Empowering Human Performance: A Case Study of Team Resource Management in CHC

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ABSTRACT

Crew Resource Management (CRM) is a well-known training concept developed in the aviation industry in the 1970's to reduce human error after several horrific accidents. It has since expanded to other high-risk industries. The goal of CRM is to increase human performance, increase team performance and utilize all available resources to achieve the highest level of safety possible. Research has shown that CRM is effective but results on the organizational level has not been established. CRM has traditionally only been implemented in the sharp end, while results are expected for the whole organization.

This case study aims to explore the expansion of CRM in the non-operational parts of an organization by researching the project Team Resource Management (TRM) in CHC, an offshore helicopter operator. TRM is CRM for all employees, both operational and non-operational. The purpose is to shed a light on how it is done and what the possible benefits are as well as factors that can inhibit the success of CRM in the non-operational part of an organization. This study's aim is answering: Why should CHC prioritize Team Resource Management?

To answer this question interviews with employees in CHC, other CRM experts and document analysis has been conducted. To achieve the aim of this study, theories on safety and risk management in organizations and human factors has been used.

The results show that the potential benefits from TRM could increase the organization's reliability by creating a reliable flow of high-quality intelligence across departments, which increases the chance of achieving a shared situation awareness on an organizational level. The reliable flow of high-quality intelligence also enables the different actors within the system to see their part in the organization and how they affect each other. The factors that might inhibit the organization experiencing these benefits are weak safety leadership, blunt/sharp end difference in risk perception and potential for reaching a saturation point in terms of safety initiatives. The analysis not only found factors that might inhibit the project's success, but also hurt the organization's safety culture. The final conclusions recommend CHC to prioritize TRM, as it is shown to be a cost-effective safety measure that will provide a holistic approach to safety management and increase the organization's reliability.

SAMMENDRAG

Crew Resource Management (CRM) er et velkjent treningskonsept utviklet i luftfartsindustrien på 1970-tallet for å redusere menneskelig svikt etter en rekke alvorlige flyulykker. Siden den tid har konseptet blitt tatt i bruk og tilpasset andre industrier med høy risiko. Målet med CRM er å optimalisere den menneske ytelsesevnen ved å samarbeide i team og utnytte alle tilgjengelige ressurser for å oppnå høyest mulig sikkerhet. Forsking viser at CRM er effektivt, men så langt er det ikke empirisk bevist å ha effekt på organisatorisk nivå. CRM har tradisjonelt sett bare blitt implementert i den skarpe enden, mens resultater forventes på organisatorisk nivå.

Denne casestudien har tatt sikte på å utforske utvidelsen av CRM inn i de ikke-operative delene i en organisasjon ved å forske på Team Resource Management (TRM) i CHC, som er en offshore helikopteroperatør. TRM er kort fortalt CRM for alle ansatte, både i den skarpe og butte enden av organisasjonen, med sikte på å besvare: Hvorfor bør CHC prioritere Team Resource Management?

Gjennom intervjuer med ansatte i CHC, andre CRM-eksperter, samt dokumentanalyse er potensielle fordeler organisasjonen kan oppnå fra TRM identifisert. For måloppnåelse er det benyttet ulike teorier innen sikkerhets- og risikostyring for organisasjoner samt teorier innen feltet «human factors».

Resultatene viser at de potensielle fordelene ved TRM kan øke organisasjonens pålitelighet ved å skape en pålitelig flyt av høykvalitetsinformasjon på tvers av avdelinger i organisasjonen. Dette øker sjansen for å oppnå en felles situasjonsbevissthet på organisatorisk nivå. Den pålitelige flyten av høykvalitetsinformasjon gjør det også mulig for de ulike aktørene i systemet å se hvor de er i organisasjonen og hvordan de ulike aktørene påvirker hverandre i et sikkerhetsperspektiv. De faktorene som kan hindre organisasjonen i å oppnå disse fordelene er en svak sikkerhetsledelse, forskjellen i risikopersepsjon i den butte og skarpe enden og et potensielt metningspunkt når det kommer til sikkerhetstiltak. Analysen fant ikke bare faktorer som kan hemme prosjektets suksess, men også skade organisasjonens sikkerhetskultur. Den endelige konklusjonen anbefaler CHC å prioritere TRM, da det viser å være et kostnadseffektivt sikkerhetstiltak som vil gi en helhetlig tilnærming til sikkerhetsstyring og kan øke organisasjonens pålitelighet.

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ABBREVIATIONS

AAIB – Air Accidents Investigation Branch

ADM – Aviation Decision-Making

CAA – Civil Aviation Authority UK

CRM – Crew Resource Management

EASA - European Union Aviation Safety Agency

ICAO – International Civil Aviation Organization

KSA – Knowledge, Skills, Attitudes

LOSA – Line Operations Safety Audit

NDM – Naturalistic Decision Making

NOTECHS – Non-Technical Skills

MDA – Minimum Descent Altitude

SA – Situation Awareness

SMM – Safety Management Manual

SMS – Safety Management System

SOP – Standard Operating Procedure

TRM – Team Resource Management

TEM – Threat and Error Management

CHAPTER 1: INTRODUCTION

1.1 Background

17:17:02 Co-pilot:	Hundred to go
17:17:03 Commander:	Roger
17:17:11 Commander:	Checking the height
17:17:12 Co-pilot:	Just watch your airspeed now
17:17:13 Commander:	Oh yeah
17:17:17 Commander:	Wow, what's going on here, wow wow wow oh no, oh no no no no
17:17:21 Commander:	Oh ####
17:17:22	(sound of impact)
17:17:23	-end of recording-

(Air Accidents Investigation Branch, 2016)

Those were the last 21 seconds of the cockpit voice recording from the Super Puma helicopter on approach to Sumburgh Airport on 23 August 2013. The CHC-operated helicopter was transporting 16 offshore workers back to land when the accident happened. The helicopter crashed into the water and four of the passengers lost their lives on their way home from work. This accident illustrates how fast things go from normal operation to full-blown accident in high-risk industries. After several terrible aircraft accidents in the '70s and '80s the concept of Crew Resource Management (CRM) was developed and later made mandatory for all crews, as it still is today. The accident rate in aviation has drastically declined, however, accidents still occur, and organizations are continually striving to manage risks and improve safety. In 2018 at the Sola Conference on Helicopter Safety, the Regional Director of CHC EMEA, Mark Abbey, gave a presentation with the title "On Managing an Offshore Helicopter Business, Challenges Towards 2038" (The Sola Conference, 2018). In his presentation he spoke about CHCs' new and innovative project as a part of the organization's commitment to safety. They wanted to enroll all their employees in a concept similar to CRM. He called it "Team Resource Management (TRM)".

1.2 Research problem

Today CRM is a training concept for the pilots and crew at the sharp end (see definition in chapter 3), but impacts are expected in the whole organization. Exploring the expansion of the concept CRM in the organization as a whole, as CHC is doing with TRM, can contribute to practice and knowledge to fill the gap in the existing literature on the subject. The central research problem is:

Why should CHC prioritize Team Resource Management?

To be able to provide a thorough answer to the research problem, three research questions have been formulated. The first one is concerned with the relation between the concepts of CRM and TRM and will help explain what TRM is. Since CHC is developing and implementing this project on their own initiative, they must expect it to lead to some benefits for the organization. Finding out what the possible benefits are will help answer the question about why prioritize the project. The third research question is about identifying potential factors that might hinder CHC from reaching the benefits identified in the previous research question. The three research questions are:

- What is the relation between Team Resource Management and Crew Resource Management?
- What are the possible benefits from Team Resource Management in CHC?
- Which factors can inhibit Team Resource Managements success in CHC?

1.3 Literature review

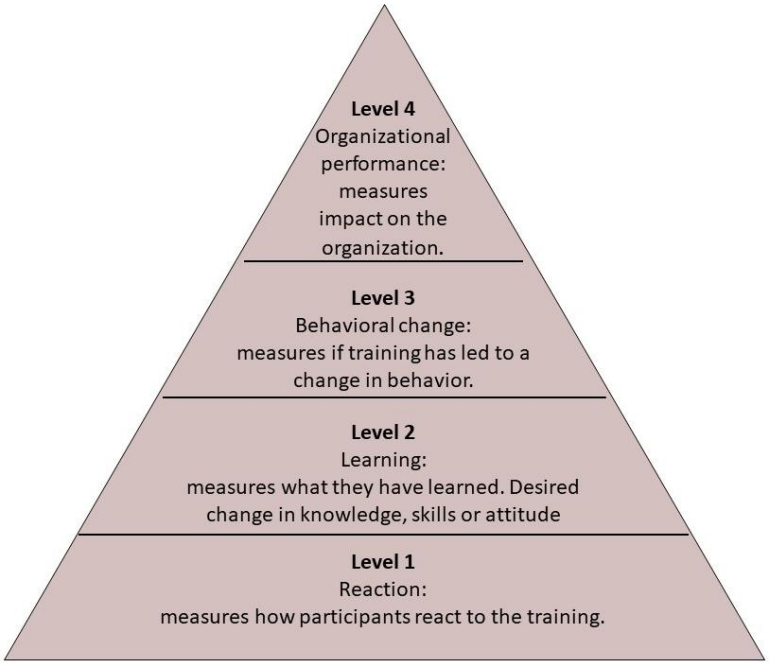
A search on Google Scholar for "Crew Resource Management" gives 243.000 hits (15.01.20). The literature review reflects the fact that field of CRM is comprehensive. A thorough literature review has been conducted to give the reader an introduction of the concept of CRM. The review also seeks to find out if CRM shows positive effects, if it has been implemented in other areas with success and if it has been expanded in the non-operational parts of organizations before. If not, it emphasizes the need for this research.

1.3.1 Does CRM work?

Salas, Burke, Bowers, and Wilson (2001) reviewed 58 published papers on CRM training to determine its effectiveness in aviation. Five years later they published another review of 28 papers on CRM within aviation and other fields (Salas, Wilson, Burke, & Wightman, 2006).

Both articles used the four level model (reaction, learning, behavior and organizational results) for evaluating training programs developed by Kirkpatrick (1967), see Figure 1.

Figure 1 Four levels of evaluation of training (Kirkpatrick, 1967)



The results from both reviews indicated that the CRM training had positive effects in the participants when it came to reaction, learning and behavior, but when it came to level 4 results there was little evidence showing that CRM has a positive effect on the organizations safety overall. That however does not mean that CRM does not have a positive effect on the organization's overall safety, but rather illustrates the lack of measuring CRM's effect on organizations as the authors state. It has not been empirically established that CRM leads to a reduction in the number of accidents. Because of the difficulty of measuring the effectiveness of CRM, evidence on an organization as a whole is seldom collected. This kind of measurement requires longitudinal data, which is not only time-consuming, but also hard to define criteria for. It is also challenging to control external variables that might influence an organizations effectiveness or safety. Another point to make here is that in the cases from the review, they implement CRM only in the sharp end and expect results to show in the whole organization.

In 2003 the Civil Aviation Authority UK published a report on the methods used to evaluate the effectiveness of CRM training in the UK aviation industry. Their review indicated that there were positive effects of CRM training. However, the report found that few companies were

measuring and evaluating the multi-level effects of CRM training, mainly because training personnel have limited resources and experience in evaluating effectiveness. The report also stated that assessments on the organizational level are difficult to carry out. While most organizations say that their main goal with CRM is to improve overall safety and effectiveness, this is very rarely evaluated due to reasons mentioned above (O'Connor, Flin, Fletcher, & Hemsley, 2003).

While most of the research find indications of positive effects of CRM (Bolstad, 2018; Goeters, 2002; O'Connor et al., 2008; Taylor, Robertson, Peck, & Stelly, 1993; Thompson, Tourville, Spiker, & Nullmeyer, 1999), Helmreich and Wilhelm (1991) found that some participants showed a negative change in their attitudes. They seemed to resist the concepts of CRM and in fact moved further away from the desired behavior after CRM training. They raise the issue, and challenge organizations to deal with CRM failures, where crew members might be unable or unwilling to adopt the CRM concepts. However, Helmreich and Foushee (1993) suggest that this will be mitigated by selecting pilots and crews based in their abilities to work in a team, or CRM skills.

1.3.2 CRM in other fields

Since its introduction in the aviation industry in the late 1970s, the CRM concept has been adopted in many other fields that require high reliability in teams at the sharp end. For instance Bridge Resource Management and Maritime Crew Resource Management in the maritime sector (Weintrit & Neumann, 2016), Anesthetists' Non-Technical Skills in health care (Flin & Patey, 2011), and offshore oil platform teams in the oil industry (O'Connor & Flin, 2003).

Salas, Wilson, Burke, Wightman, and Howse (2006, p. 65) claim "*one of the greatest challenges still faced by the CRM community is how to move from a community of interest to a community of practice. (..) CRM needs to be more about 'walking the walk' and not just 'talking the talk'."* Further, they claim that CRM training lacks standardization when it comes to what to train and how to train it, and that might hinder its progress. They go on to claim that if CRM is trained and defined differently from field to field, or even airline to airline, it is hard to accumulate knowledge and learn from each other. On the other hand, Havinga, De Boer, Rae, and Dekker (2017) claim that standardization once made sense, however today when CRM is applied in so many varied fields, it is more important to adapt the training concept to the actual

field and thoroughly describe what the training consists of, what it is intended to do and what change is expected.

1.3.3 CRM in relation to organizations as a whole

Salas, Bowers, and Edens (2001) published "*Improving teamwork in organizations: Applications of Resource Management*" that outlines the progress in the field of CRM and provides evidence that CRM can be applied to a variety of contexts and occupations, and that it can provide benefits in organizations. They claimed, in 2001, that CRM training has not reached corporate America, even though there has been an increased focus on team training and how human factors affect performance. Further, the authors claim that CRM can help increase teamwork in various settings and also solve organizational problems (Salas, Bowers, et al., 2001, p. 2). "*We seek to launch CRM training into a wide variety of industries and organizations as a viable intervention that can be used to enhance teamwork and organizational effectiveness as well as minimize human error*" (Salas, Bowers, et al., 2001, p. 3). Salas, Wilson, Burke, Wightman, et al. (2006) problematize this because CRM training in general still has not gotten the attention from the so-called "*upper echelons*" of organizations. The problem is that CRM training costs money, and unless CRM training shows positive economic impact on the bottom line, it will be challenging to make organizations prioritize CRM programs. The paradox, they claim, is that CRM will not be successful if it does not have the full support of the organization, and most organizations will only support it if it is a success (Salas, Wilson, Burke, Wightman, et al., 2006). The book supports that CRM has something to offer in the organization, although the authors are only talking about applying resource management in the sharp end teams of the organization.

