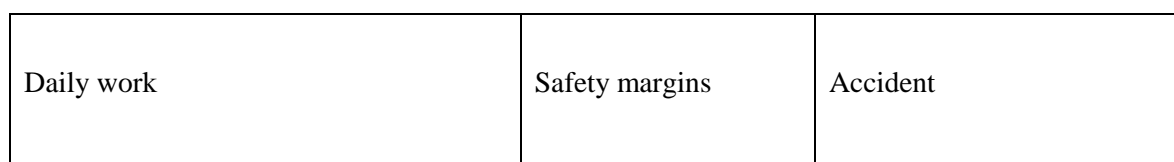
Figure 2: A generic illustration of the safety margin located as a buffer between daily work and accidents or mishaps.

The initial question, which was the main research question, generated most of the essential information. Follow-up questions were posed when there was need for more profound answers. The questions were asked in the same manner at all interviews, with supplementary probes such as "Can you tell me more about.." , and "You mentioned…, can you elaborate on that?" (Kvale, 1996). Sometimes the researcher had to interfere if a respondent went too far away from the subject, due to time restrictions.

3.3 Data analysis and considerations

3.3.1 Approach, coding and categorization

The results from the interviews and the focus group were structured with the use of thematic analysis. Thematic analysis is an analysis of the major themes to be found in the data gathered and is a useful analytic approach in circumstances in which the data consist of material from " interviews, focus groups, newspaper articles and the like" (Howitt, 2013, p. 180). This analysis approach has a lot in common with content analysis.

The guidelines that Braun and Clarke (2006) provide were used as a basis for the thematic analysis. Six steps of analyses are described: Data familiarisation, initial coding generation, searching for themes based on initial coding, review of themes, theme definition and labeling and report writing. Even though these steps are listed in sequential order, overlap and movement back and forward between stages took place.

Part of the data familiarisation took place already when the data were being collected during the interviews and focus group. Later on, when the notes and summaries from the interviews were written down, the data familiarisation continued and were the basis for the beginning of the analyses
The initial coding was based on the written material, which was read through several times and each line of the written material was coded. Each code was structured into three different units of results: meaningful statements example statements and junk statements. The procedure followed suggestions from Neuendorf (2002). All responses to the questions in the interviews were analyzed together. When classifications were added these were also considered in the coding.

After the initial coding, the codes were collapsed into themes. There was a search for patterns in the coding. The codes were first collapsed into subthemes and then grouped into the main themes. The major themes were considered the themes which at least five (the unit is regarded as one in this work) of the respondents regarded as important for avoiding a negative decrease in safety margins in risky

work. After a more profound analysis and discussions with the supervisor, the themes were reviewed, and there were some changes in the labelling of themes during the process.

3.3.2 Ethical considerations

To ensure anonymity and confidentiality, several considerations were attended to. The written text from the interviews was anonymized by editing word and sentences that could be traced back to the respondents. Since one of the aims of the study was to compare the answers across groups, statements were connected to the profession that each respondent represented. The contact information about the respondents was stored safely. The written text from each of the interviews conducted in Norway and the coding information was stored in a safe. The written text from the focus group discussions which were conducted abroad were stored in a special suitcase, which belonged to the researchers current job, especially made for storing sensitive information.

Informed consent from the respondents by the means of informing about the general aim and purpose of the study, confidentiality, voluntariness and the right to withdraw from the study at any time without consequences etc., is mandatory (Langdridge, 2004). In this study, informed consent was ensured by information about the study sent on email to agree on prior to the interviews (Appendix A) and focus group (Appendix B). None of the respondents decided to withdraw from the study.

3.3.3 Reliability and validity

Reliability and validity are two central methodological aspects that need to be discussed in order to say something about the quality of the findings in this study.

There is a demand that the data generated in a study are reliable, and that the data have been generated in a reliable way. Reliability means that measures should exhibit consistency over time and internally over the various sub-sections of the measure (Howitt, 2013). The structure of the study and the procedures used should be presented as detailed as possible. In that case, other researchers should be able to conduct to same study and reach the same conclusions (Riege, 2003). Some researchers, especially those conducting qualitative research, reject the notion that there are any fixed, measureable characteristics of people, and they regard their data as situationally bounded. That means that they do not expect to find data obtained from individuals to be consistent across research situations (Howitt, 2013). There are also discussions whether replication should be a goal in qualitative studies, but anyhow, it is important to describe the method used in the research as detailed as possible (Riege, 2003).

The other basic requirement in research is validity of results. Central concepts are internal and external validity. Yin (2010) presents two forms of validity regarding case studies: internal or construct validity and external validity. Construct validity confirms that the study is based on a logical process that maintains consistency with the use of correct operational measures from the research questions to conclusions (Yin, 2010). This type of validity relates in this case to how a researcher performs the coding and classification work. Is it true to the data material and consistently handled?

Qualitative research is considered valid when the distance between the meanings as experienced by the participants and the meaning as interpreted in the findings is as close as possible (Polkinghorne, 2007). The issue of validity in qualitative research is usually interpreted as the "extent to which the analysis fits the data (usually text)" (Howitt, 2013, p. 442). So it is the internal validity of the analysis which is the focus here.

External validity will ensure that the findings in the study are applicable outside the confines of the selected case study (Yin, 2010). The goal of this thesis is not to generalize the findings to every organizations involved with risky work, but rather offer an empirical contribution to test and challenge available theoretical hypotheses related to safety margins.

The extensive experience and the positions the respondents held, are assumed to provide validity regarding the themes of this study i.e supporting external validity. The fact that the respondents could comment on the interpretation of the answers later on supports this assumption.

3.4 Results

In this section the results from the individual interviews and focus group will be presented. There will be descriptions of the views given by each participant from the individual interviews. The views emanating from the focus group will be presented without discrimination between respondents. The following headings are based on the categorization of the information collected from the interviews and focus group (Appendix E). These are the main factors which all six (the unit is regarded as one in this case) of the respondents in general regarded as most important for avoiding a negative decrease in safety margins in risky work:

A. The importance of leadership.
B. End state.
C. Experience transfer by communication, training, exercises, learning and deviations.
D. Risk analysis.

E. Procedures and sharp-end involvement.

F. Decision making.

G. Management of complexity and safety cultures.

Other factors regarding safety margins mentioned by the respondents were (Appendix F): research reports, media coverage, global threats, political decisions, technical equipment, maintenance, physical and psychological performance, bonuses, education, ready for change, clear language and role clarity. One to three of the participants mentioned each of these factors, and because of the low numbers, they will not be used as headings or main findings in this paper, but some of the factors contribute to discussions in the main headings.

3.4.1 The importance of leadership

Leadership was regarded as important in order to avoid a negative decrease in safety margins among all respondents. Both the counterterrorism police unit and the military leader said that it was the leaders who had the power to get the resources needed to avoid a decrease in safety margins and they also in general decided the safety margins. The counterterrorism police unit stated that the leaders were almost always within reach and it was easy to contact them if something happened.

The military leader explained that he and his fellow colleagues had a great responsibility regarding safety margins. They took the decision about when to take action regarding missions, and they also had the final say regarding decisions about end state. The leadership support was also important for both motivation and sense making for the soldiers. The helicopter pilot said that the management involved the employees regarding topics related to safety, and that the management prioritized safety at all occasions.

The entrepreneur explained that he prioritized safety because he had the responsibility if something went wrong at the construction site. His actions were noticed among the employees, so he had to "walk the talk" regarding safety. The safety manager also emphasized the importance of leadership regarding safety margins, but he thought it was difficult because the top manager of the organization did not prioritize safety. He said that this situation made his leadership more difficult. He explained that he sometimes criticized the lack of support to his employees, and he figured that he was not perceived to be loyal.

3.4.2 End state

This was one of the most important factors for the counterterrorism police unit regarding safety margins because of the high level of risk they experienced both in training and on missions. Before every drill and mission, the end state was communicated to the members of the unit. Everyone had to tell the end state out loud to the other members in order to be totally sure that everyone had understood the end state and had the same opinion about it. They had experienced that when they did not do that when training, the drills had sometimes gone wrong and that the safety margins had been crossed.

The end state was mostly decided by the management, but since the unit had their team leader as part of the management, they thought it was good enough. The unit had sometimes experienced that the end state had changed after involvement from the unit, and that had lead to better results regarding the operations. Another important issue was that when they knew the end state it was easier to decide what kind of procedure to use.

The military leader said that the end state was considered very important in the military, and without a unified end state, a mission could easier fail, and thereby the safety margins would be exceeded. Before drills and missions, they assured that all of the soldiers and leaders knew the end state. Then they also could decide which procedure or procedures they should use. If the people working together had different views about the end state that could lead to disaster, because they could eventually work towards conflicting end states and use different procedures.

The end state was in general decided by the military leaders. Sometimes the end state was decided by coalitions of countries they worked with. When the end state was decided they had to be loyal to the decision. Their missions could be very complex, and that was why the top leaders decided the end state, because they had the overall knowledge about the missions. One of the advantages of military leaders was that all of them had sharp-end experience.

The helicopter pilot said that the end state was discussed before every flight and operation. They performed a safety job-analysis with the contractor where the end state was discussed. The end state had to be totally clear and both the pilot and the contractor had to agree before they started the operation. The pilot said that their company had experienced problems if the understanding of the end state was not clear enough. If they had to prolong the operations because of unclear understanding of the end state, that would increase the expenses for the contractor. The pilot could be trapped between the wish to deliver good service to the contractor and the gradual decrease in safety margins, if he had to take any short-cuts. He said that he had not experienced situations where the safety margins had actually been crossed, but he thought that he had been close to crossing the lines a few times.

Inexperienced pilots were likely to be involved in accidents because of the time pressures from the contractor.

It was important to communicate with the contractor early in a process if he saw that the operation would take more time than expected. He mentioned an example where the operation had to be prolonged because of an unexpected event. The contractor could say that: "You can just fly across the main road; then you will save a lot of time, and we can finish the work at the time we agreed on". But because regulations said that you were not allowed to cross the road when you had underlying cargo attached to the helicopter, the helicopter pilot had to decline the proposal. The pilot said that crossing the main road would almost never lead to accident, but if they exceeded the safety margins, they would get in trouble if the cargo fell down and injured both people and equipment etc. There was also a discussion that they would normalize what in the beginning was considered a violation of rules, because "everything went fine and it would most certainly happen again".