Vik and Løge (2016) examined factors that affect incident reporting in Bristow Norway. Bristow Norway is, like CHC, an offshore helicopter operator. They found that there was a lack of communication and trust between parts of the management and the technicians in the organization, which led to a decreased willingness to report. There was also insecurity around what should and must be reported. Bad communication between the management and those working in the operational part of the organization was brought forward as a problem that can influence safety in the sharp end.

Dowd (2010) is the only literature found where CRM has been integrated to an airline's culture. This does not mean that it has not been done with other airlines or industries, but there is a lack

of documentation available to the public and a lack of scientific literature concerning the subject. The integration of CRM in Air Canada led to a change in the organization which in the long run led to a change of culture in the airline. The article emphasizes the complexity of organizational culture change. The author says that the integration of CRM in Air Canada is only anecdotal, from the perspective of a participant and the change agent. The results showed that Air Canada's culture not only changed, but the CRM concept became a way of doing business, from the boardroom to the training department. The author claims that it takes about eight to ten years to achieve these results. "*In the late 1980s CRM started in the cockpit, as Cockpit Resource Management. Then it became Crew Resource Management, and, finally, Corporate Resource Management*" (Dowd, 2010, p. 382).

Anca (2010) outlines how CRM is trained outside the USA in the article "*Conversations on CRM outside the USA*". In this article an employee from an Argentinian airline said that if CRM is not expanded to other areas of the organization, the training is not complete. He further says that the focus in his region is to promote the "complete" or corporate training of CRM. However, it is not mentioned how this expansion has happened or how it should happen.

In the 2010 edition of "Crew Resource Management" the authors provide some final words about the new challenges and possibilities within CRM: "*In yet another more interesting development, airlines have attempted to extend CRM into other non-operational departments. These initiatives are enviable and honestly heroic. Some have called these programs 'Management Resource Management' or 'Organizational Resource Management.' By whatever label, the future holds much promise only if it is guided by learning from CRM implementation it is early stages*" (Helmreich, Kanki, & Wiener, 2010, pp. 498-499). However, the 2019 edition provided no further research or comment on the transition to the organization, except for in the description of the six generations of CRM, where the third generation, or framework as it is referred to there, is described as: "*#3. Organizational Inclusion and Culture (1993): Crew resource management, CRM beyond aviation, Corporate resource management*" (Farrow, 2019, p. 480). According to this author, corporate resource management became a part of CRM in 1993.

Summary

As the literature review reveals, most of the research is centered around teams in the sharp end of operational performance. Research seems to be lacking on how CRM can or should be implemented in the rest of the organization, and what effects that might have.

- CRM training has shown to have positive effects when it comes to reaction, learning and behavior leading to a reduction in human error. There is little, or no evidence, found in the literature that shows that CRM in the sharp end has a positive effect on the organization's overall safety.
- Several researchers stress that there are issues and challenges concerning measuring effects from CRM training, to the point where many do not measure at all due to lack of resources or other factors.
- The concept of CRM has received a great deal of attention outside the aviation industry and CRM has been implemented in many other industries.
- There is no scientific literature about implementation of CRM in the non-operational parts of an organization. However, there are several sources saying CRM training is not complete until it has reached the whole organization.
- CRM seems to be a concept that is implemented and trained in the sharp end, though results are expected on an organizational level.

1.4 Objectives

The evolution of CRM has gone from cockpit to crew, and as the example from Air Canada shows, finally to corporate. As far as the author is aware there has been no research in the implementation of CRM in all departments of an organization. The Air Canada example is only anecdotal, as is the statement from the Argentinian airline. There seems to be a gap between practice and what the scientific results show. As the literature review shows, CRM in teams can improve communication, decision-making, workload management, safety, and effectiveness. The goal of this thesis is to provide research on the implementation of CRM concepts in organizations by studying the TRM project at CHC. The purpose is to shed a light on how it is done and what the possible benefits and challenges are of implementing CRM in an organization. Therefore, the author considers there is a need for this research to explore what CRM concepts in organizations can offer. This comprehensive field requires a comprehensive

study as well. The three research questions outlined in 1.2 are connected and lead up to the research problem. Therefore, this case study is comprehensive.

1.5 Limitations

The extensive literature review indicates that this field is comprehensive. Therefore, it is necessary to clearly state the limitations to this research. This research does not try to measure the actual effects of implementing CRM in an organization, because the project of implementation is still ongoing. However, measurement on an organizational level is highly suggested, as this is something lacking in research. This requires longitudinal data, therefore not suitable for this research.

This study does not consider if the specific content of the TRM course is suitable for its purposes. The content is purely based on CRM and builds on 40 years of experience. The question of how CRM is relevant in the blunt end is however addressed.

This research acknowledges, but does not take into account *how* regulators, customers and the economy affect CHC.

The terms accidents, disasters and crisis are not differentiated. They are all understood as an unwanted outcome.

1.6 Structure

Chapter 1 gives an introduction of the theme, presents the research problem and the research questions. It also contains a thorough literature review that gives the reader a brief overview of the field of CRM. Thereafter the objectives and limitations are stated. Chapter 2 introduces the organization being researched and the regulatory environment it operates in. A recent accident is also described. Chapter 3 presents the theoretical framework that lays the foundation for the discussion. Chapter 4 describes the methods and research strategy used in this research and reflects on the validity, reliability, strength, and weaknesses of this research. In chapter 5 the findings are presented. In chapter 6 the discussion ties together the theoretical framework with the findings to provide new insights. Chapter 7 concludes with the most important findings and provides an answer to the research problem.

CHAPTER 2: CHC

This chapter provides an overview of the company CHC and gives a contextual understanding of the regulatory environment it operates in both in terms of CRM and safety management. The environment CHC operates in is affected by regulators, customers, previous accidents, and the economy. In this chapter a short description of a helicopter accident the company had in 2013 is provided. How the accident happened is described in this chapter, whereas findings from the accident investigation are presented in chapter 5.

2.1 Canadian Holding Company

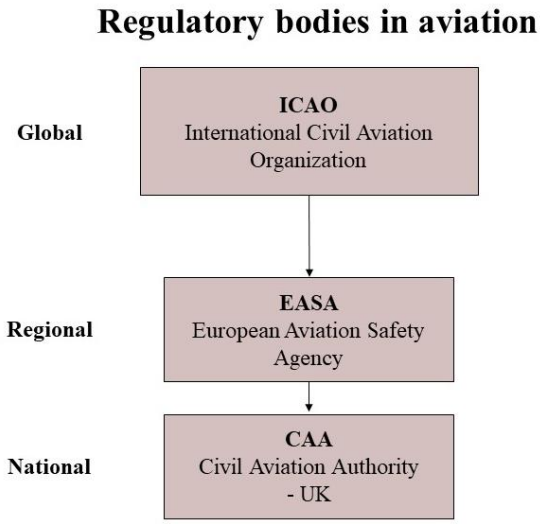
CHCs history started in 1947 when Okanagan Air Service was founded by three Canadian Air Force veterans in Canada. They started out with one Bell 47-B3 helicopter. Soon they renamed the company to Okanagan Helicopters Ltd and in 1954 they became the largest commercial helicopter operator in North America. Fast forward to 1987 and Canadian Holding Company (CHC) was created from Okanagan Helicopters, Toronto Helicopters and Sealand Helicopters. In 1999 CHC took ownership of Norway's Helicopter Services Group. Today CHC operates in some of the most distant and challenging locations in the world, both on and offshore. They also operate one of the most extensive search and rescue (SAR) networks in the worlds, as well as emergency medical services (CHC, 2019a, 2019b). CHC has 120 heavy and medium helicopters that operate in over 15 countries. CHC consists of three regions that cover their global operations: Asia Pacific (APAC), Europe, Middle East, and Africa (EMEA) and Latin America (LAM). EMEA has offices in Manchester, UK, Aberdeen, Scotland and Stavanger, Norway.

The TRM project started in Aberdeen, therefore this thesis only gathers data from that office. CHC Aberdeen is one of few offshore helicopter operators. Offshore helicopter transport is considered high risk, since the industry has experienced several fatal accidents. In 2013-2018 there were 59 accidents that in total led to 147 fatalities (HeliOffshore, 2019). In comparison, the fatality rate in the helicopter industry is 3.8 million per flight hours, whereas in the fixed-wing industry the fatality rate is 0.4 per million departures (ibid.). Note that there is a difference in how those numbers were measured, however it is numbers HeliOffshore uses to compare offshore flying with fixed wing flying when discussing safety matters.

2.2 Regulatory context

To understand the context CHC operates in, it is essential to understand the regulations of the industry. CHC must comply with regulations from the International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA) and the Civil Aviation Authority (CAA) in the UK.

Figure 2 Regulatory bodies in aviation (own)



ICAO is a United Nations specialist agency with the aim of reaching "*consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable, and environmentally responsible civil aviation sector"* (International Civil Aviation Organization, 2020). It has 193 member states and regulates all civil aviation transport, including helicopters. Two important documents concerning safety in the aviation industry are ICAO's Safety Management Manual (SMM) and ICAO annex 19 Safety Management. The states must have a State Safety Program (SSP) to ensure an acceptable level of safety in aviation operations. CAA is the regulator in UK. CAA is responsible for the SSP in the UK. Through the SSP the states' safety strategy is managed, regulated and administrated (International Civil Aviation Organization, 2016). One level lower, the operator must have a Safety Management System (SMS) with the aim of identifying risks and hazards and continually assessing safety (ibid.). EASA is an agency of the European Union and has regulatory authority and sovereignty over its member states. EASA also conducts inspections and monitors the applications of regulations in their member states, whereas ICAO

does not have that kind of authority. Even though the UK has withdrawn from EU, it will be treated as a member state until 31.12.2020 (European Aviation Safety Agency, 2020).

CHC must comply with regulations concerning CRM training. The CRM training is officially regulated by the Commission Regulation (EU) No 965/2012 – Air Operations (European Union Law, 2012). It states that the operator must build their own CRM training program to fit with their company culture and standard operating procedures (SOP). It must however follow the approved syllabus as defined in ORO.FC.115 where all topics shall be covered in a period not exceeding three years. The syllabus is attached in Appendix J. The CAA has developed a handy guide to provide an applied practical CRM training guide called CAP 737 based on the regulated requirements from EASA. This is a practical guide many operators lean on, including CHC.

2.3 Sumburgh accident in CHC, Aberdeen

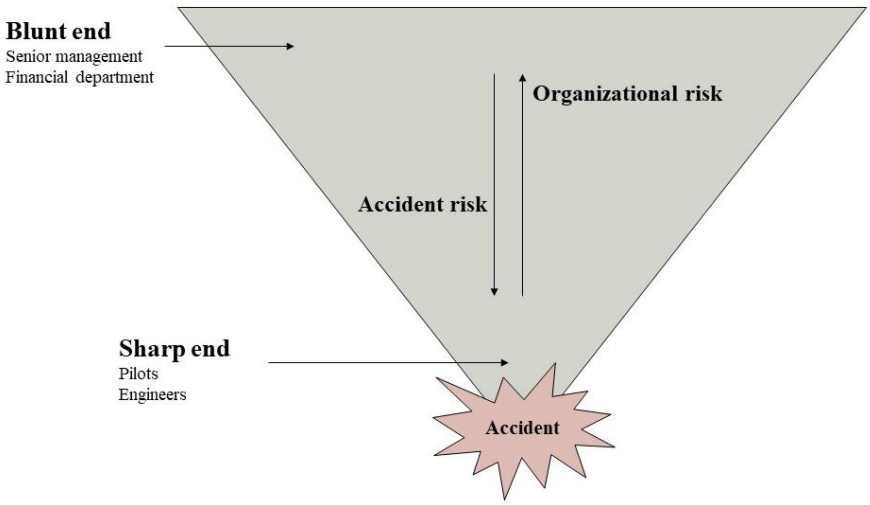
As a part of the context of this research it is necessary to include an accident CHC Aberdeen had. On 23 August 2013, the AS332 Super Puma helicopter was planned to transport sixteen offshore oil and gas workers from the Borgsten Dolphin semi-submersible drilling platform in the North Sea to their final destination: Aberdeen Airport. The helicopter had planned a refueling stop in Sumburgh Airport, located on the southern part of the Shetland Island. At 17:17 the Super Puma helicopter crashed in the sea on their approach to land in Sumburgh Airport. In addition to the sixteen passengers there were two crew on board. Four of the passengers died. The weather conditions were poor, so the pilots had to approach the airport only aided by the helicopter's instruments. The pilots failed to monitor the helicopters instruments efficiently and did not notice the decrease in air speed until it was at a critically low state. The commander attempted to recover the helicopter but was unsuccessful and the helicopter crashed into the sea (Air Accidents Investigation Branch, 2016). The investigation concluded that there was no evidence of technical failures. The accident led to a change of procedures and training within CHC. The whole office in Aberdeen was greatly affected by this accident.

CHAPTER 3: THEORETICAL FRAMEWORK

This chapter will lay the theoretical foundation for the discussion that will follow in chapter 6. This case study is about the TRM program in CHC, which lies within the field of human factors. The program is developed and implemented within an organization. Therefore, this theoretical framework consists of two parts: one outlining the organizational perspective on safety and one covering the field of human factors. Human factors and organizational perspectives on safety are not entirely separate theories; therefore, this chapter must be read in its entirety.

The sharp and blunt end are generic terms used to describe which part of the organization one is referring to. Reason (1997) describes the sharp end as teams or individuals that work in the hazardous process in a system. The blunt end is the other end of the system, working far from the operational part. The blunt end affect the system's safety through providing resources, constraints and priorities (Reason, 1997). The two ends face different risks in the organization. The sharp end face risks of serious accidents, while the blunt end is concerned with organizational risks such as financials and reputation. Figure 3 illustrates that the various risks are increasing in the direction of the arrow. In light of this, the divide of the theoretical framework can be understood as a separation of the sharp and the blunt end, where the sharp end is traditionally concerned with human factors, while the blunt end is organizational.