When the firefighters were training they always knew what the goal of the training should be. That was always communicated and discussed before training. When they were preparing for a real operation, the chief fire manager on site went through all the information they had before entering a site. Everybody on the team knew their specific tasks and what they should achieve. "If we do not know what we shall achieve, the safety margins decreases immediately", he said. When they had a lot of information about the situation regarding how the building was constructed and how many people were in the building, it was easier to keep the safety margins at an acceptable level. If they did not know anything about the place they were about to enter, it was easier to exceed the safety margins, but that was something everybody on the team knew.

The entrepreneur said that the company had agreed on the end state with the contractor before they started their job. It was written down in the contract and also discussed with the contractor. He explained that it was very important to do that, because then they knew what kind of procedures they should use during the construction period. That involved both what kind of equipment to be used and which of the employees that should be involved in the work.

Every employee knew their tasks, and they had morning briefs before they started up their work, where the goals of the work for that specific day were discussed. It was normal that the end state had to be modified, both on a daily basis and regarding the total end state. That was because the environment could rapidly change. They could meet obstacles in the environment. The ground could present problems regarding the content of the soil, and then they had to change the end state. He said that it was important that the middle leaders communicated the changes both to the contractors and to the employees.

They had a culture where the employees had no problems with communicating with the management, when they had discovered new things that would affect their work and could lead to using more time on a specific task. He said that this openness was very important. In previous companies he had worked with, the communication was not that good, and that had sometimes ended up in accidents.

Normally they had an option in the contract, where they could charge more if they experienced situations which no one could have anticipated before they started the job. This was very important, because if they did not have the possibility to renegotiate they could lose a lot of money, and that could lead to decreasing safety margins because of the importance of making profit to the company.

The safety manager said that normally every employee knew the goals of the tasks they were doing. Sometimes they were involved in operations that could be risky. In these situations the goal of the operation, was not clear enough, and he meant that they were lucky who did not have experienced any major accidents. They had recently started a project that hopefully would bring the situation regarding personal safety on the table and increase the safety.

3.4.3 Experience transfer by communication, training, exercises, learning and deviation

All of the respondents proposed five factors that could lead to a good experience transfer: communication, training, exercises, learning and deviation. In this section the respondent's answers to all these factors will be described.

The counterterrorism unit said that after every exercise and mission, they discussed what was good, what could be improved and what they had learned. Every other unit did the same and they got a management summary every day about what the other units have experienced. Everyone had to sign that they had read the summary and it was mandatory to talk about the summary in the unit. They asked themselves: "What does the experience mean for me as an individual and for us as a team?"

If there were several units who conducted a new exercise, the management summaries were discussed later the same day or early next morning. They had a rule that they should never to something that could decrease the safety margins based on procrastination. The timespan from when an experience was made, and to the time when the improvement of procedures was implemented, was never more

than 2 days. "If we do not fix it immediately, we can die", was their response to my question on why they fixed it immediately.

Every day they talked about fictive situations that they believed they could face. They tried to discuss every aspect of a mission. That included how they communicated and what they did if something unexpected took place etc. There were almost no fictive operations that were too strange to discuss. "We are challenged by people who think differently and who acts differently than the normal threats". They were worried that they could experience losses that could have been avoided if they had talked it through before, and that was why they thought reflection groups were one of the best ways to increase the experience transfer. "Talking and discussing is way better than just reading", they explained. When they discussed solutions, they could end up discussing the entire organization and also what it meant for each member of the team and the interaction between them. After every near miss or mishap they described the happenings in their deviation system, which was available to all units. They discussed in teams when needed, after they read the summary from the group of employers and employees who were in charge of the deviation system. They were never punished in any kind of way for reporting to the deviation system. "Punishment would ruin the entire system", one of the members said, and explained that they would seldom use the system if they knew they were punished for reporting errors. That could dramatically decrease the safety margins.

The military leader believed in an apprenticeship as one of the best learning methods for experience transfer. The on-the-job training has been proven to be effective in the military. It requires experience of the teaching soldier. He said that some of the tasks performed in training were quite difficult and that the soldiers sometimes needed close follow-up. If there were too inexperienced soldiers there was a chance that the training would not be appropriate at their level and that could minimize the safety margins both in training and exercises and insufficient if they were to use their skills on real missions. The military had both debriefing and defusing sessions after they had been through tough situations. The military leader explained that these gatherings were excellent arenas for experience transfer because they learned from real-life situations and could discuss the experience with each other and with the leaders. They had deviation systems, and they discussed deviations that were relevant for them. He said that they could probably be even better in communicating near misses and mishaps to each other.

The helicopter pilot explained that they always discussed dangerous situations and near misses with their colleagues, and he thought that this was one of the best ways for experience transfer.

They used a system called Opscom for experience transfer. After near misses or accidents they described the mishap in the system. It was immediately sent to the management, who took the

necessary actions. The recorded event together with an FSL (Flight safety letter) was distributed to every pilot. They were not allowed to fly until they have signed that they have read and understood the FSL. He thought that the systematic use of the Opscom system provided great learning opportunities both individually and for the company. Before an operation where several helicopters were involved, they discussed the operation with each other. If this communication showed that one of the pilots had doubts about flying, then the operation was set on hold. If that happened, they involved the chief supervisor. This procedure was important regarding safety margins. They always wrote a report about their last flight and they also had to read reports from the pilot who had the last flight before them. They discussed the situation both when they succeeded and when the safety margins had been challenged.

The entrepreneur said that they had morning briefs where they communicated and discussed the plan for the day. They also discussed deviations that were important for their job with everyone involved in the operations. Everyone had the chance to ask questions about their work, and often safety related topics were discussed. He thought these discussions were very good and important regarding safety margins. He said that they could be better in communicating deviations, because he knew that some of the deviations were not communicated to absolutely everyone who should know about the near misses or mishaps. They had a system where new and unexperienced employees had the chance to work close with more experienced employees, and he thought that was good for learning.

The firefighter said that between every shift the team members and leaders on duty talked with each other to get information about the last shift. They also had a whiteboard where they wrote down if some of the equipment was defect and if something special had taken place at the shift. He thought this was a great opportunity for experience transfer. They had a deviation system where all near misses and accidents were written down. They discussed these situations in their team, but he thought they could be even better, and have more systematical discussions about deviations and how to communicate important deviations to the involved people.

The safety manager said that they had morning briefs every morning where they discussed the plan for the day and the progress of the projects they were involved in. They discussed both success stories and situations where they had need for some help. This was an arena where safety issues and deviations were discussed. They had developed a new deviation system, where near misses and accidents were reported. As part of improving the safety culture in the organization they had communicated to everyone that no one would be punished for reporting near misses or mishaps. He thought that this was one of the reasons why the reporting had increased by more than 300 %. The new system had made it easier to communicate the deviations, but he explained that they had not succeeded in communicating deviations in a systematic way to management on a higher level. When they participated in risky

operation, they performed a safety job-analysis before the operation. Sometimes this led to training sessions, to increase their skills and knowledge. These sessions had sometimes ended up in what he called "deep" learning, where they discussed every aspect of an operation. The feedback from the employees had been positive towards this learning.

The members of the counterterrorism police unit were all very experienced, and according to media they were one of the best counterterrorism police units in the world. "We know we are good, but everything is temporary. We do not know what tomorrow brings of challenges, so it is very important that we train every day to increase our performance". Almost 60% of their time at work was based on training. The team leader said that: "We always have in mind that we can meet people who are highly skilled, so our everyday training is a way to keep our senses alert" They introduced unexpected events in their training, to test the procedures and decision making skills. They used helmet cameras during most of their practices, and there were operators who gave them live feedback during training. The group said that the live feedback helped them a lot in their performance, because they could adjust their procedures immediately. They also used cameras in the training facilities and they coordinated the pictures from the facilities and from their helmet cameras to give the best possible feedback. After the training they evaluated what they had been through. They discussed what was good and what could be improved both regarding individual performance and unit performance. They said that because of this brief they had developed new techniques and improved both written procedures and their ability to improvise when unexpected events took place in real missions.

The military leader said that they trained a lot, and that it was considered very important regarding safety margins. The problem was that the time they could use for training had been reduced a lot the last years. He said that the reduction in training could affect the safety margins. That was because they would use longer time to automate their skills that was very important both in training and on missions. Every soldier in general knew the safety margins regarding training. The safety margins were set because of regulations and by their own internal standards, but the military leader said that in some situations the margins could be too broad and that could be a problem because the gap between practice and real missions could be too broad. The military leader explained that no one had ever told him after a mission that "we trained too much".

The entrepreneur said that their company seldom did any training, but if their safety job analysis showed that the skills from the employees did not meet the demands of the task, the employees had to train. It could be both individual training and training as a group. Usually the supervisor or one of the experienced employees took charge and arranged the training. Without this training, they could not perform the task.

The helicopter pilot stated that the pilots and management talked a lot about different risky situations that they can face on their operations and flights. They used flight simulators in their training period at school, but they seldom used flight simulators after they started working. Pilots have to go through certification every 6 month or annually, depending on the certification. They have to show to the regulators that they can handle every helicopter model that they used. The pilot said that if they flew more than 3 models annually, there could be a problem with their up to date skills on every model. When they started to fly a new helicopter they have to train before they could start their first flight on their own. Every six months they went through an Operator Proficiency Check (OPC). An OPC is an analysis conducted by a training captain and is for the purpose of testing the operations being performed by the pilot. It usually takes an hour. Every year they also go through a Proficiency Check (PC). A PC is an analysis of the pilot skills and knowledge in a particular operational area. They have to go through a PC on every helicopter model they use. The pilots are required to undertake proficiency checks to ensure that they are competent conducting particular kinds of operations, because after gaining a qualification, it is quite normal for some of the skills to deteriorate over time. A proficiency check ensures that the skills continue to meet the standards from regulators.

The firefighter said that they have to pass annual tests including strength and endurance tests. The firefighters have a competence pool where the demands of every task and position are listed. The individual competence is marked on the check list, so everyone at the station knows what you have been through of drills and exercises and what competence level you have. Dialogues between firefighters were also considered to be training. They talked with each other about obstacles and challenges they could meet both in training and on missions. The results could lead to requirements of certain performance training to meet the challenges they faced. They also prepared themselves mentally for future missions. They could think through fictive scenarios and how they could handle them. It was also normal to go through scenarios when they were on the way to a site.