Figure 3 Blunt and sharp end illustration (own)



PART 1: ORGANIZATIONAL RISK AND SAFETY MANAGEMENT

While CRM can be understood as a way to manage risks and safety in teams, other theories cover how this is undertaken in organizations. Accident theories, or rather the theory of why they happen, are important because they indicate how accidents can be prevented from occurring. The understanding of how accidents occur has gone through a change over the years. Dekker (2006) describes this change as going from "*the old view*" to "*the new view*" of human error, where the old view blames the person at the sharp end: the nurse giving the wrong medicine, the operator pressing the wrong button or the co-pilots choice not to speak up to the captain about a safety issue. In this view the correlation between accident and cause is easy to see and easy to fix. Get rid of the "*bad apples*" and the rest will take care of itself. According to Dekker (2006) this will not lead to improved safety. He introduces the "*new view*" which is a systemic approach because he claims that the human error at the sharp end is merely a symptom of a problem deeper within the system. Therefore, the system would not be safer if it simply got rid of the person at the sharp end making a mistake, because the same mistake would be made by the next person as well. This is in line with Reason (1997) and his theory about organizational accidents, as he explains that accidents do not have one single cause, but have multiple causes that involve both people operating on various levels of the organization, the technology, and the environment it operates in. Their consequences reach further and have effect on uninvolved populations, environment, and assets.

3.1 Risk and safety

Risk can be understood in many ways and it greatly depends on what perspective one has. The aviation industry is an industry familiar with risk. In Annex 19 "Safety Management" by International Civil Aviation Organization (2016, pp. 1-3) the term safety risk is used. The term is described as: "*the predicted probability and severity of the consequences or outcomes of a hazard"*. The risk approach in aviation is dominated by risk assessments and risk management where the general view is that all risks can be measured, assessed, and managed. The definition focuses on the probability of a risk occurring and the expected outcome. This two-dimensional view expresses an objective risk existing independently of a person's perception of the hazard, a view in line with ontological realism (Aven, Renn, & Rosa, 2011). Aven and Renn (2009) proposes the following definition of risk: "*risk is conceptualized as uncertainty about and severity of consequences of an activity with respect to something humans value".* In this definition another dimension is introduced: uncertainty. ICAO's definition does not include the

uncertainty aspect which implies that risk can easily be predicted with probabilities and calculations. Aven and Krohn (2014) present a new perspective on how to understand and manage risks. In their new perspective they focus on the knowledge dimension, the unforeseen and the potential for surprises. They claim that probability-based perspectives, as presented by ICAO, are too narrow. The knowledge dimension means that the strength of the knowledge is evaluated and used to present risks. However, risks may be presented and based on solid knowledge but understood differently. This can be explained by the fact that individuals perceive risks differently. This is addressed in chapter 3.1.1.

Safety seems to be the other side of the coin. International Civil Aviation Organization (2016, pp. 1-2) defines safety as: "*the state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level".* In their perspective, safety is the state where risks are reduced and controlled, not a state free of risk. The literature on safety problematizes how to define and understand safety. Safety is often understood as something that does not happen and the risks are managed properly. This has been addressed by Weick (1987) which resulted in a new understanding of safety, as a dynamic non-event (he used the term reliability, however Hollnagel (2014) refer to it in terms of safety). Safety as a dynamic non-event means that it is an ongoing situation where everything is under control and the outcomes are constant which means that there is no unwanted outcome and therefore nothing to pay attention to (Weick, 1987). In aviation, safety is therefore understood as a dynamic state where risks are reduced and controlled so that no unwanted outcomes occur.

Hollnagel (2014) describes two perspectives on safety: safety I and safety II. Safety I is the more traditional view as outlined in the paragraphs above, where the goal is to reduce and control risks to prevent negative outcomes by finding and eliminating possible causes. Hollnagel (2014) presents a variety of problems connected to this perspective: assumptions about causality, that systems can be decomposed into meaningful constituents and that events must be predictable. He further explains that as the world is changing and becoming more complex, systems are becoming more intractable (see Table 1), and therefore the assumptions made in the safety I perspective are no longer valid. He defines safety II as "*a condition where as much as possible goes right, indeed preferably as a condition where everything goes right"* (Hollnagel, 2014, p. 134). He continues to explain: "*The understanding of how something is*

normally done (everyday work) is a necessary prerequisite for understanding whether something is (potentially) wrong" (ibid., p. 135). Therefore, in the safety II perspective, safety means the presence of success. The more success, the safer the system. Safety management in the safety II perspective focuses on the things that go right in everyday work, and making sure things go right more will therefore reduce the amount of times things go wrong.

Table 1 Tractable and intractable systems (Hollnagel, 2014, p. 119)

	Tractable system	**Intractable system**
Number of details	Descriptions are simple with few details	Descriptions are elaborate with many details
Comprehensibility	Principles of functioning are known	Principles of functioning are partly unknown
Stability	System does not change while being described	System changes before description is completed
Relationship to other systems	Independence	Interdependence
Controllability	High, easy to control	Low, difficult to control
Metaphor	Clockwork	Teamwork

3.1.1 Risk perception

People understand and respond to risks differently. How a risk is perceived depends on various factors such as if the individual exposes himself voluntarily or not, if the source of risk is unfamiliar and new, personal factors, if it is a dreaded risk as well as other factors (Sjöberg, 1998, 2000). Knowing how risks are perceived is important, just as Renn (2008, p. 92) emphasizes: "*Risk perception belong to the contextual aspects that risk managers need to consider when deciding whether or not a risk should be taken, as well as when designing risk reduction measures*". Therefore, when managing risk it is important to understand how they are perceived in an organization. Sjöberg (2000, p. 9) says that in cultural theories, risk perception is understood as "*a reflection of the social context and individual finds him- or herself in".*

3.1.2 Safety culture

The context employees find themselves in is organizational. Therefore, according to Sjöberg (2000), risk perception will be reflected by the culture in the organization. As a part of organizational culture, there is safety culture, which is connected to employees' values, beliefs, norms, and the organization's structure to handle, mitigate and reduce risks. Turner, Pidgeon, Blockley, and Toft (1989) define safety culture as: "*the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious*". Great Britain Heath and Safety Commission (1993, p. 5) provides a similar definition and adds on: "*Organisations with a positive safety culture are characterised by communication founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures".* There are four components that together makes up an informed culture as Reason (1997) calls a good safety culture. The four components are described below.

- **Reporting culture**: a safe culture is a culture where incidents, near-misses and concerns are reported. Engineering a reporting culture presupposes a system where reports can be sent in, analyzed, and acted upon. For this system to work it needs not only to be easy to make the report, but also trust in that the report will be handled with confidentiality and acted upon without unfair disciplinary proceedings.
- **Just culture**: having a just culture means that individuals will not wrongfully be disciplined for incidents or bad behavior. However, intentional reckless actions have to be addressed. A just culture is preoccupied with learning, not punishing.
- **Flexible culture**: A flexible culture indicates that the organization is reliable, as understood by Weick (1987) and La Porte (1996), and that it manages to change its structure depending on the danger it faces. Reliability is further addressed in chapter 3.3.
- **Learning culture**: a learning culture is about observing the current level of safety, reflecting, and analyzing what that data means, creating, and designing measures and programs to deal with factors identified in the previous step and implementing them. According to Reason, the last step is the most challenging: becoming a learning culture. The TRM program is currently at the last step (implementing, doing, testing).

If an organization has a reporting, just, flexible and learning culture they have an informed culture, i.e. safety culture. Reason (1997) claims that a safety culture is rarely attained, and that the process of trying to attain it is more important than the product itself.

3.1.3 Safety leadership

"*We have found through 30 years of accident investigation that sometimes the most common link is the attitude of corporate leadership toward safety. The safest carriers have more effectively committed themselves to controlling the risks that may arise from mechanical or organizational failures, environmental conditions and human error."*

– Jim Hall, chairman National Transportation Safety Board (U.S), quoted in Tullo (2019).

Leadership of crews, teams and departments has been identified as crucial for safe and effective operations (Yukl & Lepsinger, 2005). Leaders are found both in the blunt and sharp end. Leadership has been identified as a contributing factor in several serious accidents, such as Chernobyl, Piper Alpha and Challenger (Cullen, 1990; Mark & Carver, 1987; Meshkati, 1991). As a result of these horrific accidents, a vast amount of research has been conducted on leadership and its relation to safety outcomes, and the term "*safety leadership*" has emerged. Flin and Yule (2004) divide leadership into three organizational levels: supervisors, middle managers, and senior managers. They further identified examples of good safety leadership in managers and supervisors where they should monitor and reinforce their workers safe behaviors, participate in safety activities, be supportive of safety initiatives and clearly show that they emphasize safety over productivity. Over 60 years ago, Heinrich (1959) also emphasized how important leaders are in preventing accidents: "*The supervisor or foreman is the key man in industrial accident prevention. His application of the art of supervision to the control of worker performance is the factor of greatest influence in successful accident prevention*" (p. 22). Flin and Yule (2004) say that senior managers often are located away from the sharp end of the organization, but still have great influence on safety performance in the organization. "*Senior managers can demonstrate their commitment to safety by developing and providing resources for a comprehensive safety program, showing concern for people, encouraging participatory styles in middle managers and supervisors, being clear and consistent in their support for safety, and displaying transformational behaviors*" (Flin & Yule, 2004, p. 48).

3.2 Normal Accident Theory

The world we live in today is growing more and more complex. Perrow (1999) would argue that the world is getting more tightly coupled and its interactive complexity is increasing. When a system is tightly coupled it means that there is little slack in the system, which implies that there is little margin for error. A system with interactive complexity is a system where it is hard to see or understand its sequences of events, and its parts interact with each other. If a system is both tightly coupled and has a high degree of interactive complexity, Perrow (1999) claims that accidents will happen and it is "*normal*" for those kinds of systems, which is known as the Normal Accident Theory (NAT). Normal accidents, or system accidents as it is also referred to, involve an unanticipated interaction of multiple failures of components, and involve harm to people. Perrow (1999) argues that these kinds of accidents are hard, or even impossible, to avoid because they cannot be predicted. Perrow's theory is based on his study of several accidents in high technology systems, such as nuclear and aviation industry. He describes the aviation industry as a system with high interactive complexity and tightly coupled, therefore normal accidents are expected in the industry and cannot be eliminated by creating barriers or increasing redundancy or reliability. According to Rijpma (1997) theorists of NAT believe that reliability enhancing measures only increase the complexity of the organization, and thus the likelihood of normal accidents. Perrow (1999) acknowledge that accidents are not only caused by technology but also matters related to the organization, leadership and the employees involved.

3.3 Reliability in Organizations

Often viewed as opposing to Normal Accident Theory is the theory of High Reliability Organizations (HRO). Researchers (La Porte, 1996; Roberts, 1989; Roberts & Rousseau, 1989; Weick, 1987) have studied organizations that operate in high risk industries that according to Perrow (1999) would experience normal accidents. However, they found that these organizations operated with an extremely high level of reliability and without accidents over time. Organizations with high reliability are obsessed with failure, comfortable with complexity, has a sensitivity to operations, committed to resilience and deferent to expertise (Vogus & Sutcliffe, 2007; Weick & Sutcliffe, 2011).

The concept of reliability applies to both technology, humans, and organizations. Reliability is defined as the "*lack of unwanted, unanticipated, and unexplainable variance in performance*" (Hollnagel, 2014). In this understanding of reliability, Hannan and Freeman (1984) claim that

reliability is achieved through highly standardized routines. Through standardized routines the organization can repeat and reproduce patterns of activity to ensure that it has the same expected outcome every time. However, many researchers are skeptical towards too many procedures and standardized routines, as it is rigid and creates little room for adaptability (Hollnagel, 2014; Klein, 2011; Weick & Sutcliffe, 2011). In fact, Hollnagel (2014) describes performance variance as something completely natural and claims that it will always be present where people operate in a socio-technical system. This kind of performance variance is not, in his perspective, viewed as a deviation, but rather an important ability to adjust to the changing context one operates in, in order to achieve positive safety outcomes. Further, Hollnagel (2014) goes on to describe the system's ability to adjust its functions before, during or after changes and disturbances as resilience.

Weick et al. (2008) claim that the traditional understanding of reliability is not applicable to the conditions under which organizations must function in reality. Organizations must handle unforeseen situations which do not necessarily have a standardized routine or procedure. Therefore, to remain reliable, an organization must be able to adapt and adjust to handle unforeseen situations. Or in the words of Weick et al. (2008, p. 35): "*unvarying procedures can't handle what they didn't anticipate*". Furthermore, the authors describe how one can achieve reliable variations in routines, by achieving stability in the process of cognition. Which means that reliable outcomes, become the result of stable processes of cognition. However, there can be a gap between the variations of the system and the variations of employees in the system. Weick (1987) outlines two ways of reducing the gap between the variety of the system and of its human sources. One is fostering a culture that favors face-to-face communication, because systems that are complex require thick and rich information that is hard to pick up on via written communication means. The second one is to have work groups that are made up of divergent people. People that have similar training and background, will most likely notice the same things. Phenomena such as groupthink can also arise in groups that are uniform (Jones & Roelofsma, 2000). Weick (1987, p. 116) claims that: "*If people look for different things, when their observations are pooled, they collectively see more than any one of them alone would see*".

3.4 Information processing in organizations

Turner and Pidgeon (1997) examine how disasters and larger accidents emerge in organizations, based on evidence of past disasters. To be able to foresee and prevent accidents and disasters happening, it is important to seek to identify organizational preconditions. After examining several disasters, Turner and Pidgeon (1997) found similarities in how they came to develop into disasters. A developmental sequence of six stages is presented:

1. **Notionally normally starting point:**
    a. Initially culturally accepted beliefs about the world and hazards.
    b. Associated precautionary norms in laws or codes of practice.
2. **Incubation period:** the accumulation of an unnoticed set of events which are at odds with accepted beliefs about hazards and the norms to control them.
3. **Precipitating event**: forces itself to the attention and transformation of the general perceptions of stage two.
4. **Onset:** the immediate consequences of the collapse of cultural precautions become apparent.
5. **Rescue and salvage:** the immediate post collapse situation is recognized in ad-hoc adjustments which permit the work of rescue and salvage to be started.
6. **Full cultural readjustment:** an inquiry or assessment is carried out, and beliefs and precautionary norms are adjusted to fit the newly gained understanding of the world.

(Turner, 1976, p. 381; Turner & Pidgeon, 1997, p. 85)

In the context of this study, the first two are the most relevant since the latter four are post-crisis. However, in light of the expanded understanding of the stages of a crisis, it is a cyclical process where the post-crisis phase leads to a new pre-crisis phase since the former crisis has changed our understanding of the world and developed a "new normal" (Kruke, 2012). Therefore, all stages are included.

In Tuner and Pidgeon's (1997) view, almost all disasters have precursors or warnings that could be discovered and handled to prevent the accident from happening, but they are only made obvious in hindsight. In the incubation period discrepant events develop unnoticed, and there is a lack of information flow as well as a misperception among individuals and/or groups within the organization. However, their findings indicate that some people might be aware of the

danger that develops but fail to interpret it or communicate it correctly. Therefore, it is not necessarily the lack of information that leads to accidents but rather issues with the flow of information. Turner and Pidgeon label this as variable disjunction of information. It is: "*a (complex) situation in which a number of parties handling a problem are unable to obtain precisely the same information about the problem, so that many different interpretations of the situation exist"* (Turner & Pidgeon, 1997, p. 50). In other words, there is no common situation awareness across the organization. Just because something is unforeseen, does not mean it is unforeseeable. "*High-quality intelligence is necessary for correct action*" (p. 6). High-quality intelligence is a term developed by Wilensky (1967) and says that information that is clear, timely, reliable, valid, adequate and wide-ranging becomes high-quality intelligence. In this context, he refers to intelligence as in the military understanding of the term: gathering, processing, interpreting, and communicating information. However, in this perspective the aim is not to fight an enemy of a foreign state, but rather accidents and disasters.

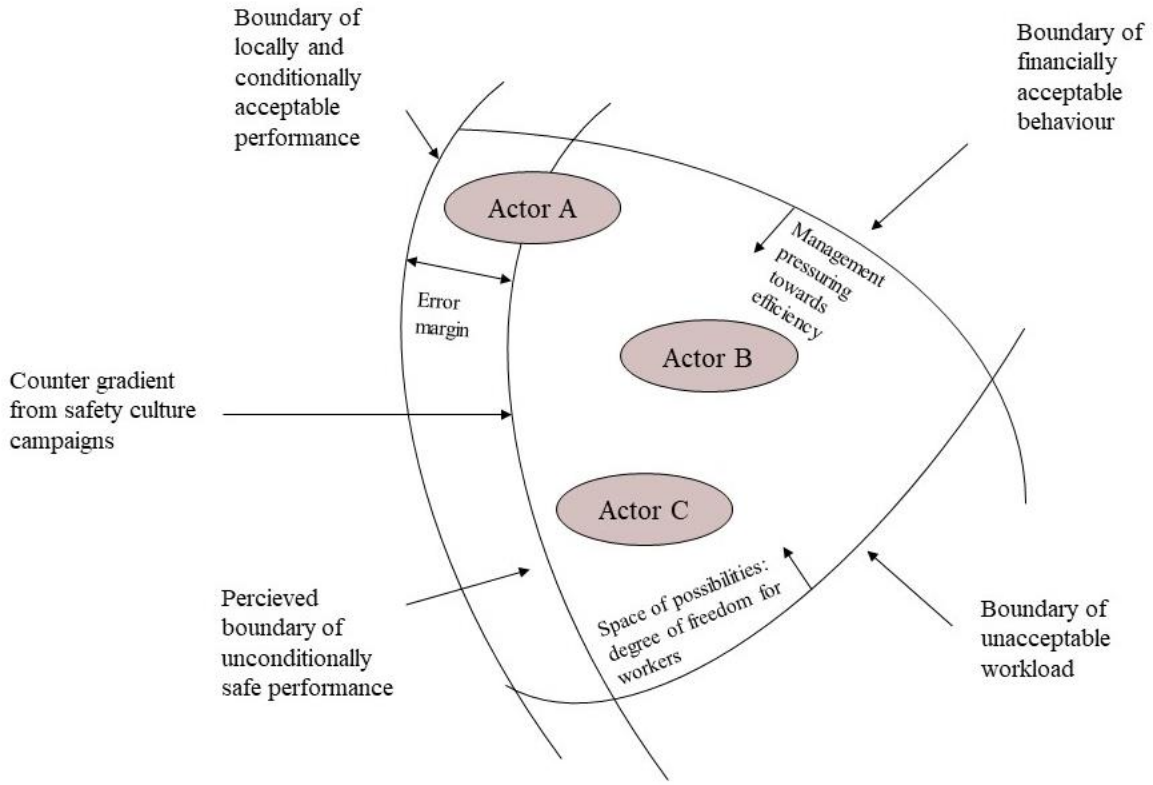
3.5 Risk management in a dynamic society

Organizations do not operate in a vacuum. Rasmussen (1997) outlines the challenges of risk management in socio-technical systems, where he claims that accidents are not caused by a coincidence of independent failures or human error. Rasmussen claim that organizations operate in a "*very aggressive and competitive environment*" (p. 186), which will likely influence decision-makers to focus on short term financial gains and survival, rather than long term safety and welfare. This cost-effectiveness pressure in a competitive environment is what leads to a systematic migration of organizational behavior in an unsafe direction. However, the system is complex and the whole system becomes more than the sum of its separate parts (Rasmussen, 1997).

The aviation industry, both fixed wing and rotatory, are constantly pressured when it comes to costs and even more so now with the current pandemic. Therefore, to survive, an organization cannot spend unlimited resources on safety measures and risk reduction. This dilemma in organizations will be experienced by both teams and individuals, and will, according to Rasmussen, result in risky behavior. The organization's focus on productivity and efficiency can result in individuals and teams pushing the limits of acceptable risk and workload. This is what Rasmussen calls migration towards the boundaries of safe performance. Individuals and teams will also try to improve performance, which will result in variations in the way they

work, Rasmussen calls this "*Brownian movements*". Brownian movements refers the field of Chemistry, where Brownian motion describes the stochastic motion of particles induced by random collisions with molecules (Chandrasekhar, 1943). The direction of the particles are constantly changing and therefore leading to a seemingly random nature of the motion. In this analogy, the particles are actors that are constantly influenced by the organization's management, culture, and other factors, driving them towards the boundary of safe performance. The organization will try to manage risks with various safety campaigns, that will increase the margin of error, as illustrated by Figure 4.

Figure 4 The migration model with several actors (Rasmussen, 1997)



PART 2: HUMAN FACTORS

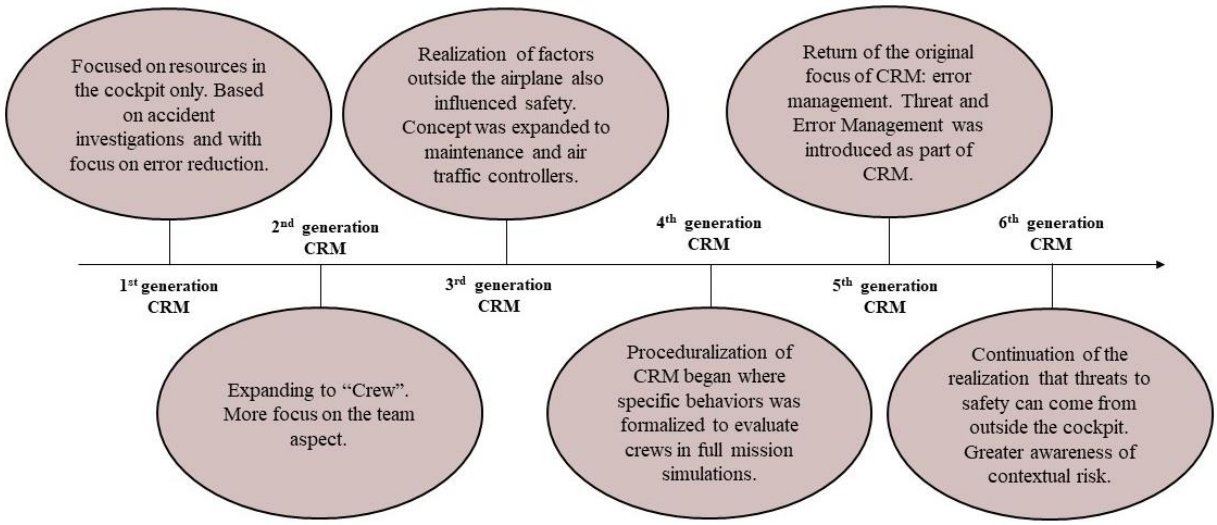
Several horrific accidents caused by human error happened before the 1990s. Examples are the Tenerife crash of Pan Am Flight 1836 and KLM flight 4805 (1977), Bhopal plant explosion (1984), Japan Airline Flight 123 crash (1985) and Chernobyl (1986). The Tenerife accident was caused by misunderstandings in the cockpit (Weick, 1990), Bhopal was caused by organizational factors and lack of safety culture (Eckerman, 2005; Weick, 2010), in many ways similar to Chernobyl where causes were to be found "*in the lack of human factors (micro- and macro-ergonomics) considerations*" (Meshkati, 1991). The Japan Airlines Flight 123 accident was caused by mistakes and insufficient work by the maintenance crew (Kobayash & Terada, 2008). With these events, and many more, as a historical background, the science of human factors evolved. According to the definition by the Health and Safety Executive (2017), "*human factors refer to environmental, organisational, and job factors, and human and individual characteristics, which influence behavior at work in a way which can affect health and safety*". In this definition the organization includes the culture of the workplace, its resources, communication, management, and leadership. Job factors are factors related to ergonomics, such as design of the workplace and how it considers the human limitations and strengths. Job factors also refer to procedures and the nature of the task. Individual factors are a person's skills, personality, competency, risk perception and interpersonal skills, such as communication style or leadership. The aim of the field of human factors is to enhance human performance, health, and safety. By drawing on knowledge and methods of fields like engineering, psychology, physiology, behavioral and social sciences, the human factors field tries to optimize human performance, and thus reduce human error.

3.6 Unpacking the term Crew Resource Management

The term Crew Resource Management is a term that is often referred to when speaking about human factors and non-technical skills. The development of CRM started in the aviation industry after it experienced some horrific accidents. The accidents were not due to technical failures, but rather human errors, and in retrospect found to be very easily avoidable. The aviation industry had to act. In 1979 the National Aeronautics and Space Administration (NASA) sponsored the workshop "Resource Management on the Flight deck" with the aim of investigating the causes of air transport accidents (Cooper, White, & Lauber, 1980). Analysis of the investigation material led to a conclusion of failures in leadership, team coordination, communication, lack of assertiveness, inattention and inadequate decision making (Crichton,

O'Connor, & Flin, 2013; Endsley, 1988a; Flin, 1996). At this workshop, the training concept "Cockpit Resource Management" was developed with the aim of reducing pilot error. Psychologists and pilots at the workshop identified behaviors revealed in several investigations of accidents in aviation. Through various methods, key non-technical skills for best practice were identified.

Figure 5 Generations of CRM (own)



This is described as the first generation of CRM. (Helmreich, 2006; Helmreich, Merritt, & Wilhelm, 1999). The CRM training program initially met skepticism and resistance from some pilots, deeming it as "charm school" or "psychobabble" (Helmreich et al., 1999). Later, the concept was expanded and turned into the term as we know it today: Crew Resource Management. It still had the label "psychobabble" hanging over it, even though the general consensus was more positive than before. As CRM evolved, the realization of other factors' influence on flight operations safety came into greater focus. Similar concepts were developed for air traffic controllers and maintenance. Threats were not only coming from within the cockpit (Helmreich, 2006). How CRM developed through generations is showed in Figure 5, based on Helmreich et al. (2010); Helmreich et al. (1999); Kanki, Anca, and Chidester (2019).

As Salas, Wilson, Burke, Wightman, et al. (2006) problematizes, the term CRM has taken on a life of its own. CRM has been adapted by many other industries, where the authors have noted that it is often understood as a psychological or performance-oriented construct. However, they mean that CRM is only an umbrella term of characterizing the knowledge, skills and attitudes

(KSA) for a team to be successful, whether it is in the flight deck, the boardroom, the operating room or in the incident command center. Their understanding of CRM focuses on KSA. This makes sense considering that CRM rarely has a clear and concise definition in the literature. If the KSA's vary from team to team, depending on where they operate it does not necessarily make sense having a very specific definition. A broad and unspecific definition can however, lead to different interpretations and understandings, which seems to be the case with CRM.

A widely used definition of CRM in aviation is: "*the effective use of all resources, including hardware, software, and people, to achieve the highest possible level of safety*" (Federal Aviation Administration, 1991, p. 24). This offers a broad definition and understanding of CRM, without specification if it is on an individual, as a team, or as an organization. However, this seems to be the most used definition.

Tullo (2019, p. 61) seemingly gives us the answer by stating: "*the true definition of "teamwork" or CRM is its focus on the proper response to threats to safety and the proper management in crew error*". This definition indirectly claims that teamwork is the same as CRM, and vice versa. This seems to be total opposite of what Anca (2010) says when he claims that CRM is often misunderstood as simply being a team. However, if examined further, it is evident that they have the same focus, where both bring in the concept of threat and error management. Threat management indicates that one tries to manage the threat before it becomes an error. Error management implies that an error has occurred, but the crew manages to trap and correct the error before it leads to a serious situation, which means that the crew must adapt to the changing conditions. This can also be understood as resilience as outlined in chapter 3.3. This definition also fits with the definition offered by Federal Aviation Administration (1991), but uses the words "*to achieve the highest possible level of safety*", which indirectly means managing threats and errors as well.