When they are on an operation they get information from 110. They always ask the driver if he knows the address. They will always strive to make each other better, and question asking with the purpose of increasing their awareness and skills is important for avoiding a decrease in safety margins. The tasks and roles are already established at the beginning of their shift. They go through their gear and equipment at the beginning of their shift.

The safety manager explained that earlier, they seldom arranged training, but the last year they have started up with more systematic training. They use the results to discuss how they could improve their overall safety performance. The training had been quite brutal, because they now knew that they did not have the skills to meet the growing challenges from the surroundings regarding safety.

3.4.4 Risk analysis

The counterterrorism unit said that in their training, their safety margins were based on previous risk analysis. There were risk analyses made both from the top management and the unit. Based on their level of skills, the risk would often be different compared to a regular police unit. What some regular police force described as red could be yellow from the counterterrorism unit point of view, because the counterterrorism police unit were more experienced and had more skills on certain tasks, in comparison with the regular police force. The unit stated that they always made their own risk analyses based on the management risk analysis because they had a need to dig deeper into the risk. If not, the safety margin would decrease. The risk analyses were repeated when they were introduced to new training methods, change in equipment, new threats in the environment etc. The procedures they used were based on the risk analyses. That was why the risk analyses had to be up to date.

The military leader explained that The Norwegian Armed Forces had a document called "UD 2-1 The Norwegian Armed Forces Safety Rules and Regulation for Land based military activities" (2014), which presented risk analyses for their training, exercises and missions. They were updated every sixth month or more often. The military had made risk analysis on every possible risky activity, and the procedures were made according to officially documented the risk analyses. When they were on a mission they always went through the procedures, unless they did not have the time.

The helicopter pilot stated that they performed risk analysis on every known task. When they were performing a risk analyses on a new activity they involved approximately 10 pilots and the training captain. At first, everyone performed their own analyses. Normally the deadline was 14 days from when they started out. They found the risk factors which they figured were relevant and they estimated the probability and consequences and they suggested risk decreasing actions. After the individual risk analyses, everyone met up and discussed the findings with the goal to find consensus in the group. If there were any disagreements, the flight leader had the final word. Before every operation the helicopter pilots read the analyses, but they also performed a safety job analyses on the specific task. The pilot said that the law and regulations demanded that, and he thought that the safety job analysis were extremely important. That was because every situation different even though it was the same type of task that was about to take place.

The firefighters performed risk analysis on every known task, and they also performed a safety job analysis before operations. These were revised continuously. The supervisor revised the risk analysis, and the analysis had to be approved by the chief fire officer and the work environmental committee. The supervisor worked in the sharp-end and also regularly had contact with the management. The

firefighter said it was a good thing that the work environmental committee had to approve the risk analysis. In the committee there were representatives from both the management and the employees. When they were about to enter a fire site, the chief fire officer went through the procedures. The procedures were based on the risk analysis.

The entrepreneur said that they performed risk analysis on every known task and they also performed a job safety analysis (JSA) before every task which involved risk. Every person involved in the task participates in the JSA. He explained it was important that the JSA was taken seriously, because even though they had done the same task before, the environment was never the same. The entrepreneur thought that the JSA was an excellent arena to discuss risk, because "then you discuss a real situation, and it is not just theory". If they did not perform JSA the safety margins were decreased. He said that not every entrepreneur company performed good JSAs, and that had resulted in accidents.

The safety manager said that they performed risk analysis on tasks that involves risk. They had to do this annually. The people involved were normally the safety manager, one person from the safety department and the safety representative. Lately they had also involved an external consultant which was an expert on safety management. The safety manager thought it was very important to perform risk analysis, but he felt that it was difficult to communicate the results to the rest of the company.

3.4.5 Procedures and sharp-end involvement

All of the informants explained that they had procedures on almost every known risky action that took place in their work. The counterterrorism police unit also had procedures about what to do if uncertainties and unknown risks took place.

The members of the counterterrorism police unit said it was important that the leaders involved the unit, because "we know what happens in the real world". The counterterrorism police stated said that they had procedures of all known risky actions that took place in both training and on their missions. If not, they said that the safety margin would be crossed too many times, and that the results could be fatal. They explained that the procedures had some space for differentiation because both in training and in real missions, the tasks about to be performed could take different turns and there was almost impossible to have procedures on everything that could take place. They said that if you were too rigid regarding procedures, you could put yourself, your colleagues and a third party in dangerous situations. Almost every training, and especially every mission, introduced something that was different from the content in the procedures, and if they were too governed by procedures they stated that they could miss important clues in the environment, and that could lead to accidents. The procedures were changed continuously based on new research, new training methods and based on the experiences from both training and missions that the unit themselves or other units had experienced.

They also had close cooperation with counterterrorism units in other countries. Their experiences also contributed to the change of procedures. If they introduced new equipment and subtasks they also had to change procedures. They had a timespan of less than 2 days from when they experienced the need to change procedures, until the procedures should be implemented in the other counterterrorism police units. They thought that the rapid response was in general very positive regarding safety margins, but they were also aware that responding too fast could leave out some factors that could be important regarding safety margins. The unity meant that procedures which were outdated were useless and could decrease safety margins.

The development and improvement of procedures were based on close cooperation between management and operators. One of the unit members said that he was more involved in both development and improvement of procedures in the counterterrorism unit compared with his previous work as a police officer. The unit leader explained that it was utterly necessary that everyone involved in missions had to be a part of developing and improving procedures. "If you have never experienced the trouble and complexity that we meet, there is no way you can make procedures that will be good enough regarding safety margins", the unit leader said. The members of the unit stated that they felt safer when they knew they had a saying about the procedures.

The unit had to memorize all procedures. Before implementing the procedures for the first time the unit thoroughly discussed the procedures and they all had to present the procedures for the unit. They said that it was easier to improvise when they knew all the procedures. Every day they gathered and discussed procedures and possible harms that they could be exposed to. They thought that these reflection groups were perhaps one of the most important factors regarding keeping the safety margins at the best level.

The military in general, and the branch where the military leader worked in, had procedures for every known risky work. The procedures were developed and improved as a cooperation between management and soldiers. However, not every soldier participated regarding development and improvement of procedures. That was based both on the huge amount of soldiers and the varying experience level they had. Experienced soldiers and the military leaders took part in the development and improvement of procedures. They were extremely focused on end state both in training and on missions, and they discussed the procedures as a part of their goal of reaching the preferred end state. Procedures were improved based on experience from both training and missions, and like the counterterrorism unit, they had close cooperation with military in other countries. Because they had a lot of soldiers and military leaders they had to have procedures on every risky action. If not they could end up with too many different ways of solving potential dangerous tasks. When they trained, they had to follow procedures all the time, but in combats, they could break the procedures if the surroundings

and enemies were differed form expectations. The military leader assessed that both types of decisions could keep the safety margins within as acceptable levels as possible.

The entrepreneur said that his company had procedures on every known risky activity. It was developed and improved as a cooperation between management and experienced employees who had more formal responsibility. The entrepreneur explained that without procedures, accidents would probably take place very often and the safety margins would be crossed daily. The consequences if an accident took place would be deadly in many occasions, and he said that in the entrepreneur industry there were accidents that lead to loss of life annually. Because of the increase of foreign workers, the importance of updated procedures was more important than ever. He experienced that workers from eastern European countries had a different safety culture than in Norway. They took more chances in work, they could forget to use the safety equipment, and some of them had a mind-set that accidents were normal, and nothing to worry about. It was important that the procedures were written in different languages, so that every employee could be familiar with the explanation. The development of procedures into different languages could also be something that increased the safety margins, because the employees who developed the procedures had to discuss important factors regarding procedures with others and because of that, it could increase their understanding of the importance of relevant procedures. If the procedures did not work as expected, the operators summoned the management, and the procedures were revised as soon as possible.

The safety manager stated that the company has procedures on almost every activity. The problem was that some of the procedures were out of date, and that they were seldom used. One of the reasons for that, the safety manager thought, was probably because both he and the employees were not involved in risky work on a daily basis. However, he knew that some of the procedures were out of date. He took the responsibility for the situation, but he said that the safety culture regarding safety was not good. The general manager did not care about safety to a large extent. He could argue along the lines that: "We have never experienced any accidents for many years, so it means that we are doing everything right. Why waste money on something we do not need".

The safety manager explained that this safety culture had to change, because they would not be prepared if something happened. He thought that the attitude towards safety had changed for the better the last years, but still IT-security had the highest priority. There was also confusion about who was responsible for development of procedures in the organization. The safety manager said that because of the interview for this thesis, he would start to improve the procedures in cooperation with some of the employees.

The helicopter pilot said that they had a lot of procedures in the organization. They do a pre-flight inspection (PFI) before their first flight after lay-offs. They inspect the entire helicopter by themselves, where they follow written procedures. They are not allowed to wear their personal cellphone, because if they get a call, it could distract them from their inspection. They had examples of accidents that had taken place because the PFI was interrupted by a phone call and the pilot forgot to remove loose objects, that later on caused the accident. They also do a daily inspection (DI). It is done before the first flight of the day. It is almost as comprehensive as the PFI. After every flight they do a walk around (WA). They inspect the helicopter to look for deviations. After the last flight of the day they do an inspection called After last flight (ALF). All these procedures require use of many of the senses. They look, listen, feel and smells. They wear the company cellphone during inspection, and that can be a threat towards the inspection, but since it is the company cell phone they are in a better "safety-state", if they have to answer the phone call.

The procedures during a flight have certain "must do" tasks involved, but they are broad enough so you can have individual adjustments. They have procedures based on the wind direction, the weather, the weather forecast, the environment etc. During flight, you have to draw the synergy from every procedure, and it means that you sometimes have to break some procedures if you think the outcome will be better. It means that if you always follow procedures, that can lead to accidents. The pilot said that experienced pilots had a better understanding on when they should break procedures during flights.