Helmreich and Foushee (2010) connects CRM and human factors in their definition "*Just as the performance and safety of a system can be degraded because of poor hardware or software design and/or inadequate operator training, so too can system effectiveness be reduced by errors in the design and management of crew-level tasks and of organizations. CRM is thus the application of human factors in the aviation system*." (Helmreich & Foushee, 2010, pp. 4-5). Flin et al. (2003) focuses on CRM skills in their definition and state that CRM skills are: "*the*

cognitive and social skills of flight crew members in the cockpit, not directly related to aircraft control, system management and standard operating procedures.".

None of the definitions exclude each other, they present slightly different perspectives. In conclusion, here CRM is understood as a training concept with he aim of being able to use all resources (hardware, software and people including teamwork) to achieve the highest possible level of efficiency and safety in everyday work. By achieving a high level of efficiency and safety employees are attentive, make good decisions, share information, and cooperate well. When employees manage threats and errors, accidents are also less likely to occur. If errors however do occur, employees will use all resources available to restore and handle the situation, understood as resilience. This means CRM is used both in normal operations to reduce the likelihood of unwanted situations, and when an unwanted situation does occur to minimize the potential negative outcome.

3.7 Non-technical skills

Non-technical skills are defined as the "*cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance"* (Crichton et al., 2013, p. 1). These skills include situation awareness, decision-making, communication, teamwork, leadership, and management and coping with stress and fatigue. More specifically, what those skills are and what elements they consist of, depends on the occupation and the task at hand. By identifying the key non-technical skills in a given occupation, then applying necessary training to optimize those KSA in workers, a workplace can improve its safety and efficiency (Crichton et al., 2013). These skills are not any mysterious, secret skills, but rather skills that the best practitioners do to achieve high performance and safety. In the following sub-chapters, the six different skills are described.

3.7.1 Situation awareness

Endsley (1988b, p. 792) provides the most cited research on situation awareness (SA) where she defines it as " (..) *the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future*". As the definition indicates there are three levels of SA, as outlined in Endsley (1995b).

Level 1: perception

Level 1 of SA is the perception of the elements in the environment within a volume of time and space. This first step is achieved by perceiving the relevant elements in the environment and gathering that information. Perception is a term often used in psychology and refers to the "*process or result of becoming aware of objects, relationships, and evens by the means of the senses, which include activities as recognizing, observing and discriminating*"(American Psychological Association, 2018). A person's memory, goals and objectives will determine what elements they in fact direct their attention to and find relevant. Furthermore, there are several factors that can affect the ability to perceive the relevant elements, such as stress, workload and complexity of the information and situation.

Endsley (1995a, p. 2) lists the following errors related to the first step of SA:

A. Data not available
B. Data difficult to detect/perceive
C. Failure to scan or observe data (can be due to omission, attentional narrowing, or high task load)
D. Misperception of data
E. Memory failure

Level 2: comprehension

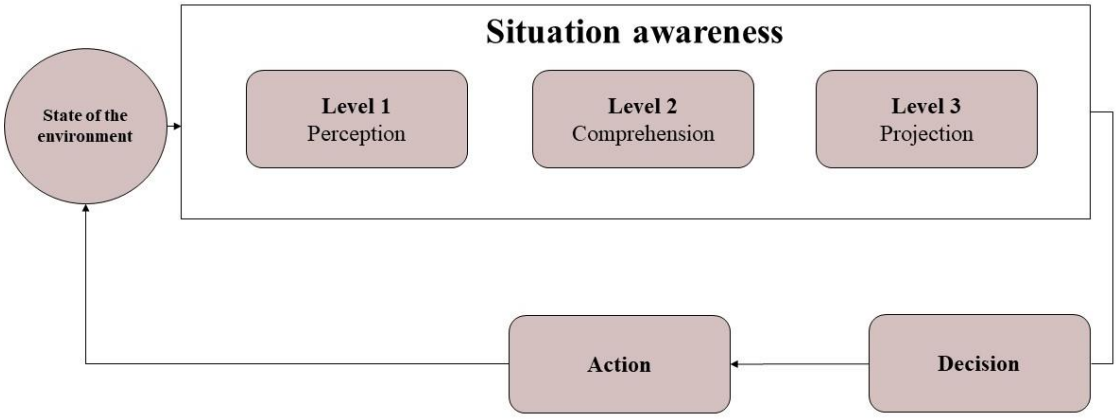
Level 2 is about comprehending and making sense of the information gathered in level 1 and understanding its significance to the situation at hand. To make sense of the information one needs to retrieve information from the long-term memory and match prior knowledge to the situation at hand. This is called pattern matching (Crichton et al., 2013). Pattern matching helps to quickly understand the situation and what its elements mean, however it does require experience. Without experience it takes more time and mental capacity to comprehend the patterns of the elements, analyze them, and compare with possible interpretations (ibid.)

Level 3: projection

Level 3 of SA is about being able to project the future status of the situation. The third level builds on the two previous levels, where first the elements need to be perceived and assessed as relevant. Then the relevant elements need to be interpreted and understood, where this understanding builds some kind of story of how the situation will evolve and what will happen

in the near future. This is what Klein (1999) calls mental simulation, defined as "*the ability to imagine people and objects consciously and to transform those people and objects through several transitions, finally picturing them in a different way than at the start"* (Klein, 1999, p. 45). This ability builds on mental models, where organized knowledge is formed into structured patterns. The use of certain knowledge structures, is known as mental models (Converse, Cannon-Bowers, & Salas, 1993).

Figure 6 Situation awareness (Endsley, 1995a)



3.7.2 Decision-making

Decision-making is a widely researched topic in many fields such as economy, business strategy, military, and psychology. Decision-making in CRM is based on the research of Naturalistic Decision Making (NDM), which is an approach that study decision-makers in real-world settings in their natural environment by conducting field research (Klein, 2008; Orasanu, 2010). Decision-making is the process of reaching a judgement, choosing an option, or a course of action, to meet the needs of a given situation (Crichton et al., 2013, p. 41). NDM research has shown that in dynamic situations where there is a lot at stake, time pressure and stress, the goal is to reach a satisfactory solution, not necessarily the most optimal one, in contrast to economic decision-making theory.

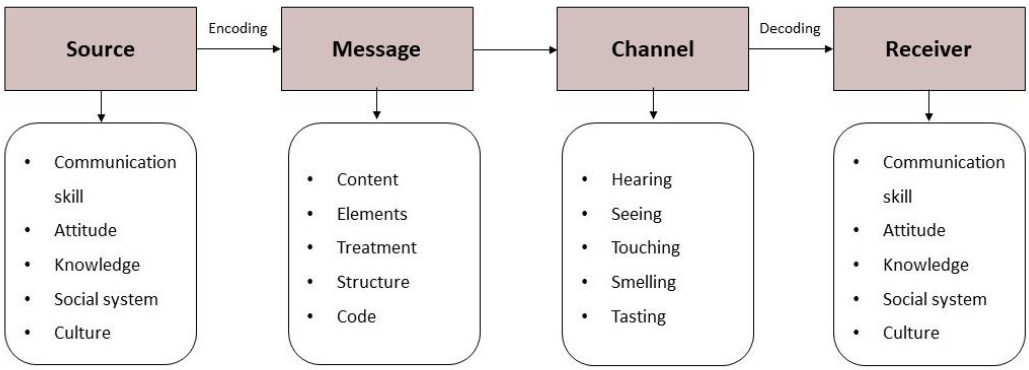
There are many reasons why people make faulty decisions. A faulty situation assessment and thus faulty situation awareness does not automatically lead to wrong decisions, but increases the chance of it (Endsley, 1995a). Likewise, a correct situation assessment does not automatically lead to good decisions, since the decision-maker could be lacking the skills or ability to perform the needed course of action. Situation assessment is the term used for the

process of achieving situation awareness (Endsley, 1995b). There are also contextual factors that can lead to poor decisions. Endsley (1995b) states that situation awareness is a function of the system of operation, and to what degree that system can provide the decision-makers the necessary information at the right time. The quality of information is also crucial, as ambiguous information makes it challenging for the decision-maker to understand the situation. Organizational factors can affect decisions being made in the sharp end. Reason (1997) has documented how latent conditions as he calls it, can lead to accidents in an organization. Latent conditions are organizational and managerial decisions and priorities that affect the whole organization - decisions such as productivity, the level of training, maintenance etc., where the decisions can end up in conflict with safety. A decision-maker's cognitive factors can lead to poor decisions. Under trying conditions decision-makers are more likely to fall into various cognitive biases leading to error (Ehrlinger, Readinger, & Kim, 2015; Kahneman, 2011; Klein, 1999; Lehner, Seyed-Solorforough, O'Connor, Sak, & Mullin, 1997). Other cognitive factors are lack of knowledge and personal perceived stress. In addition, social factors and teamwork come into play.

3.7.3 Communication

In CRM communication is essential for reaching goals. For a team to be able to reach their goals they need to communicate in a way that makes sure that they are coordinated and information is sent and understood correctly. Berlo (1960) presents a model of communication called the Sender-Message-Channel-Receiver Model of Communication (SMCR), which is a linear understanding of how communication works.

Figure 7 SMCR-model (Berlo, 1960)



The model describes communication between a sender and a receiver, where the sender first must encode the message. This encoding depends on the sender's abilities to communicate and is affected by his or her attitude, social system, culture, and knowledge. Encoding means to transform one's thoughts into a message, that can be either in the form of voice, audio, text, video, or other forms of media. The message has a content, which again consists of various elements such as language, non-verbal language, or gestures. The message will be treated and structured in a certain way, which influences its effectiveness. Code refers to how it is sent, either face-to-face verbal, non-verbal, text, video etc. The message is conveyed through a channel, which in this setting means that the message is sent through a medium. It can be indirect through newspapers, internet, telephone, radio etc., or it can be direct face-to-face. Regardless of the medium, the message will be perceived through one or several of our senses such as hearing, seeing, touching, smelling, and tasting. Finally, the message is decoded by the receiver. Whether it is received according to the intention of the source, depends on factors such as social system, attitude, knowledge, culture, and the source's ability to communicate. This process is illustrated by Figure 7. It is also important that the source and receiver is on the same level and that the receiver is willing to understand the source's intention. If the sender and receiver have totally different understandings of a phenomenon, the communication process will be more challenging. This can be related to the theory of shared situation awareness, and how that is important for effective communication and decision-making (Crichton et al., 2013; Kanki, 2010). Communication in teams, is essential to building shared mental models and better situation awareness. With efficient communication, teams can increase the chances of developing a correct situation awareness, therefore leading to better decision-making.

In CRM one practices two-way communication where there is a sender and a receiver exchanging information, in contrast with one-way communication. One-way communication is fast and indicates that the sender is in control giving instructions. The downside with one-way communication is that there is no room for feedback confirming that the instructions are understood. Two-way communication increases the chances for more accurate, reliable, and effective information transfer, where the receiver can follow up on details to make sure the information was understood correctly. This way the sender and receiver work together, increasing the chances for building shared situation awareness (Crichton et al., 2013). Research shows that crews or teams that are well coordinated communicate less explicitly and have a natural "push" of information, which means that the team members do not have to ask for the

information they need, but other members understand what they need and when they need it (Johnsen, Eid, & Mikkelborg, 2019).

3.7.4 Teamwork

In the literature on non-technical skills the term "team" is used, whereas in CRM the term "crew" is used. The term "team" is elaborated in section 3.8. This section only covers teamwork as described in CRM and non-technical skills literature.

Salas, Sims, and Burke (2005) argue that all the research conducted on teamwork can be boiled down to "*the big five*", which consists of core components of teamwork and are found in most teamwork taxonomies. In order for the big five to function the coordinating mechanisms mutual trust, shared mental models and having closed-loop communication must be present (Salas et al., 2005).

I. *Team leadership:* a functioning team must have some sort of leadership to direct, coordinate and assign tasks and activities of team members. A leader must also assess the team's performance and develop the skills, knowledge, and abilities of the team as a whole. Motivation and a positive atmosphere must be developed in the team. Such conditions facilitate team problem solving and decision-making and clarify the members roles.
II. *Mutual performance monitoring:* the team's members must develop a common understanding of team tasks and monitor each other's performance. Such behavior will help identify and prevent mistakes and lapses in other team members and therefore reduce the risk of error.
III. *Backup behavior:* team members must know each other's tasks, needs and limitations to be able to provide aid when needed. This helps the team to handle periods of high workload.
IV. *Adaptability:* adaptability refers to being able to adjust strategies and decisions based on the stream of information in a dynamic environment. This involves continually identifying and analyzing cues and changes in the environment, and thus having an updated situation awareness – both as a team and as individuals.
V. *Team orientation:* being team-oriented means prioritizing team goals over individual goals and knowing the other teammates' behavior.

(Salas et al., 2005; Salas, Sims, & Klein, 2004).

3.7.5 Stress management and coping

Stress is a term that is understood, defined, and used very widely. In the field of non-technical skills the definition of acute stress presented by Lazarus and Folkman (1984, p. 19) is mostly used: "*a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being*". As Crichton et al. (2013) state: individuals working in high-risk industries must be able to handle acute stress and perform under trying conditions, and must be able to make decisions under these conditions. In CRM, the focus is mainly on acute stress. However, chronic work-related stress is one of the greatest challenges to the wellbeing of the working force. A report from the Health and Safety Executive in Great Britain shows that work-related stress, depression or anxiety account for 44% of work-related ill health and 54% of working days lost in 2018 and up to March 2019 (Health and Safety Executive, 2019). Chronic stress can also reduce an individual's capacity to respond to and handle acute stress, therefore it is also important to account for chronic stress in high-risk industries. Baum, Cohen, and Hall (1993, p. 277) refer to chronic stress as "*the persistent negative experience or exposure of threat or excessive demand".* Further, they have found that chronic stress is a function of duration of the stressor, perceived threat (appraisal process) and response. If chronic stress is not dealt with, it can cause fatigue which will be covered in the next section. Stress management has four elements: preventing stress from occurring, identifying causes, recognizing symptoms and effects and implementing fitting coping strategy (Crichton et al., 2013).