The firefighter said that they had procedures for every risky task. The procedures were revised continuously. They were revised because of change in laws and regulations, change in equipment, new tasks, if they experience weaknesses and if the procedures did not work as expected. The supervisor revised the procedures, and the procedures had to be approved by the chief fire officer. The supervisor works in the sharp-end and also has regular contact with the management. It happened that they had to break the procedures during missions when they saw that a procedure did not work out for the exact situation. This demanded experience. They never had a unit with just employees who came straight from school. If they did not have a lot of experience it was easier to follow procedures without thinking about the consequences in dangerous situations, and that could turn out to be fatal. When you were in a dangerous situation, the firefighter said that you had to use all of your senses and you had to be able to anticipate the next step to a certain degree in order to make the right decision. If the procedures did not work; then they were immediately revised and communicated to all the acting employees. The firefighter said that there should never be a gap between what you think will happen and what really goes on at work. That is why it was so important that the procedures were revised by someone who knew what was going on at the sharp-end, according to the firefighter. They had to continuously go through the procedures, and try to memorize them, and talk about them. They had no

time to read the procedures when they were working at the fire site, but sometimes they had time to discuss before their mission started. The pep-talk was important because then you had the chance to discuss what was about to take place with the colleagues and supervisor, and you could get their opinions.

3.4.6 Decision making

The counterterrorism unit said that decision making was extremely important and that they wanted the decisions to be based mostly on facts or extensive experience. They recognized that decisions based on gut feeling could be dangerous, and that they always reminded themselves about how they made decisions. They explained that "We like to think that our gut feeling is based on experience, and sometimes it is, but we also have done some terrible choices based on gut feeling decisions". When they trained they discussed decision making all the time. They got live feedback from videos both from their helmet cameras and from cameras on the training site, and after every practice they went through the videos and discussed why they did what they did. These discussions were one of the best ways to improve decision making, and they thought that it was one of the most important things to avoid a decrease in safety margins.

The military leader said that decades ago, decision making was mostly based on what the procedures told them, and that did not always work out fine. After the Vassdal-accident in 1986, where 13 soldiers lost their lives in an avalanche, they did not have to follow procedures 100%. They trained a lot and talked about decision making. The military leader thought there was a problem that they did not have more time for training, because he said that decisions based on training with real situations, were the best. In training, they gathered experienced soldiers together with unexperienced soldier. The military leader thought that the culture was better now regarding decision making, because they had more autonomy regarding decisions now than earlier. On a mission, the commanding officer or the person with the highest rank made the overall decisions. It was extremely important that they knew the end state; because if not, they could make decisions based on the wrong end state, and the consequences could be fatal. They were allowed to make their own decisions in combats. He explained that the more experienced you were, the better decisions you usually made, because the movements and skills were more automated.

The helicopter pilot said that they discussed situations that could happen and what they should do if an accident was about to take place. Sometimes they had less than 1 second to make a decision if something dangerous was about to take place, and if they chose the wrong decision there was a huge possibility that they would risk their life. This type of decision making had to be automated. They had to fly a certain amount of hours annually to keep their license and that was good for the decision

making. "If you are not familiar with a flight model, accidents can easily occur". They had to know their own limits both mentally or physically; if not, they could push the safety margins too much. If they were not feeling fine they were not allowed to fly, because that could affect their decision making in a negative way, since they had to rely on all their senses and experience to avoid a decrease in safety margins. The most potential threat to safety margins was something the helicopter pilot called "get home it is". It meant that you were likely to accept more threats to safety margins just before your shift was over, and you were ready to go home, compared to the focus you presented before the first flight of the day. Many of the accidents in the industry happened because of the "get home it is" syndrome.

The firefighter said that the chief fire officer made the decisions before entering a fire site. When they were inside the house, they had to rely on their own decisions. Experience was a very important factor regarding decision making. If they had experienced a situation before it was easier to make the right decision. When they were on the way to the fire site they visually thought through what could happen. The firefighter thought that this visualization was very important. He felt that he mentally prepared himself and got into a good flow-zone. They never put together a team of only young and unexperienced employees. They thought that could affect the decision making in a negative way.

The entrepreneur explained that normally their decisions were based on facts regarding information about the construction site and specific tasks. If the employees were uncertain about a decision they had to ask other employees or at the end the management. He thought that the organizational culture was based on respect and you could be sure that you would not be punished if you spoke up about something you disagreed with, or if you told the management that you were uncertain about what decision to make. The entrepreneur stated that the company he worked for now was far more professional than the previous companies he had worked with. They put together teams of both young and more experienced employees. They thought that this mixture would lead to better decisions. They never let only young and unexperienced employees work together, without any supervision from more experienced employees or management.

The safety manager explained that in risky situations he thought that the decisions were based a lot on experience. He felt that the organization learned much from organized training. The problem was that they seldom had a situation with risky work on a daily basis. He felt that it was easy to forget the procedures, and if a situation occurred suddenly, they did not have any time to find the procedures.

3.4.7 Management of complexity and safety culture

The respondents mentioned complexity as important regarding safety margins. They were all involved in situation where they had to consider many factors regarding potential threats against their safety margins. The helicopter pilot said that he had to use all of his senses both before, during and after is flights in order to have control of safety. One example is that when he is on an operation he always has to look for places where he can land in case of emergency.

The respondents said it was impossible to categorize the different factors regarding safety margins from the range of most important for avoiding decrease in safety margins in risky work, to least important. Everyone explained that each factor was dependent on other factors, and that the complexity regarding the context of the factors was important. The counterterrorism police unit and the military leader stated that they discussed complexity a lot, because they had to manage the unexpected both in training and on missions.

All of the informants mentioned safety culture as an important factor to avoid a negative decrease in safety margins. They had almost the same understanding of safety culture. Everyone said that when both the leadership and employees prioritized safety, "safety first", the organization had a good safety culture. Everyone emphasized the importance of leadership regarding safety culture. If the leaders did not prioritize safety and also did not "walk the talk", the respondents pointed out that it was almost impossible to get a good safety culture.

The entrepreneur explained that his current organization had much more focus on safety than the previous organizations he had worked with and he thought that high focus from leaders on every level in the organization was a major contribution to that. The counterterrorism police unit, the military leader and the firefighter stated that if there were continuously a distance between theory and practice regarding safety, the safety culture was not good.

The safety manager mentioned that his CEO defined the absence of major accidents in the past as a guarantee for future success and a signal of a good safety culture, but the safety manager did not agree with his statement.

3.4.8 Classification regarding safety level and exposure

The respondents placed themselves in a figure which differentiated between if they were facing safety or security threats, and if they faced the threats on a daily or less than daily basis. Based on their

classification the counterterrorism police unit faced security threats on a daily basis. The military leader also faced security threats, but not in general on a daily basis. The helicopter pilot could sometimes face security threats and he was exposed to safety threats on a daily basis. The firefighter faced security threats a bit more seldom than the helicopter pilot and he also experienced pressure towards the safety margins almost on a daily basis. The entrepreneur seldom faced security threats but he experienced safety threats almost daily. The only respondent who faced security and safety threats less than daily was the safety manager.

3.5 Case discussion

The aim of this master thesis was to answer the main research question about how to avoid a negative decrease in safety margins in risky work. For this purpose seven research hypotheses were constructed from the safety literature and tested in a case study. The results were gathered from individual interviews and discussions in a focus group. Eleven common factors, presented by all respondents to avoid a negative decrease in safety margins, were identified in the analysis, and these factors are presented in section four. In addition there were thirteen other factors which one to three of the respondents regarded as important relative safety margins.

In the following section, the methodological reflections about the findings of this study will be presented, and the results gathered from the individual interviews and the focus group will be discussed against relevant theories. This part will thus connect theory and empirical findings in order to answer the main research question and the related hypotheses that were presented in the introduction section.

3.5.1 Methodological reflections

In order to say anything about the quality of the findings in this study, two central methodological aspects need to be discussed: reliability and validity.

A measure cannot be valid unless it is reliable (Howitt, 2013). Therefore will the following mention a few aspects that might have influenced the reliability, i.e. consistency of the results, for example regarding language use and interpretations, as well as interview conduct. In order to investigate the reliability of the case the research process is described and explained.

One factor that has to be considered regarding reliability is the challenge of translating the respondents' statements as correctly as possible from Norwegian to English. Because of these

challenges, the focus has been to present the essential information in the quotes as accurately as possible, so the respondents meaning are believed preserved.

Another challenge regarding reliability refers to the fact that the interview with the counterterrorism police unit was conducted in English, which was not the native language for either the researcher or the respondents. The researcher claims to speak English fluently from his point of view and the counterterrorism police unit also claimed to be fluent in English. The unit said that they cooperated with counterterrorism units in other countries and the working language in those situations was English. When there is a dialogue between people who are not communicating in their native language, there can be words and sentences that are not expressed the way the sender intended, and the interpretations in the receiver end can also contain flaws.

All of the respondents had the opportunity to check the transcriptions from the interviews and focus group discussions written down since those were sent to the participants. There were some additions to the written material from three of the respondents, and two of the respondents clarified some of their earlier thoughts which could be misinterpreted. The check related to the counterterrorism unit was made by the team leader and only one of four unit members. This could possibly affect the validity, but since their thoughts and reflections which they presented in the focus group about safety margins were very similar, the issue is probably not a major one.

The findings in this qualitative study are based on the respondent's subjective understandings of the topics being discussed and that brings up a question if the findings are valid. Are the respondents telling the truth? Could some information be withheld from the researcher? The counterterrorism police unit in the focus group said that some information was classified by law, and because of that information that could have illuminated new perspectives might have been lost. Groupthink could also occur in the focus group, as could a wish to make a good impression, but the unit was clear that one of their strengths was openness.

Another aspect regarding reliability involved the interview guide. The interview guide used in this study was based on open-ended questions, and it is possible to argue that a more structured interview guide based on previous research would give more reliable answers. However, due to the investigative purpose of the study, the decision to get the respondents view without being too structurally framed, was made. This decision made it easier to follow up on unexpected issues that were brought up. The respondents were regarded as experts and they had no problem with the open-ended format. Furthermore, the respondents illuminated lots of the same important factors regarding safety margins, based on the initial open-ended question: "Which factors are important to avoid a negative decrease in safety margins?".

The questions used in the interview guide were based on research and literature about safety. If the researcher had used different research literature, there is a possibility that the question could have been different. However, the research and literature used were based on searches in NTNU´s databases and the literature that had been recommended during the years the researcher had studied at NTNU.

The coding and classification could be a challenge when the researcher had not used tape recorder for the data collection. Because the researcher was not allowed to use any kind of recording device when he conducted the focus group with the counterterrorism police unit, he decided to not use any recording device in any of the individual interviews. It is obvious that words and sentences will be lost when the researcher has not transcribed everything that has been said. Sometimes the researcher asked the respondents to repeat some of the answers in order to write the sentences down on paper. This could interfere with the rhythm of the interview, but could also give the respondent an opportunity to think through their answers and by that give more profound answers. The researcher's background as a therapist with more than 20.000 individual consultations will give more validity to the data collection because he has been used to conduct interviews without use of tape-recorder with clients.

There are some considerations to be done regarding the use of thematic analysis. The data familiarisation, coding and generating themes could be influenced by the research hypotheses, but since the respondent's answers to the first question which was the main research question, generated topics that were almost identical with the research hypotheses this is not considered a major problem. The initial coding generation was difficult and overwhelming in the beginning. Too many initial codings were very similar to each other and those were combined. Some coding was changed several times. The reason for this similarity can have its origin in the researchers approach to practice the process of coding on the entire data material from the beginning instead of starting with a small piece of text. In that case there was a huge amount of coding which had too close similarity. A lot of time was used to re-name codings, but what was considered waste of time in the coding process, also gained deeper knowledge of the material because the researcher had to read through the written material several times.

The themes based on the initial coding also changed during the analyses and the interplay between the coding phase and theme-generation phase could sometimes be very close because some of the codings, such as decision making, ended up as themes. The theme labeling displayed close similarity between certain themes and it could be difficult to decide which kind of data that belonged with the different themes because they could fit in several themes. The close similarity between themes can affect the validity, but the researcher thinks that it reflects the answers from the respondents regarding the close

connection between different factors which influence safety margins. Feedback from the researcher`s supervisor also created more clarity about the themes.

The respondent's relation to safety regarding their position, the threats they faced and how often they faced risk, could affect the reliability of this study since they answered the questions based on different viewpoints. All of the respondents did however have extensive experience in the sharp end, and the views they presented in the interviews and focus group vindicated their knowledge of investigated themes.

Social desirability bias which is a tendency of respondents to answer question in a manner that will be viewed favorably by others (Krumpal, 2013) could affect the reliability of the results in two ways. The respondents were selected to the interviews based on their work, and there is a possibility that they felt like they were representing their organization, and thereby would illuminate their organization in the best way possible. As individuals there was also a chance that they would compare themselves with the other respondents, especially in the group interview, and give the researcher the impression that they were the best respondents. The counterterrorism police unit which represented another country could also feel that they were the country´s face, regarding aspects related to safety, and by that means exaggerate how they thought about safety margins. There was a tendency among all the respondents to have a humble approach to the themes discussed, so there is a chance that this bias described could be rather weak..

Validity stands for accuracy or correctness in relation to a criterion (Howitt, 2013). In this context: can the results be generalized to other similar settings?

Because of the low number of respondents the results in this thesis cannot be expected to provide essential theoretical or methodical contributions to the field of safety. The aim of this study was not to generalize the findings to all safety related workplaces, but to test available hypotheses across divergent work risk situations. The study offers an empirical contribution to theoretical hypotheses related to safety margins.

Since the respondents had different backgrounds and worked in different areas regarding safety, their answers to the researcher`s questions would be affected by that. They were all presented a drawn figure (Figure 2 in section 3.2.2) which exemplified what was meant by a safety margin and how it worked as a buffer between the safe work and situations where accidents or unexpected negative events took place. Even though many of the factors mentioned by the respondents where the same, there were also some differences in their answers. It makes sense in a way because they worked within different fields of safety, but it can also be that they thought differently about safety margins. The

safety manager, who did not face safety threats on a daily basis and almost never would experience consequences regarding his own life and health at work, was more focused on the broad picture of safety margins, compared to the helicopter pilot who had to continuously think about safety before, during and after several flights and operations during the day. The respondent`s first thoughts about safety margins in the interviews showed these differences. The selection of diverse backgrounds could affect the validity, but it also illuminated a broader view regarding safety margins.

Both the military leader and the counterterrorism police unit talked about the importance of drills and real missions in relation to safety margins, and at times they did not differentiate between these two situations when they elaborated their thoughts. The researcher asked for clarification if they were talking about drills or missions, since the stakes regarding safety normally are higher when they are on a mission. However, in both cases, and especially the counterterrorism police unit, underlined that their drills were as close as possible to real life events, so this unclearity might not influence the validity too much.

3.5.2 Contributions from this case

This section will first discuss general tendencies based on the respondent's answers, before the discussion move on to more specific patterns related to safety margins that can contribute to the research literature.

3.5.2.1 General remarks

The respondents own placement in the figure (Figure 1 in section 3.1.3) which differentiated between if they were facing safety or security threats, and if they faced the threats on a daily or less than daily basis, showed some patterns and variations across the respondents. Based on their classifications the counterterrorism police unit faces security threats on a daily basis. The military leader also faced security threats, but not in general on a daily basis. These two respondents mentioned most factors which influenced the safety margins, and it can be argued that when you face security threats the focus on safety is, or should be, higher then when you seldom face security threats. The reason for this, can be that security threats introduces more unknown events which can lead to more impact on safety margins and consequences from accidents.

Both the helicopter pilot and the firefighter mentioned that they could sometimes face security threats and they were exposed to safety threats on a daily basis. These respondents mentioned fewer factors that affected the safety margins than the counterterrorism police unit and the military leader, but more factors than the rest of the respondents.

The entrepreneur said that his organization seldom faced security threats but they experienced safety threats almost daily. The only respondent who faced security and safety threats less than daily was the safety manager and based on the answers, the security manager presented less factors that could affect the safety margins than the other respondents.

There are too few respondents over all to make robust conclusions regarding the respondents own classification regarding if they were facing safety or security threats, and if they faced the threats on a daily or less than daily basis and the results from the interviews, but there is an indication of an interesting pattern. The more specific answers about safety margins will be addressed in the following.

3.5.2.2 The level and presence of leadership and sharp end experience

All of the respondents mentioned leadership as one of the most important factors regarding safety margins. The respondents said that when they experienced that their closest leader had a high focus on safety and "walked the talk" they felt more satisfied regarding safety margins. This creates trust (Andersson et al., 2006) and trust between leaders and employees lead to better performance regarding safety (Bass et al., 2003).

The organization where the safety manager worked in did not have high focus on safety from the higher leadership, and that affected the safety margins in a negative way. The safety manager explained how there were seldom any personal consequences for the leaders in the organization if they broke the law and regulations. Based on the fact that the safety manager mentioned significantly less factors which could avoid a decrease in safety in the individual interview, it can be argued that this lack of personal consequences can decrease the focus of safety and thereby decrease safety margins. The level of leadership described by the respondents varied. The employees interviewed; the firefighter, the helicopter pilot and four of the members in the counterterrorism police unit talked about their nearest leader which was usually a middle leader. These types of leaders were close to operations and all had sharp end experience. The respondents stated that the sharp end experience from their leaders was a sign of quality because the leaders had experience with the field of safety and also still had the "employees mind" regarding safety. The entrepreneur, safety manager, military leader and the team leader in the counterterrorism police unit described both how they as leaders could affect safety margins and also have their nearest leader affected safety margins. It seems like the presence of leadership was regarded as important and it gets support in the research literature (Dahl and Olsen, 2013). Both how the leaders in this study were present for their employees and how the leaders in this study felt the presence from their closest leader. All of the respondents, except the safety manager explained how leaders on a higher level in their organizations had sharp end experience. Regarding the respondent's answers in the interviews it seems like sharp end experience

from the leaders is necessary to avoid a negative decrease in safety margins in risky work. The answers from the respondent´s supported that the research hypotheses number two about the importance of leadership.

3.5.2.3 The understanding and the level of end state

The research hypotheses number three in this thesis suggested that a lack of a unified end state could cause negative consequences to safety margins. In the case of the counterterrorism police unit and the military leader, they faced threats against their lives both in training and exercises, but especially on missions, and the result could be fatal if there were severe goal conflicts or misunderstanding of the end state among the involved people. According to the research literature goal conflict can affect the safety margins in a negative way (Dekker, 2011). The counterterrorism police unit and the military leader discussed the end state among the involved people, and everyone had to know it and explain it to the others in the group. Since these dialogues were mandatory and part of their safety culture, these types of jobs could be an exception from what Dörner (1989) says about contradictory goals as the rule, not the exception, in complex situations.

All of the respondents had different solutions on how, and where to discuss the end state. These discussions about end state should be mandatory in every profession who is dealing with risky work. The discussions can challenge aspects and get a deeper understanding of the end state. That is better than just reading about it and can create double-loop learning (Argyris, 1977). However, there are some considerations to think through. To know the end state is not the same as the end state is understood by everyone involved. The need of verbal interpersonal communication between all the involved people can be considered important. When this kind of communication is regarded as good it will lead to a sense of ownership and can thereby increase the level of trust among the involved people (Löfstedt, 2005)

If external parties are involved in operations, the solutions about end state presented by the entrepreneur and the helicopter could be an option. They explained that they had an agreement with the contractor about the end state before an operation took place. This understanding of the end state could avoid the goal conflicts that can happen because of both time pressure and economic expenses, and can be considered important to avoid a decrease in safety margins where external parties are involved. If organizations are bounded by these types of constraints it can lead to migration towards the non-accepted limits of boundaries (Rasmussen, 1997).

The respondents described different levels of end states. The counterterrorism police unit and the military leader described both strategic and tactical end states, while the other respondents mentioned

more operational end states. These different views and levels of end state can affect the end states. On a strategic level the end state has to be broader to take care of unexpected events and the end state has to be more specific when there are tactical and operational issues involved. It can also be argued that the importance of an understood end state is more important when there are security threats, like the counterterrorism police unit and the military leader face, and when professions face threats on a daily basis like most of the respondents except the safety manager. According to the research hypotheses about the importance of end state it is obvious that an understood end state on all levels where they are present is important regarding safety margins.