3.7.6 Fatigue management and coping

Soames-Job and Dalziel (2001) define fatigue as "*a state of muscles and the central nervous system in which prolonged physical activity or mental processing, in the absence of sufficient rest, leads to insufficient capacity or energy to maintain the original level of activity".* The Federal Aviation Administration identified fatigue recognition and management as one of the most important elements of CRM training, and has their own Fatigue Risk Management program (Helmreich et al., 2010). Fatigue management is not only up the crew or individual but is also dependent on factors by organizational decisions, such as crew scheduling and rest periods. In addition, family commitments and private life also affect fatigue in work life. Dawson, Cleggett, Thompson, and Thomas (2017) documented which protective behaviors can reduce the likelihood or consequences of fatigue-related errors. The research found two categories of fatigue-reduction strategies reported by military aviation personnel: task-related

and behavior-based. Task-related strategies can be taking more time to complete the task, rotate with other tasks, offload tasks to others and double- or cross-checking one's work. Behavior-based strategies can be change of communications style, verbalize the task while doing it, increase the level of social interaction to improve alertness or increase supervisory oversight. Fatigue-proofing behaviors are used to decrease the likelihood and consequences of fatigue-related errors. Fatigue-related errors are not only a threat to safety, but also efficiency.

3.8 Team, group, and crew

The literature abounds with definitions of the term "team". In literature covering CRM the term "crew" and "team" is used side by side without any explicit discussion about differences. Collins Dictionary (2020a) says that "*a crew is a group of people with special technical skills who work together on a task or project*". Examples used are a two-man film crew making a documentary or a paramedic ambulance crew working together. This indicates that the definition and understanding of crew also means that they have a common goal and that they must do different tasks separately to reach that common goal. However, the term "group" is also said to consists of two or more people that are together in one place at one time, or a set of people who organize themselves to work or act together (Collins Dictionary, 2020b). Jones and Roelofsma (2000) state that there is not any clear and obvious difference between groups and teams, and that researchers disagree on this matter. Jones and Roelofsma (2000) refer to Johnson and Johnson (1987, p. 8) where they define a group as: "*two or more individuals in face-to-face interaction, each aware of his or her group membership, each aware of the other who belong to the group, and each aware of their positive interdependence as they strive to achieve mutual goals".* Salas et al. (1992, p. 4) define a team as: *"(..) a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited lifespan of membership*". While Orasanu and Salas (1993) focuses more on decision making as a vital part of a team and that decisions in teams are often embedded in performance, such as a flight crews deciding how to deal with a system malfunction during flight (Orasanu & Salas, 1993, p. 329). They too emphasize that the terms "team" and "group" often are used without differentiation. According to the authors, groups can be differentiated from a team by the degree of specialization of roles or knowledge relevant to the task and by the degree of member interdependence. Teams are very interdependent on each other because the members are highly differentiated in skills and tasks

they perform. Groups are on the other hand more homogenous, making them less interdependent. These dependencies are reflected in the team members specific KSA which differs between the team members and are necessary for task performance (Salas et al., 2005; Salas et al., 2004). However, as Baker, Day, and Salas (2006) points out, that simply having the team structure there, does not automatically ensure that they work as a team. To successfully work as a good team, they have to have the "big five" as outlined in section 3.7.4. In contrast to groups, where there is less differentiation between members and thus less need for coordination of the members KSA (Baker et al., 2006).

Another way to differentiate between groups and teams are in regard to decisions to be made. In groups the decision is often the main task itself, i.e. the goal of the group is to reach a decision where the challenge often is to reach consensus. While in teams, decisions are often a necessary part of achieving a common goal and is connected to specific tasks (Jones & Roelofsma, 2000), and embedded in performance (Orasanu & Salas, 1993). For example, a jury's goal is to reach a decision: guilty or not guilty. They are not very dependent on each other or very specialized but share the same goal: to reach a unanimous decision. Therefore, a jury is considered to be a group. Airline crews are often used as an example of a team. In a crew there is a high degree of interdependence and differentiation between the members, where they must perform various tasks and make various decisions to reach the common goal. The captain has to complete checklists to take off, while the cabin crew has to make sure the passengers are informed about the take off and wearing their seatbelts (tasks). The captain or co-pilot must make the decision at one point to carry on with the takeoff or to abort it (decisions). To achieve the goal (a safe flight) the crew must coordinate and communicate these tasks and decisions between the members of the crew. All teams may be a form of group by its definition; however, all groups cannot be considered to be a team. Based on the review of the definitions of team, it is understood that it consists of these elements:

1. Two or more individuals.
2. A common goal.
3. A high degree of differentiation between the members, which means that there are specialized KSA.
4. A high degree of interdependence between the members.
5. They make decisions, that often are embedded in performance.

6. There must be coordination to achieve the common goal.
7. Consist of the core competencies outlined in “the big five”

While the terms “team” and “group” often are discussed, the term “crew” is less so. The term “crew” is more specific than “group”, where there is the element of “special technical skills” as the definition states, makes it sound more like a team. However, the elements mentioned above indicate that there are other skills necessary to work successfully as a team as well, more than just technical skills. Therefore, crews can be understood as a team only if they consist of the seven elements mentioned above. That means that some crews might be considered to be a team, while others are not, based on how they score on those elements.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

This chapter outlines the choices that have been made during this research process with the aim of answering the research questions. The aim has been to create reliable knowledge based on empirical evidence and logical arguments. To achieve that, this chapter will present and clarify the choice of methods, data collection and analysis, as well as the logics of inquiry it builds on. Furthermore, the research's validity and reliability are presented. Lastly, the strength and weaknesses of this research will be discussed.

4.1 How this case study came about

Coincidences led me to this project with CHC and University of Aberdeen. As mentioned in 1.1, I heard about TRM at the Sola Conference. Being interested in CRM and non-technical skills, I approached Mr. Mark Abbey after his talk there. He was very forthcoming and told me that they have full transparency on all matters of safety, and he put me in contact with CHCs CRM expert and TRM developer, located at their office in Aberdeen, UK. After that, many e-mails have gone back and forth between us. In January 2020 I proposed writing my master's thesis about their project, to which he was positive and forthcoming.

4.2 Case study as research approach

Case study research is a mode of inquiry. Yin defines it as an empirical inquiry that investigates a contemporary phenomenon in a real-life context (Yin, 2017). This is a single-case study of CHCs' TRM project. There are several rationales for selecting a single-case study in opposition to multiple case studies. The rationales behind making this a single-case study with CHC and their TRM project were firstly the unique chance I got to research them with full openness. This opened a possibility to provide research on a unique project and thus contribute to the research on CRM expansion in organizations. As Yin (2017) states, "unusual" cases are a rationale for single-case studies. The fact that I have not found similar cases also argues for a single-case study. Another rationale behind the choice of single-case study was the ability to gain a deeper understanding of the case, as the researcher can use all the resources to focus on one case, which will increase the chances of producing higher quality research and deeper insights given the time limitations and resources. According to Yin (2017), another rationale for choosing a single-case study is that the case is a revelatory case, where the researcher is given access to a phenomenon that earlier has been inaccessible to empirical study (Yin, 2017, p. 50). I do not believe that this kind of access has been inaccessible for researchers before, but rather that the

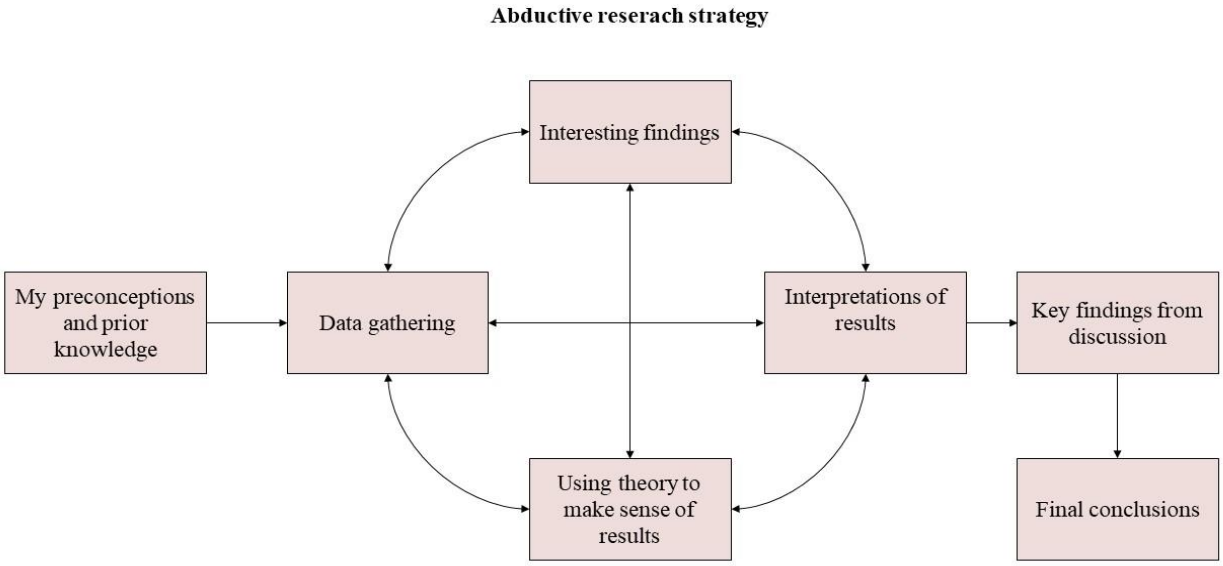
information about this kind of project has been unknown for researchers. I believe there are several operators within aviation that have extensive knowledge and experience with similar projects, however there is very limited literature to find, indicating it has not been a subject for research and publication. Lastly, choosing to do a case study allowed me to collect data from many different sources of evidence that would give me a good understanding of the case and lastly provide deeper insights (Yin, 2017).

This case study can further be described as an embedded, single-case study with several units of analysis. The main unit is the project TRM as the "case", with the organization and individuals as subunits. The line between considering this as a single-case study and a multiple-case study might be thin since I have interviewed informants outside of CHC. However, I still argue that it still is a single-case study as I have done so only to gain a better understanding of the case, which is TRM in CHC. As the literature review and the theoretical framework shows, the field of CRM is comprehensive, therefore the cope of this research is big enough as a single-case study. Case studies are normally qualitative, and this research is no exception. The aim for this research is to gain a deeper insight and understanding of the case that is researched and therefore the choice fell on using a qualitative method for data collection and generation. A qualitative method means collecting and generating data in the form of words, text, and pictures and the focus is on interpretation of data (Jacobsen, 2015). With qualitative methods new in-depth knowledge can be created in contrast to quantitative methods where the focus is on numbers and statistical reasoning (Johannessen, Christoffersen, & Tufte, 2016).

When framing a research design, it is important to examine what logic of inquiry is the most suitable to answer the research question at hand. For this research, an abductive logic of inquiry is used. Abductive logic builds on a method between deduction and induction where it continuously shifts between those two. In abductive strategies, the starting point is the social actors being investigated and the research is driven by the findings underway (Blaikie & Priest, 2019). This was the logic of inquiry that best reflected the research strategy. I started out with little knowledge of the aviation industry and CHC's project. Therefore, I wanted to have an exploratory design where the research questions have been adjusted as I have gathered data to increase insight and understanding during the research process. This process is illustrated in Figure 8. Data has been gathered in several rounds and for each round it has been analyzed and explained with help of theory. The data gathering has also been influenced by results from

previous data gathered. For example the first interview with the consulting company helped steer the interview guide for the next round of interviews with CHC. Yin (2017) also discusses the importance of adaptivity in case studies, where the researcher should be open for adjusting the case study design by new information or discovery during data collection. The abductive research approach together with an adaptive design of the case study helped a great deal when the global pandemic COVID-19 broke out and affected everyone. This approach showed to be a resilient approach that let me quickly adjust to the new situation. What adjustments I had to do during the process is described in Appendix A.

Figure 8 Illustration of research approach with abductive logic of inquiry (own)



4.3 Research process as conducted

Research strategy is the overall plan for conducting a research study and involves several decisions along the way. Underway several adaptations and changes had to be made because of COVID-19. The initial plan was to take part of a TRM course in Aberdeen and follow up participants with a questionnaire. This was planned in addition to the in-depth interviews at CHC. However, the TRM course was moved after I had booked my tickets. After I had been in Aberdeen conducting the in-depth interviews, I received the news that all courses were cancelled due to COVID-19 and therefore it would not be possible to do post-course questionnaires. The research process as conducted is described in more detail in Appendix A

as an attempt to take the reader with me on the way from start to end with this research and how the research strategy has been conducted. The description of the process confirms that it has not been a linear process, and the abductive strategy has been applied.

4.4 Data sources and collection

In social research there are three forms of data: primary, secondary, and tertiary. Primary data is the data collected by the researcher herself. Secondary data is data collected by somebody else but still in its raw form. Whereas tertiary data is collected and analyzed by someone else. The form of data also indicates how close the researcher has been to the collection. Primary data indicate the researcher's direct involved in the collection, whereas with tertiary data the researcher has little knowledge of how the data has been gathered and analyzed (Blaikie & Priest, 2019). The further the researcher is from the data collection, the harder it is to determine the quality of data. This research is based on primary and secondary data that has been collected in the form of qualitative data. The primary data are the 8 interviews with informants I have conducted. The secondary data consists of the documents described in 4.4.2.

4.4.1 Interviews and selection of informants

Table 2 Informants

Informant code	Title	Location	Date	HH:MM
Informant 1	Consultant working with CRM	Stavanger	07.02.20	01:06
Informant 2	Safety & Quality CHC	Aberdeen	04.03.20	00:27
Informant 3	Pilot and CRM instructor CHC	Aberdeen	03.03.20	00:36
Informant 4	Training Department CHC	Aberdeen	02.03.20	00:33
Informant 5	CRM expert CHC	Aberdeen	03.03.20	01:23
Informant 6	Professor Human Factors and Applied Psychology at University of Aberdeen	Aberdeen	05.03.20	Ca. 01:20
Informant 7	Previously worked for CAA UK and Bristow Group. Now consultant.	Online	05.05.20	Ca. 01:45
Informant 8	CEO HeliOffshore	Online	22.05.20	00:56

Selection of informants were twofold: inside and outside of CHC. To provide context and a deeper understanding of similar projects I had interviews with various informants outside of CHC (informants 1, 6, 7, and 8). The first one was with a consultant company in Stavanger working with CRM and its transferability to various organizations (outside of aviation). I contacted them early in the process to learn about their experience with similar project, because of the lack of literature to lean on. This interview gave me a better understanding of what I was looking for, therefore I adjusted the interview guide before the interviews with CHC. While in Aberdeen I got to meet one of the professors from University of Aberdeen that have been working with CHC with several projects. I was there with my contact from CHC and got to ask the professor some questions about the TRM project. Later in the process when analyzing the data, I felt the need to discuss it with other experts on the field to not be too reliant on information from CHC alone. I contacted an expert that have worked in the Civil Aviation Authority in the UK and in Bristow Group after reading some of his material that I found relevant. He had valuable insights from other perspectives, both from the regulatory perspective as well as from another offshore helicopter operator. He had also done similar projects as TRM in Bristow Group. Informant 8 is the CEO of HeliOffshore and therefore has firsthand knowledge about safety in the offshore helicopter industry, which also had experience with a similar project from the fixed wing industry. This was a purposeful selection based on the informant's expertise and knowledge on the subject. Informant 1 was to explore the topic before digging further in, while the remaining informants outside of CHC was used to triangulate the perspectives.