3.5.2.4 Sharp end involvement and procedure following

One of the research hypotheses in this thesis was concerned whether involvement of employees in the sharp-end is necessary to ensure acceptable safety margins. All of the respondents agreed on the importance of sharp end involvement, but there were different levels of involvement described by the respondents. The counterterrorism police unit explained their involvement of participating in developing procedures as the most important factor regarding sharp end involvement, because they faced dangerous situations on a daily basis. This will fit in the model 2 bottom-up paradigm described by Hale et al. (2012) because the members in the unit are regarded as sharp end experts in their field of work. Both the helicopter pilot and the entrepreneur explained that representatives from both middle leaders and employees were involved in procedure making. The involvement of the sharp end will make the employees more adaptive towards procedures (Otsuka et al., 2010) and if the people working in the sharp end are involved in making of procedures they could feel more ownership and that could give more sense-making and thereby ensure acceptable safety margins (Weick, 1993). The other respondents described procedure development as a more top-down activity, similar to model 1 by Hale et al. (2012), but since the leaders which made the procedures had sharp end experience, they felt that it was acceptable. The safety manager said that it was impossible that more than thousand employees should be directly involved in procedure development, but during the interview he saw the need of involving some representatives from the employees more often in the future in matters related to procedures and safety in general. Based on the answers from the respondents and the research literature and as an answer to the research hypotheses, it seems like representatives from the employees, and especially sharp end experts, should be involved in procedure development. The solution presented by the helicopter pilot and the entrepreneur where middle leaders with sharp end experience are involved could be recommended to ensure that there are involvement from someone with sharp end experience.

The research hypotheses number five suggests that following procedures is essential to ensure acceptable safety margins in risky work. All of the respondents emphasized the importance of the

existence and use of procedures to avoid a decrease in safety margins. Everyone had procedures on almost every known risky action that took place in their work. The counterterrorism police unit and the military leader explained that they also had procedures about what to do when unexpected events took place. This will be further discussed in section 4.1. These types of procedures could be recommended for every professions involved in risky work because unexpected events will very often occur (Weick and Sutcliffe, 2007).

The possibility to deviate from procedures if necessary was regarded important and especially the counterterrorism police unit, the military leader, the helicopter pilot and firefighter pointed that out. The reason for that is because no procedures can take considerations for every possible action, especially regarding unexpected events. The model 2 paradigm states that procedures should have many exceptions and only be used as guidance and be adaptable to situations. Violations of procedures are seen as inevitable and the way to know how to violate safely without any negative outcome is sometimes regarded as a badge of mastery of the activity (Hale et al., 2012). Becker (2005) is also positive to deviate from procedures because he explains that procedures need to be embedded in the situational context (Becker, 2005). However, to deviate from procedures require deep knowledge about the procedures and also experience in coping with different risky situations. In situations when there is only inexperienced people involved, deviation from procedures can lead to fatal error. It is also important that there is an understanding from the beginning between the involved parties if procedures can be broken if necessary, because what happens if you break the procedures to secure satisfying safety margins, but the outcome is fatal? Will you be punished by the organization? Will the laws and regulations consider these violations done with the best intents in all situations? Thus, following and breaking procedures seems closely related to considerable expertise and to perception of consequences.

3.5.2.5 Training, exercises, communication and learning

One of the research hypotheses posed in this thesis claimed that communication, training and exercises are necessary to avoid a decrease in safety margins. Both the military leader and the counterterrorism police unit said that they were involved in training and exercises on a daily basis. The firefighters also conducted training and exercises on a regular basis. The training and exercises enhance the resistance to face the threats they meet in their daily work. Based on the answers form the respondents regarding important factors to avoid a decrease in safety margins, it seems like training and exercises are more important when you face security threats and when you can be exposed to security and safety threats on a daily basis.

The military leader addressed a problem regarding that the time they could use for training and exercises had been reduced the last years. They would then use longer time to automate their skills and that could affect the safety margins. The military leader also explained that the gap between training and exercises compared to the situation they faced on missions could be too broad sometimes.

All of the respondents explained that the training and exercises should be close to real life situations, and this is something that every profession which faces threats should consider. The research literature also states that training as close to real events as possible is preferable to give maximum training transfer to increase performance and avoid a decrease in safety margins (Dahlstrøm, Dekker, van Winsen, and Nyce, 2009). However, we should be aware that there are limits for our ability to prepare ourselves for the problems we may encounter (Dekker, 2015).

The entrepreneur said that their company seldom did any training, except when job safety analysis demanded that. A reason for that can be that training and exercises do not create any instant economic return, but mainly costs for an organization, and in demanding economic situations the main focus can be put on actions that create economic value immediately for a commercial organization. This can eventually lead to a decrease in safety margins. However, the use of job safety analysis (JSA) could prevent the decrease, and every respondent, except the safety manager in some occasions, used the JSA before every risky task.

The helicopter pilot explained that they had to go through certifications every 6 month or annually and they had to show to the regulators that they could handle every helicopter model that they used. The inspection from a regulator will ensure that their skills are up to date, and demand training if not. Regulators can stop the work, and this could affect the economic situation and the reputation. The fear of these severe consequences for an organization can be positive regarding safety margins.

The firefighter said that they had a competence pool where the demands of every task and position were listed. The individual competence was marked on the list, so everyone at the station knew what training and exercises each firefighter had been through and what competence level they possessed. Because of this competence pool everyone would also know what to train for. To be able to know each other's qualifications could strengthen the safety margins because the colleagues would know each other competence level, but everyone should be aware of that a competence pool does not say anything about the skills; just that you each individual have completed certain demands and it could create false safety.

The counterterrorism police unit had daily discussions about fictive situations they could face and they tried to discuss every aspect of a mission. They used all of the maxims from "the cooperative principle" by Grice (1975), but they did not avoid the submaxim which stated: "Do not say that for

which you lack adequate evidence". That is because they wanted to challenge the assumptions presented. According to the answers from the respondents it seems like they used the conversation maxims in general, and that is proof for effective communication

All of the respondents used reflection groups to discuss safety and these discussions were regarded as one of the best ways to increase the experience transfer by communication from the respondents, and they said that talking with each other about safety was much better than reading about safety and created better learning. When they discussed safety, they could end up discussing the entire organization and also what it meant for each member of the team and the interaction between them. Generally it seems like discussions about safety were important regarding safety margins and there were elements of both organizational communication (Dynes and Quarantelli, 1977) and interpersonal communication (Bochner, 1989) involved, and this could easier create double-loop learning (Argyris, 1997).

The counterterrorism police unit had a rule that the safety margins should never be decreased based on procrastination, because in the meantime they, or other similar units, could experience accidents with possible fatal outcome. That is why they never used more than two days to improve whatever was not good enough according to their level of standards. It was only the counterterrorism police unit that completed the improvement so fast among the respondents in general, and based on their extremely high focus of safety on every level, other organizations could learn from this effort. However, there is a possibility that they could lose important information by improving procedures so fast. The level of safety and security threats and the size of the organization could also affect the speed of changing procedures. In a company where several thousand people work, like the work of the safety manager, it is impossible to change procedures to often, but in smaller units like the counterterrorism police unit it is easier to change procedures often.

The military leader believed in an apprenticeship as the best learning methods for experience transfer. The firefighter, entrepreneur and the safety manger also used apprenticeship in periods. This way of learning and experience transfer should be considered when you are involved in risky work. You will have the possibility to gain deeper knowledge about the situations you face. Lave and Wenger (1991) called the use of apprenticeship as situated learning, because they have placed learning in a social context where learning involves participation in a community of practice. They also states that to participate in the sociocultural practices of a community is essential to the mastery of knowledge and skill among unexperienced employees.

Learning was considered important regarding safety margins. If we compare the respondents' approach to create a learning organization the organizations were on different levels. The

counterterrorism police unit, the military leader, the helicopter pilot and the firefighter are competent at all five main activities regarding systematic problem solving described in section 2.6.8: Experimentation with new approaches, learning from their own experience and past history, learning from the experiences and best practices of others, and transferring knowledge quickly and efficiently throughout the organization (Garvin, 1993). The entrepreneur used every activity except systematically experimentation with new approaches. Reasons for that can be that their activities are strongly regulated, and involve many third parties. The safety manager used all activities except transferring knowledge quickly and efficiently throughout the organization, even though they are getting better at this activity.

One important aspect that the helicopter pilot brought up was that before an operation where several helicopters were involved, the involved pilots discussed the upcoming operation. If one of the pilots had doubts about flying, the operation was set on hold, and they involved the chief supervisor for further instructions. The room for redundancy which was created when to parties questioned the upcoming situation, including the governing variables and subjected them to critical scrutiny (Argyris and Schön, 1974) and also had to agree of flying before a potential risky operation, is something other organizations could learn from.

The importance the counterterrorism police unit placed on instant feedback and the possibility to discuss what was good and what could be improved after training and exercises is also something other organizations could learn from. The live feedback they went through can also be interesting for other organizations. Organizational learning can then to occur (Argyris and Schön, 1978).

3.5.2.6 The use of deviation for creating better safety margins

The use of deviations to prevent future accidents and to track small failures was brought up as important from all of the respondents regarding safety margins, and this is according to the research literature (Weick and Sutcliffe, 2007; Vaughan, 1999). The counterterrorism police unit and the military leader reported every near miss, mishap or accident in their deviation system. The deviations were discussed in teams when needed, after they read the summary from the group who were in charge of the deviation system. When organizations use deviation systems to report near misses, mishap or accident it is important that the persons who report the deviation get feedback about what would be done to prevent the same happenings to take place. The military leader and entrepreneur said that they could probably be even better in communicating near misses and mishaps to each other.

None of the respondents' were punished in any kind of way for reporting in the deviation system. There was consensus among the respondents that they would seldom use the deviation system if they

knew they were punished for reporting errors. If it happened, that could dramatically decrease the safety margins in a negative way. The helicopter pilot explained that they were not allowed to fly until they had signed that they had read and understood the Flight safety letter which described deviations. This mandatory action is in general preferable because you have to read through what happened and that can promote learning in a way that you might prevent such actions in the future. A problem can be that these letters can lead to information overload, and that you do not read through everything and just sign. This might not be a problem, because the pilots are much occupied with safety, and they do not get so many letters or information from the management. In general all of the respondents used the deviation system. Based on that, it seems like the normalization of deviance is not present in the organizations.

3.5.2.7 Decision making

All of the respondents mentioned decision making as important regarding safety margins, and based on the individual interviews and focus group the researcher will rank decision making as one of the most important factors regarding how to avoid a negative decrease in safety margins. This is due to the fact that eventually it is the decision about what to do, that will lead to an action. Even though everything else regarding keeping safety margins on a satisfying level is present, a bad decision can exceed all of that, with fatal results. Both the military leader and the counterterrorism police unit said that decision making was extremely important to avoid accidents and that they wanted the decisions to be based mostly on facts or extensive experience and less on heuristics. They recognized that decisions based on gut feeling could be dangerous and that they always reminded themselves about how they made decisions.

It was mandatory that the counterterrorism police unit and the military discussed decision making based on how they performed in training, exercises and on missions. They thought these discussions were one of the best ways to improve decision making. This view of decision making made in the natural environment is called naturalistic decision making (Dekker, 2015) and is something that all profession involved in risky work should emphasize in their daily work. Decision making made in table top exercises were regarded as important, but evaluation of decision making after real events, will probably give more learning to an organization based on the view form naturalistic decision making. More training and exercises can also affect the decision making process in a positive way because you expand the repertoire of skills and experience and the skills can be automated.

When discussing decision making in a group there is a possibility that groupthink will occur (Janis, 1972). Decision making situations in groups often start out as situations where the group tries to reach consensus, and can end up as consensus causing decrease in safety margins (Baron, 2005). Group

decisions are more likely to both ignore and under-weight external points of view (Minson and Mueller, 2012). There is a possibility that group think can occur based on the answers from the respondents, but among the counterterrorism police there was an understanding that every aspect about safety should be brought up on the table. This openness should be recommended. Another way to steer clear of group think is to seek external advice to avoid the "we know best" situation described by De Dreu and Beersma (2010). To ensure that consensus is not contaminated by shared biases, group membership can also be intentionally selected for diversity because members with different backgrounds and experience are likely to see problems in different ways and advocate different solutions which can then be considered (Smith et al., 2015). This might be a better solution than bringing in external advice if you are working in an organization which deals with sensitive information. None of the respondents mentioned that they systematically used a devil's advocate to encourage dissenting point of view to avoid groupthink, even though they appreciated and encouraged other opinions. The use of a devil's advocate is recommended, and should be something that the respondents should try to systematically use (Smith et al., 2015).

All of the respondents agreed on the importance of experience and expertise as important regarding decision making. The respondents could almost on a daily basis, except the safety manager, experience unexpected events. The respondents would seldom let unexperienced employees work alone with tasks that required important decision making regarding safety. This is on line with the thoughts of naturalistic decision making researchers who explains than experts have an ability to make sense of situations by using their experience base of relevant knowledge, and their situation assessment " which is "the sense of understanding what is going on during an incident" (Klein, 1989, p. 51).

Another important aspect regarding decision making was presented by the helicopter pilots. He said that they were not allowed to fly if they were not feeling fine both mentally and physically, because that could affect their decision making in a negative way, since they had to rely on all their senses and experience to avoid a decrease in safety margins. The firefighter and the counterterrorism police unit also had attention about this. This attention towards the physical and mental health could probably be transferred to other professions.

The helicopter pilot introduced the concept of "get home it is". Many of the accidents in the aviation industry can be related to that. How to avoid that safety margins decreases when you are close to finishing your operation could be interesting to study among more professions than just in the aviation industry. Dekker (2011) says that when employees expect and accept changes from the former norm "They have come to believe that things will "probably be fine" and that it will do "a good job" (p. 15). In the modern work life there is higher demands for effectivity which can affect the safety margins,

and there are not many studies about the "get home it is" concepts in other professions than the aviation industry.

When the firefighters were inside a burning object, they had to rely on their own decisions, if they were not instructed by chief fire officer. Experience was a very important factor regarding decision making in this environment. If they had experienced a similar situation before it was easier to make the right decision. The safety manager and the helicopter pilot also agreed on this. There seems like a link between experience and decision making based on the answers from most of the respondents, and that is why the mix of experienced and unexperienced employees should be recommended in professions involved in risky work. High Reliability Organizations move the decision making in the organization to those with most expertise (Roberts, 1990). This is quite different from other organizations where decisions are based on their rank in the hierarchy (Weick and Sutcliffe, 2007).

The safety manager explained that the organization learned much from exercises, but the problem was that they seldom were situated in a situation with risky work on a daily basis, and it was difficult to automate the skills gained from the exercises. The entrepreneur said that normally their decisions were based on facts regarding information about the construction site and the use of the appropriate procedure. The openness regarding communication of decision uncertainty was important. The employees would not be punished if you spoke up about something you disagreed with, or if you told the management that you were uncertain about what decision to make. This just culture can avoid a decrease in safety margins (Dekker, 2011)

4. GENERAL DISCUSSION

In this section the objectives are to put focus on the main research question about how you can avoid a negative decrease in safety margins in risky work and try to answer the rest of the research hypotheses. This section has a more theoretical approach than the case discussion section by introducing relevant theory and will try to build on these theories and the results from the case discussion in order to suggest how to avoid a negative decrease in safety margins in risky work. The case discussion section had more focus on the case specific results, and this section tries to discuss factors that were not profoundly illuminated in the case discussion section, but still is believed to be relevant regarding the main research question and research hypotheses.

4.1 Safety culture and facing the unknown

One of the research hypotheses in this thesis claimed that a good safety culture is necessary to avoid decrease in safety margins. Pidgeon (1991) describes safety culture as the employers and employees understanding of the hazards in their workplace, and the rules and norms governing safe working (Pidgeon, 1991). This definition to not mention prioritization as important, and for organizations involved in risky work it can be argued that high prioritization of safety should be emphasized. That is also in line with all of the respondents who mentioned that when both the management and employees prioritized safety; four of the respondents used the sentence "safety first", the organization had a good safety culture. This is also according to Bailey (1997) and his thoughts about a good safety culture. Hallowell and Gambatese (2009) described that when upper management had consideration of primary goal of the organization, for example by participating in regular safety meeting this upper management support was the contribution among 12 others that generated the best effect on safety. This shows the importance of leadership in order to create a good safety culture. Pidgeon (1991) explains the importance of "understanding of the hazards", and that is more profound and better than just talking about "knowing the hazards". In section 3.5.2.5 the importance of reflections group to gain deeper understanding is described as important, and based on the definition from Pidgeon (1991) these discussions will create a better safety culture.

Another interesting factor regarding safety culture happens when organizations define the absence of major accidents in the past as a guarantee for future success. This was brought up by the safety manager as the thoughts of his CEO. This is according to Dekker (2015), a wrong assumption and can actually lead to more accidents. Weick also points out that a long period without any accidents can rely on a stochastic variation that is dependent of other factors (Weick, 1993). Dekker (2011) takes it further by explaining that: "Borrowing more and more from safety may go well for a while, but we never know when we are going to hit" (p. 39). How to keep up the focus on safety, when there are few reported accidents or mishap in an organization can be a challenge. Based on the answers from the respondents and research literature, a satisfying safety culture is necessary to maintain safety margins in risky work.

Dekker states that safety culture have been "increasingly deployed to fill the social-organizational complexity vacuum left by sequence of events models (Dekker, 2015, p. 245). Dekker draws the line from safety culture to complexity. It is interesting that Dekker challenges what he calls The Cartesian-Newtonian worldview, where causality describes that for every action there is an equal and opposite reaction (Dekker, 2015). His arguments that complex systems are sensitively dependent on initial conditions and that small banalities of normal work can slowly degenerate into fatal disasters (Dekker, 2015) are something that the researcher in this study are not sure that every people involved in risky

work in general are familiar with. To be able to address and solve small problems before they expand is therefore recommended.

To be influenced by features outside of the organization, both known and unknown factors, can affect safety margins in a negative way (Dekker, 2011; Rasmussen, 1997; Weick and Sutcliffe, 2007). Changing environment causes changes in the number of agent (Dekker 2011) and that will change the dynamics of any complex system. To have total control of the environment and changing agents is impossible, and that demands a lot from those involved in risky work. One solution against uncertainties and unknown event is to put focus on these issues like the HROs do. HROs want to see as much about the environment and the risks that they face as possible, in order to avoid a decrease in safety margins. They also welcome diverse opinions and experience because it helps them to do more with the complexity discovered (Weick and Sutcliffe, 2007). There can be argued that too many opinions can lead to decision making problems, but there is probably better to get too many opinions than too few.

Risk analysis and procedures normally do not consider unknown events, but as explained in section 3.5.2.4 the counterterrorism police unit and the military leader said that they had procedures about what to do when unexpected events took place. These types of procedures could be recommended for every professions involved in risky work because unexpected events will very often occur (Weick and Sutcliffe, 2007). To consider unknown risks that can take place could be a part of risk analysis in organizations that deals with risky work. However, we should be aware that it is difficult to assess certainties of particular outcomes in organizations dealing with complex systems (Dekker, 2015), but higher focus of uncertainties and unknown event could probably give positive contributions regarding safety margins. HROs are in general more concerned with safety margins related to unexpected events, but according to Weick and Sutcliffe (2007) there is no reason that non-HROs should not be concerned about unexpected events because "it becomes clear that many organizations are just as exposed to threats as HROs are, and just as much in need of mindfulness" (p. 19).

Another interesting aspect from the research literature is about similarities of situations, which every organizations experience. When HROs see close similarities between past, current and possible future negative events, they increase their alertness (Hollnagel, 2006). This is because the close similarities can be observed as superficial, but instead can hide profound and complex differences which can prove fatal. Dekker (2011) has similar arguments when he points out that if an organization is repeating its actions, because of former success, the result will not predictably lead to the same result because the situation has changed during the time (Dekker, 2011). There is an expression called "Never change a winning team", and the researcher is aware that it can be appealing to repeat what used to work.

5. CONCLUSION

In this thesis the researcher discussed how we can avoid a negative decrease in safety margins in risky work and the aim of this thesis was to add more knowledge about safety margins.

In order to answer the main research question and research hypotheses of this study a semi-structured focus group interview with a foreign counterterrorism police unit and individual interviews with an entrepreneur, military leader, firefighter, helicopter pilot and a safety manager were conducted.