The informants at CHC were randomly chosen with the help of my contact at CHC, Blaikie and Priest (2019) call this non-probability sampling. Because many of the employees at CHC Aberdeen travel a lot it was hard to arrange interviews prior to arrivals. Therefore, interviews with informants in Aberdeen depended on who was there, had available time and was willing to be interviewed. Ideally, I wanted to conduct more interviews and preferably with senior management. However, that was challenging. It was a terribly busy time and CHC was undergoing cuts which might have affected people's willingness to partake in the research.

Informant 4 had earlier taken part in the TRM course and informants 3 and 5 were directly involved with the project and CRM at CHC, and can be considered key informants, which means that they have expert knowledge on the research topic (Andersen, 2006). Interviewing

them gave me information about the project and how they felt the implementation thus far had gone. The interviews with the other employees at CHC gave me important information about their perception and understanding of the project, which gives an indicator of challenges as well as what potential or actual benefits they see emerging from the project.

4.4.1.1 Conducting interviews

A semi-structured form of interview was judged to be best suited for this research. Semi-structured interviews means that the researcher in advance prepares an interview guide with a set of key questions but has the flexibility to deviate from the order of the questions as well as the freedom to ask follow-up questions (Andersen, 2006). This allows for the interviews to be more like a conversation and therefore not as formal as a structured interview. Prior to the interviews the interview guide was prepared (interview guides are attached in Appendices C-G, and the frame for conducting interviews in Appendix B). As mentioned, after the first interview with the consulting company in Stavanger I adjusted the interview guide before interviews at CHC, which is in accordance with the abductive research approach. Later, interview guides for the following interviews were based on the knowledge gained from prior interviews as well as literature.

Interviews with CHC employees were conducted at CHC in Aberdeen, in an office or meeting room without distractions. The interview with the consulting company in Stavanger was conducted at their office in Stavanger. All the interviews in CHC and informant 1 were recorded with the informant's consent (the consent form is attached in Appendix H). I preferred to record the interviews to be able to be fully present in the interview and not to worry about taking notes or remembering what was said. I was also worried that the Scottish dialect would be a challenge, so having the recording going was a reassurance. However, the dialect was no issue as the informants were good at explaining themselves. In addition, it was a reassurance for me to be able to go back and listen to the recording several times to make sure the transcription was accurate.

The interviews with informant 7 and 8 were conducted online and were unstructured interviews with few questions I had prepared in advance. The goal of the interviews was to get their opinion and thoughts on taking CRM into the blunt end and their experience concerning this. I also presented some of my findings, which we then discussed. The interviews were not recorded but I took notes during the interview and right after the interview I structured my notes and wrote

a short report. The interview with informant 6 was conducted at the University of Aberdeen in the professor's office together with my contact from CHC.

4.4.2 Documents for analysis

The documents analyzed consist of both official documents that are available publicly as well as internal documents I have been given permission to use. The official documents are mainly from regulators within the aviation industry and has been used to first of all understand the regulatory context, and then to provide empirical data to answer the question on how TRM relates to CRM, as well as how it is connected to the company's safety management system. I was given all necessary documents from CHC and official documents were found online through www.skybrary.aero. The documents are presented in Table 3.

Table 3 Documents for analysis

Publisher	Document	Published	Available from
CAA	CAP737 - Flight-crew human factors handbook	2016	www.caa.co.uk
ICAO	Annex 6 – Operation of Aircraft	2010	www.icao.int
ICAO	Safety Management Manual (SMM)	2009	www.icao.int
ICAO	Annex 19 - Safety Management	2016	www.icao.int
EASA	The principles of Threat and Error Management (TEM) for Helicopter pilots, Instructors and Training Organizations	2014	www.easa.europa.eu
AAIB	Report on the accident to AS332 L2 Super Puma helicopter, G-WNSB on approach to Sumburgh Airport on 23 August 2013	2016	www.gov.uk
CHC	Integrated Safety Management Manual	2018	Internal document CHC
CHC	CRM Training Modules	NA	Internal modules CHC
CHC	TRM Module	2019	Internal module CHC
CHC	12 SMS elements	2018	

4.5 Data reduction and analysis

After the process of gathering data in forms of interviews and documents I was left with a vast amount of raw data. Raw data had to be reduced and analyzed to draw out important information relevant for this thesis. Methods for analysis are used to structure and systemize the data. In this research all the data was imported into Nvivo. Nvivo is a tool to categorize and classify data that will help when analyzing vast amount of data at once. As Blaikie and Priest (2019) claim, data collection, reduction and analysis often merge into a cyclical process. The analytical process is a process that continues during the whole research process.

The recorded interviews were all transcribed manually in Nvivo and coded. Coding is a process where words, phrases or paragraphs are marked and assigned various codewords. This process helped get to know the data material well and at the same time organize it into more meaningful information which was easier to analyze because I could look at one theme at a time. I decided to code after themes, because when reading the interviews, it became clear to me which themes they were talking about. This is a form of deductive coding or also called axial coding, where the researcher codes from key concepts and themes (Johannessen et al., 2016). Dey (2004) describes this process involving three activities: describing, classifying, and connecting data. After the initial coding, the data was classified in categories, to further simplify the analysis. One paragraph could be given several codes, for instance “communication” was a code and when the informant spoke about the challenges, they had communicating across departments it was coded both as “communication” and “challenges”.

The analysis started when I first collected data in February. Since then I have, as illustrated in Figure 8, moved between interpreting and analyzing findings and explaining them with theory. Before the data collection started, I had some preconceptions and knowledge on the subject, but could not be qualified as an expert on the subject. As Figure 8 shows, there have been multiple rounds of interpreting results and using theory to make sense of the findings, and then gathering data again. I have conducted three rounds of interviews and for each interview I have gained knowledge. I supplemented with documents that were relevant, some of them recommended by the informants. Therefore, I argue that my preconceptions and prior knowledge have not affected the final conclusions, which have been steered by the data collected and interpretations based on theory.

4.6 Criteria of research quality

"*Attaining absolute validity and reliability is an impossible goal of any research model*" (LeCompte & Goetz, 1982, p. 55).

Absolute validity and reliability is unattainable; however, all research should strive to conduct all parts of the research in a rigorous manner. Different criteria are used to assess rigor or quality of the research. In qualitative research the criteria for quality are different forms of validity and reliability. The steps I have taken to strive towards a satisfactory level of rigor are described in this chapter.

4.6.1 Reliability

In social research the concept of reliability is a known challenge. Reliability refers to the replicability of the study. Which means if another researcher follows the same steps as I have in this research, that researcher should find the same empirical data and arrive at the same conclusion. There are some obvious challenges with this kind of test of research quality in case studies. First of all, the case study is a study of a phenomenon in a real-life context in real time. A replication of the study will be conducted at a different time with maybe a slightly changed context, therefore it is unlikely to find the exact same data. This study has been conducted at one point in the process of the TRM project. Data collection later in that process can lead to different results. Secondly, LeCompte and Goetz (1982) say that human behavior is not static and can therefore not be exactly replicated, regardless of the methods and design used. Having the same database increases the chance of the study's replicability. However, Johannessen et al. (2016) still argues that researchers might come to different conclusions even with the same data material at hand. In qualitative research the researcher herself is viewed as an instrument that is closely tied to the research, and the data will be interpreted in the light of the researcher's prior experience and background.

However, several steps have been taken to mitigate this and increase the quality of the study. The aim of this chapter has been to provide exact description of the research process, as Yin (2017) describes as a way of increasing the reliability of a case study. He says that the researcher should try to "*make as many procedures as explicit as possible*" (Yin, 2017, p. 46). I have in detail described the steps taken along the way and adjustments I have had to make in Appendix A. The frame I used for conducting interviews is described in Appendix B. The interview guides are also attached to increase the study's reliability (see appendices C-G).

Tjora (2012) say that reliability in social sciences is more concerned with that there should be a clear connection between the findings, the analysis, and the result of the research project. The interviews with informants 7 and 8 increase this study's reliability as they also could strengthen some of the findings we discussed and my interpretation of them.

The information given and the data created in an interview is the result of a social process (Andersen, 2006). A researcher's influence, also called the interviewer effect, when close contact with informants is impossible to eliminate, however there are steps to take to minimize the negative effects it can have (Johannessen et al., 2016). I spent three days with CHC in their office. During that time, I was aware of how I conducted myself and not just in the interviews. I tried to be polite, curious, and forthcoming to everyone and I hope they perceived me as that. I wanted to establish trust between me and the informants so they would be comfortable with me and the interview setting. I had many nice chats with people while not interviewing people, both about the project and other topics. I was also aware of my own demeanor during the interview as well. I sat towards the informant, actively listened, and had positive body language. I also created a frame for all the interviews as a reminder to myself on how to conduct the interview to prevent interview bias (see Appendix B).

How I as a researcher interpret and analyze the data affects the study's reliability. The interpretation of findings is as Johannessen et al. (2016) also pinpoint, based on the researcher's knowledge, background and personal factors. The researcher must be aware of what and how personal factors can influence the interpretation of findings, if not it can decrease the reliability of the study. Therefore, I believe it is relevant to comment on my point of view as a researcher as well. The reason I decided to write my master thesis on this project was because I personally find CRM and human factors interesting. I have taught several classes in human factors for dispatchers in fire services, and I am an advocate for human factor awareness in all fields. As Tjora (2012) writes, a personal engagement can be both a strength and a weakness in a research project. Commenting on and being aware of my own beliefs and connection to the theme studied through the process has minimized the potential risk of influencing the research. I argue that my interest in the subject has been a strength that has made me dig deeper in search of information and understanding of the theme of this study. On the other hand, it can also lead to the researcher becoming blind for other opinions and understandings. To mitigate this, as briefly described in section 4.5 and illustrated by Figure 8, I have continuously moved back and forth

between findings, interpretation and theory as well as gathered more data when necessary. To minimize the risk of being biased in the analysis, all the recorded interviews were transcribed in Nvivo which has allowed me to make sure that all the quotes used are correct. It has also helped me systemize the data and see what the data actually was saying. The transcripts of the interviews as well as the official and unofficial documents make up the case study database. The documents that have been used in the analysis are static, and together with the transcribed interviews they could, with CHC's approval, later be evaluated and analyzed by other researchers, which increases the inter-reliability (Johannessen et al., 2016).

4.6.2 Validity

Validity in general refers to if the conclusions are a valid representation of the real world and if the data gathered answer the problem statement (Johannessen et al., 2016). According to Yin (2017) there are three kinds of validity to consider in case studies: construct, internal, and external. The goal has been to produce results with high validity, and this was something I considered and planned for early in the research process.

Construct validity is concerned with "*establishing correct operational measures for the concepts being studied*" (Yin, 2017, p. 42). Issues establishing construct validity is not just a known challenge in case studies, but also with using the abductive approach as I have. Danermark, Ekstrom, and Jakobsen (2005) highlight the issue with using an abductive approach, as there are no fixed criteria to make the conclusions valid. Since conclusions are based on the researcher's interpretations, there is no universal truth to be "discovered", the conclusions are constructed. To make sure my findings and conclusions are as valid as they can using an abductive approach in a case study, I took several steps. The reason behind using informants outside of CHC was to use multiple sources of evidence, also called data triangulation (Yin, 2017). The interview in early February helped me ask better questions and get insight in projects alike TRM before collecting data with CHC. Later, I compared those data to see if they were coherent. The interviews with informants 7 and 8 allowed me to discuss findings and my interpretations with experts to check if we had the same understanding and interpretations. This approach, together with document analysis, has allowed for a convergence of evidence (Yin, 2017). The documents served as another source of evidence. Using multiple sources of evidence is, according to Yin (2017), a good way to increase the construct validity of case studies.

A threat to the validity of this research is that I did not get to interview someone that was negative towards the TRM project. One explanation might be that all employees were positive towards the project, or maybe a more plausible explanation was that people negative towards the project was negative towards being interviewed as well. However, forcing someone to participate was not an option as it goes against the ethical considerations of this study. Therefore, there was little I could do to mitigate this.

Internal validity is a test of causality, used where studies aim to find a relationship between two variables that can establish a causal relationship. This test is only used for explanatory or causal studies and not for descriptive or exploratory studies such as this one (Yin, 2017). Internal validity can also be concerned whether not informants recognize what is written and feel they have been portrayed correctly. To make sure I had correctly interpreted and understood the findings, I sent a draft to informants 1, 5 and 7 to review. Some minor adjustments were made based on those comments. See Appendix I. This is also a way of addressing construct validity in case studies, where the informants recognize and agree the way they are referenced (Yin, 2017).

External validity, or generalizability, refers to the question of whether the findings in this study is generalizable beyond this particular case. In quantitative studies the external validity covers issues as samples and populations to achieve statistical generalizability, which is not the main issue in qualitative studies. In qualitative studies the term analytic generalization is used. Traditionally, case studies have been ridiculed when claiming external validity. However, as Flyvbjerg (2006, p. 12) outlines in his article about misunderstandings on case study research: "*One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas 'the force of example' is underestimated"*. Considering that the aviation industry is a heavily regulated industry, operators will in many ways be similar to each other. CHC Aberdeen is an offshore helicopter operator and one of the co-founders of HeliOffshore. HeliOffshore is an industry collaboration with offshore helicopter operators globally where they cooperate on matters of safety. It is also an industry where people rotate and where it is not uncommon to have experience from other operators. Because of these factors, I believe that this study offers generalizable results relevant to other offshore helicopter operators as well. The results can be

used by other offshore helicopter operators to consider implementation of similar projects as TRM.