Eleven factors to avoid a decrease in safety margins were described as important by all respondents and they are discussed in this thesis. These factors were: leadership, end state, communication, training, exercises, learning, deviations, risk analysis, procedures, sharp end involvement, decision making, complexity and safety culture.

The factors and answers presented by the respondents give indications that the research hypotheses cannot be rejected, but due to the low number of respondents it is impossible to draw solid, final conclusions.

Contributions to the field of safety and especially safety margins based on this study are:

- Security threats on a daily basis increase the focus on safety margins.
- Everyone involved in an operation should understand the end state, and be aware that there is a difference between strategic, tactical and operational end state.
- Lack of personal responsibility can affect the safety margins in a negative way.
- Leaders with sharp end experience are preferable when dealing with risky work.
- Everyone should know in which situations they can break procedures.
- Organizations should emphasize that the meaning of procedures is understood.
- The timespan from when a procedure needs to be revised, until the new, revised procedure is understood by everyone involved in an operation, should be decreased in smaller teams who deal with risky work on a daily basis.
- Training and exercises should be as close to real life situations as possible.
- Live feedback can avoid a decrease in safety margins.
- More focus on how to avoid a decrease in safety margins when you are close to finishing your operation ("get home itis") can improve safety.
- Reflection groups to discuss safety can avoid a decrease in safety margins.

5.1 Implications

The present thesis has introduced factors that can avoid a negative decrease in safety margins. It would be interesting to repeat this study with more respondents and by introducing respondents from other organizations. A quantitative study with the use of questionnaires could also strengthen the findings and the possibility to draw more certain conclusions. One suggestion for further research is to build on the new contribution that this study has identified to get a deeper knowledge of the strength of impact on safety margins. The interconnections between the eleven factors mentioned in this study should also be investigated further.

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7. APPENDICES

Appendix A: Informed consent form – individual interviews.

Informasjonsskriv/samtykkeerklæring

Takk for at du har sagt deg villig til å delta på intervju i forbindelse med min masteroppgave. I min masteroppgave i Organisasjon og Ledene, med spesialisering i sikkerhet, pålitelighet og vedlikehold på NTNU, ønsker jeg å intervjue både ledere og ansatte som har yrker der sikkerhet betraktes som viktig.

Mål med forskningen

Jeg ønsker å fokusere på hvordan man kan unngå en negativ reduksjon i sikkerhetsmarginer i organisasjoner som jobber med risikofylt arbeid. Foreløpig problemstilling er: "How to avoid a negative decrease in safety margins in risky work?"

Dine forberedelser

Jeg er interessert i dine personlige meninger og erfaringer. Noe du kan tenke på før intervjuet er følgende: Hvordan kan man unngå en negativ reduksjon i sikkerhetsmarginer i din organisasjon? Tenk på hvordan det er i dag og hvordan man eventuelt kan forbedre dette? Spørsmålene vil omfatte faktorer som omhandler sikkerhetsmarginer og blant annet hvordan både ledelsen og ansatte kan påvirke dette.

Selve intervjuet

Oppgaven skal skrives på engelsk, men intervjuet vil foregå på norsk. Det er bare du og jeg som er tilstede under intervjuet. Det vil ikke bli brukt båndopptaker, men jeg vil notere dine svar underveis. Intervjuet vil sannsynligvis ta mellom 1-2 timer. Tid og sted avtales på forhånd.

Oppbevaring av datamaterialet og konfidensialitet

Din deltakelse i studien er frivillig og du kan når som helse trekke deg både fra intervjuet og studiet uten at du trenger å oppgi noen grunn. Alle notater knyttet til din deltakelse vil da bli slettet. Innsamlet datamateriale vil oppbevares i låst skap og all materiale kodes slik at anonymitet og konfidensialitet bevares. Jeg kontakter deg hvis jeg har spørsmål til innsamlet materiale. Hvis masteroppgaven

eventuelt omarbeides til artikkel eller bok i ettertid, vil jeg be om tillatelse fra deg til å bruke innsamlet materiale.

Kontaktinformasjon

For spørsmål kan du kontakte meg på mobilnummer 40903639 eller pr.mail:
fysiokompetanse@gmail.com. Informasjon og skjemaer sendes per mail.

Med vennlig hilsen

Rune Pedersen

_____   _____   _____

Sted   Dato   Navn

Appendix B: Information to the counterterrorism police unit

Information

Thank you for your participation in my research. Because of the high level of security and confidentiality that you have demanded, this letter is based on your request of information and I accept your demand of no written consent. As I have been told from my informant, you have enough information about me, my current work and ongoing research. This letter will be sent by mail to my connection in Norway who will distribute it to you.

Research question

 "How to avoid a negative decrease in safety margins in risky work?"

About the interview

It will last 1-2 hours. I know the country, city and date where the interview will take place, and I will wait for further information from you regarding exact time and meeting-place.

Data material and confidentiality

Your participation in this study is voluntary and you can withdraw from the study anytime without any explanation. All the written material will in that case be erased. We have agreed beforehand regarding have the written material will be coded and kept both in your country, on the travel to Norway, in Norway in the period until the thesis is done and for the future. I will send you the written material, and mail questions through my informant in Norway if necessary. If this thesis will end up as an article or as a book, I will ask for your permission.

Contact information

If you have any questions, you can contact me by phone 004740903639 or by mail: fysiokompetanse@gmail.com. Informasjon og skjemaer sendes per mail.


Best regards,
Rune Pedersen

Appendix C: Interview guide for the individual interviews

Bakgrunn:

- Stilling:
- Antall år i nåværende stilling:
- Arbeidsoppgaver:
- Hvilken utdanning har du?
- Har du hatt annet arbeid på samme arbeidsplass? (stilling/antall år/arbeidsoppgaver):
- Har du hatt annet arbeid? (stilling/antall år/arbeidsoppgaver):

Hoveddel:

- I utgangspunktet så er forskningsspørsmåleet mitt «How to avoid a negative decrease in safety margins in risky work?» Jeg tegner følgende figur:

Daily work	Safety margins	Accident
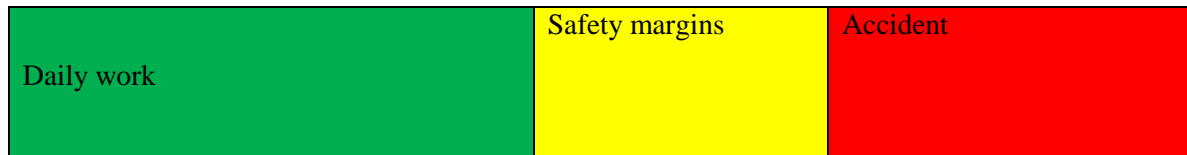
1. Hvilke faktorer mener du er viktige for å unngå en negativ reduksjon i sikkerhetsmarginer i ditt arbeid?
   - Hvorfor er faktorene du nevnte viktige?
2. Hvem bestemmer sikkerhetsmarginene i din virksomhet?
3. Hva gjør man for å opprettholde sikkerhetsmarginene i din virksomhet?
4. På hvilken måte har ledelsen et ansvar i forhold til sikkerhetsmarginer?
5. På hvilken måte har de ansatte et ansvar i forhold til sikkerhetsmarginer?
6. Har dere et avvikssystem?
   - Hvis ja; hvordan brukes det?
   - Har det noen negative konsekvenser hvis dere melder avvik?
7. Hva legger du i begrepet sikkerhetskultur?
   - Hvilken betydning kan sikkerhetskultur ha for sikkerhetsmarginer?
8. Hvilke faktorer som du har nevnt mener du er viktigst for å unngå en negativ reduksjon i sikkerhetsmarginer i ditt arbeid?

Avslutning:

- Har du noe mer å legge til/tilføye?

Appendix D: Interview guide for the individual interview with the counterterrorism police unit.

Background:
- Position:
- Number of years in current position:
- Work tasks:
- What is your education?
- How you worked in different positions at your current work? (position/number of years/ work tasks):
- How you worked in other organizations (position/number of years/ work tasks):

Main part:
- As a start, the research question in this study is «How to avoid a negative decrease in safety margins in risky work?» The following figure is drawn.:

Daily work	Safety margins	Accident

1. Which factors do you think are important regarding how to avoid a negative decrease in safety margins in your work?
   - Why do you consider these factors important?
2. Who decides the safety margins in your organization?
3. What is done to maintain the level of safety margins?
4. What is the leadership responsibility regarding safety margins?
5. What is the employee responsibility regarding safety margins?
6. Does your organization have a deviation system??
   - If yes; how is it used??
   - Are there any negative consequences if you report deviations??
7. How do you define safety culture??
   - How does the safety culture affect safety margin?
8. Which factors is most important regarding avoiding a negative decrease in safety margins?
- Do you have more information to add?

Appendix E: Important factors regarding safety margins suggested by all informants

Participants / Factors	Counter-terrorism police unit	Military leader	Firefighter	Entre-preneur	Helicopter pilot	Safety manager
Leadership	X	X	X	X	x	x
End state	X	X	X	X	x	
Communi-cation	X	X	X	X	x	x
Learning	X	X	X	X	x	x
Risk analysis	X	X	X	X	x	x
Deviation	X	X	X	X	x	x
Procedures and sharp-end involvement	X	X	X	X	x	x
Decision making	X	X	X	X	x	x
Training and exercises	x	X	X	X	x	x
Complexity	x	X	X	X	x	x
Safety culture	x	X	X	X	x	x

Appendix E: The crosses show which factor each of the respondents regarded as important to avoid a negative decrease in safety margins.

Appendix F: Important factors regarding safety margins suggested by 1-4 informants

Participants / Factors	Counter-terrorism police unit	Military leader	Fire-fighter	Entre-preneur	Helicopter pilot	Safety manager
Research reports	X				x	
Media coverage	X	X		X		x
Global threats	X	X				
Political decisions	X	X				
Technical equipment	X	X	x		x	
Redundancy	X				x	
Maintenance	X		x		x	
Physical and psychological performance	X	X	x		x	
Bonuses				x		
Education	X		x		x	
Ready for change	X	x	x			
Clear language				x		
Role clarity		x		x		
Redundancy	X				x	

Appendix F: The crosses show which factor each of the respondents regarded as important to avoid a negative decrease in safety margins.