When it comes to organizations outside of aviation, generalizability is more challenging. However, I do believe that this research provides relevant results for other organizations that have the same blunt end/sharp end structure. Those organizations will most likely have some sort of CRM/non-technical skills/human factor training for the sharp end, but not for the blunt end. Therefore, the findings regarding the differences between the sharp and blunt end are relevant for other organizations with similar structures. Examples of such organizations are found in offshore, maritime, healthcare and rail industries. These are also industries that have adopted many principles from aviation (Hayward, Lowe, & Thomas, 2019). The results from this research can give an indication if CRM concepts should be implemented in the blunt end of organizations.

4.7 Ethical considerations

Several ethical considerations have been taken into account when conducting this research. Core ethical considerations involved voluntary participation, informed consent, the freedom to withdraw, openness about the research and freedom from harm and risk. All informants participated voluntarily and were informed, both written and orally, about the research, how the data collected would be handled, that they could withdraw from the research at any time and that they were anonymous (see Appendix H). It was especially important to inform them about how the data material would be treated and about their anonymity, so they would not worry about saying anything they might be confronted with later. All the informants that were asked, consented to record the interview. The interviews were recorded on a recording device but was not stored electronically on the computer and it was made sure that there was no link that could identify the informants between the recording and transcription of the interviews. All recordings will be deleted when the research project has been graded.

When I conducted interviews at CHC the company was experiencing cuts and many were made redundant, while several more were worried they would be made redundant. My main contact person in CHC, and the person responsible for the TRM project, was also made redundant. Initially he was going to work until August 2020. This changed during the COVID-19 situation and his last day with CHC was in late April. This may or may not have affected the data I collected. Ethically, it was uncomfortable to ask for their time and devotion when I understood

they had other worries. However, the only mitigation I could do was to show understanding and empathy for their situation.

CHC is an organization that relies on trust from their customers that they will transport their offshore workers safely to and from work. It is also a company that operates with a great deal of risk where an accident will most likely lead to fatalities, as with the Sumburgh accident. If I then were to criticize CHC and their safety initiative, would that affect the trust from their customers and how should I handle that? That is an ethical question I have considered during this research. CHC has been clear that when it comes to matters of safety they play with an open book. On matters of safety they also cooperate with their competitors. Therefore, I was reassured if I would come to critical conclusions it would be welcomed rather than the opposite. I therefore argue that I have been aware of my ethical considerations as a researcher throughout this study.

4.8 Strength and weaknesses of research design

There is no perfect research design. It will always include trade-offs between strength and weaknesses. The strength and weaknesses of this research has been addressed both implicitly and explicitly earlier in this chapter, as in the chapter about validity and reliability. This chapter further elaborates on the research's strength and weaknesses.

One apparent weakness is the way informants were selected at CHC. Since I only knew my contact there, I relied on this help to find informants. Due to the timing and possibly other factors, several people were not willing to be interviewed. Optimally, I would have liked to interview more people in different departments and more people in management. This might have left me with data from informants that have been overly positive towards the project. I wanted to interview informants from management because some of the informants in interviews the first day pointed out management as a challenge in being successful with the TRM project. Interviews with management might have shed a light on why the informants claimed so. However, I did not want to put people in a position where they would feel pressured to participate, which would go against the principle of voluntary participation and the ethical considerations of the study weigh heavily. Also, I did not need that data to answer the research questions. I also took action to minimize the chance of getting data only from "one side", as I had the interviews with two consultant companies (informants 1 and 7), as well as employee in HeliOffshore (informant 8). They were independent and not close to the project at CHC, as the

other informants were. Therefore, I believe I have managed to shed a light on the project from several perspectives.

A strength with using qualitative method with in-depth interviews is that it provides rich and detailed data about the research topic that would not have been evident through quantitative methods. The downside is that having few informants also is a weakness often associated with qualitative research, because it makes generalization a challenge. In this case study, as Yin also highlights about case studies, the goal is not to generalize. With this kind of exploratory study, it was more important to have rich and detailed data from a few, than shallow data and numbers from many. However, if this case study about the TRM project were to be followed up by measuring its effects, it might be more appropriate using surveys to reach many. Several steps have been taken to improve the generalizability of this study, as described in 4.6.2.

The abductive research strategy has both strengths and weaknesses. Its biggest strength and the reason I chose that strategy is that it allows alternation between theory and findings. This has allowed me to adjust the theoretical framework after the findings to provide a deeper understanding. This kind of approach opens up for new insights by interpreting the findings in a new light, or as Danermark et al. (2005) call reconceptualization: describing, interpreting or explaining something within a new framework. With the abductive research strategy, the goal is not to find "true" interpretations or conclusions, but rather to provide new connections between things and to see the world differently. As a researcher I went into the real world with some assumptions and found that those assumptions had to be adjusted along the way. I consider this a strength, where the researcher is not bound to the limitations of the already selected theoretical framework but is allowed to move through the iterative process of interpreting findings. The apparent weakness of this approach is the problem with validity. But as described in 4.6.2, I have taken action to increase the validity of this study to the best of my ability.

I spend three days at CHC which made me close to the informants, which I believe allowed me to gain their trust. There is always s a chance of misinterpreting what the informants are saying. Even though I did personal interviews where I asked follow-up questions to make sure I understood them correctly, one can never be 100% sure. The closeness to the informants in the data gathering phase increased the likelihood of understanding them correctly. Sending

informants (1, 5 and 7), the final draft also indicates that I have understood them correctly, as they were given the chance of correction. In the analysis, however, I had a critical distance that allowed me to not be biased in any direction.

One weakness is the fact that I did not get the chance to observe the TRM course as planned it Aberdeen. The description of the content of TRM is therefore based on the written teaching material in the training module. However, in December 2019 I took part of a CRM course the TRM developer held in Sandnes, Norway for a drone company. That course was based on the same teaching material as TRM; therefore, I had a deeper insight in the TRM course than if solely based on the written documentation.

CHAPTER 5: FINDINGS

In this chapter the empirical data collected from documents and interviews are presented. It is divided into two parts: The first part of the chapter describes the current state in CHC of their CRM training and safety management system. This part is based on both public documents from various aviation organizations, and non-public documents from CHC recited and used with their approval. The second part of the chapter contains an outline of the TRM program and its content. Further, it presents the findings from the interviews.

PART 1: Regulations and safety in CHC

CHC refers to its safety culture as "*taking care*". By this they mean that they take care of their employees, customers, aircrafts, and the environment. Safety means taking care in everything they do, as stated on their website (CHC, 2019a). Further, they state that safety comes first. CHC annually organizes the CHC Safety & Quality Summit where safety professionals within the aviation industry from all over the world take part. CHC Aberdeen also cooperate with the University of Aberdeen and their Applied Psychology and Human Factors Group on matter of safety.

5.1 Safety Management System

The International Civil Aviation Organization (ICAO) is an organization that develops policies and standards, undertakes compliance audits, and conducts studies and analysis for its member states and stakeholder with the goal of enhancing global aviation safety. ICAO has published a Safety Management Manual (SMM) with the objective of guiding the member states in developing the regulatory framework for implementing Safety Management Systems (SMS) by the service providers. Therefore, CHC refers to the SMM developed by ICAO in their Integrated Safety Management Manual.

SMS is a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures. Safety management is a proactive way of mitigating risk and improving safety performance (International Civil Aviation Organization, 2009). In CHC their SMS is supported by various policies, as the Integrated Safety Management Manual (corporate), emergency management plan and emergency response manual. CHCs Integrated Safety Management Manual is a 154-page-long document dated March 1st, 2018 and meets the regulatory requirements. The document follows guidelines from International standards such as Appendix 2, ICAO Annex 19, and ISO 9001:2015. The guiding documents

are ISO 19011, ISO 31000, and ICAO Document 9859 3rd edition. The scope of CHC's integrated safety management system is that it: "*encompasses all safety aspects and safety management processes necessary for ensuring compliance with customer requirements and applicable regulations. It aims to reduce risks to people, property, the environment or the Company's reputation and cover all operational activities of the Company*" (CHC, 2018, pp. 0-1). The SMM specifies a SMS framework for implementation and maintenance of SMS for operators and service providers. The framework consists of four components with twelve elements. These four components and twelve elements are the same ICAO suggests. CHCs Safety Management System consists of these elements:

(1) Safety policy and objectives

1. Management commitment and responsibility
2. Safety accountabilities
3. Appointment of key safety personnel
4. Coordination of emergency response planning
5. SMS documentation

(2) Safety risk management

6. Hazard identification
7. Safety risk assessment and mitigation

(3) Safety assurance

8. Safety performance monitoring and measurement
9. The management of change
10. Continuous improvement of SMS

(4) Safety promotion

11. Training and education
12. Safety communication

The last component is promoting safety within the whole organization to build a safety culture, which will help the operator to achieve its safety objectives by encouraging workers to communicate effectively, share information and be committed to safety behavior. They have created a 7-minute-long video where they present the 12 elements. This introduction is given as a part of the onboarding process in CHC, both for contractors and employees. According to CHCs CRM expert, the 12 elements are also covered during CRM/TRM courses, as well as in safety campaigns. Neither TRM nor CRM is mentioned in the ISMM but section 4.1.6 covers "*Human factors training*" and says that "*basic human factors training will be provided by a source acceptable to the local regulatory jurisdiction*" and that it shall be developed based on lessons learned by CHC for the previous year. Lessons learned, incident reports and SMS

summary reports from SQUID is made available to all employees through the “Landing Pad”. SQUID is their system for reporting. The “Landing Pad” is the name of CHCs intranet and is used extensively for safety promotion.

5.2 Crew Resource Management

CRM for pilots and crews is mandatory, as regulated by EASA. The regulatory expectations for CRM are described in CAP 737 issued by CAA (attached in Appendix J). In CHC, CRM is understood as “*a management system which makes optimum use of all available company resources – equipment, procedures and people – to promote safety and enhance flight operations by reducing error, avoiding stress and increasing efficiency*”. Further, it is stated that CRM is not about the technical knowledge and skills to fly an aircraft, but about the cognitive and interpersonal skills of the crew. Cognitive skills are understood as the mental process for achieving and maintaining situation awareness, making decisions and cognitive readiness. Interpersonal skills (the term social skills are also used) are understood as communication, leadership, and teamwork. In addition, there are the skills that overlap, being considered both social and cognitive skills. Those skills are connected to task management, which also include recognition and management of stress and fatigue. CHC states that their CRM training aims to affect people’s KSA. The CRM training is meant to improve one’s knowledge, which when applied helps you develop skills. With these tools CHC means that one is able to and should analyze attitudes/behavior in oneself and other colleagues and how they affect safety and efficiency (CRM training modules CHC).

The company have one CRM syllabus globally, where everyone will study 12 subjects over a three-year period. It is conducted both in classroom and in simulators. However, how CRM is taught differ from country to country. In Aberdeen it is taught in the classroom once a year and practiced in simulation trainings. The 12 CRM core competencies CHC globally has agreed upon are as follows:

1. Information processing
2. Decision-making
3. Communication
4. Human Error Skill and Reliability
5. Personality, cultural, and generational differences
6. Integrated Safety Management Systems (SMS)
7. Management

8. Stress in Aviation
9. Threat and Error Management (TEM)
10. Situation Awareness
11. Assessment and Behavioral Markers
12. Accident/incident investigation

The Threat and Error Management System (TEM) is another approach to safety management in the sharp end for the pilots and crew and is a growing part of CRM. CHCs Threat and Error Management is in compliance with the legal obligations by EASA. The three basic components of TEM are threats, errors and undesired aircraft state (UAS), where management in this context means to "*plan, direct and control an operation or situation*" (European Helicopter Safety Team, 2014, p. 5). Threats are in this context defines as "*events that occur beyond the influence of the flight crew, increase operational complexity, and which must be managed to maintain the margins of safety*" (European Helicopter Safety Team, 2014, p. 6). Further, three kinds of threats are identified: anticipated, unanticipated and latent threats. Anticipated threats are those known to the crew and happen somewhat often, such as bad weather and a congested airport. Unanticipated threats occur unexpectedly, suddenly, and rarely such as laser attacks or unforeseen bird strikes. Latent threats are less obvious and harder to observe since they often are organizational factors or psychological such as fatigue or stress in the crew. Errors are in this context defined to be "*actions or inactions by the flight crew that lead to deviations from organizational or flight crew intentions or expectations*" (European Helicopter Safety Team, 2014, p. 7). Further, they divide errors into skill-based errors and mistakes according to Reason (1990). The connection between the components of TEM, is that threats and errors can result in undesired aircraft states, if not managed properly. In the words of European Helicopter Safety Team (2014, p. 15), the concept for TEM is to: "*timely detect, interpret and promptly respond appropriately to the threat, error or UAS*".

5.3 Safety Management System and Crew Resource Management

CAP 737 offers a checklist of 10 practical indicators of achieving effective CRM throughout the company that should be ensured by the operator. Two of them relate CRM and SMS. One states that the Safety Management System must recognize CRM issues. The other claim that "*one of the key elements of a Safety Management System is the identification of hazards and how those hazards are managed through effective risk mitigation. Poor CRM should be considered an aviation hazard whereas good CRM is an effective risk mitigation*" (Civil

Aviation Authority, 2014, p. 220). Further, the handbook says that it is important that the management at the highest level is committed to the SMS and that the safety policy should reflect that. Only that will lead to effective CRM. Unsupportive management can act as a filter for effective CRM in the organization. The safety management system also needs to recognize CRM issues (ibid.). The handbook also problematizes the fact that organizations are not able to effectively identify or assess human factor risks, even though this is one of the requirements in SMS. Further, the challenges in identifying and assessing human factor risks are pointed out: "*This is mainly due to the potential subjective nature of identification. Whilst on first examination the process appears simple, the potential of pigeonhole assessment of human factors leading to incorrect action is common. Any work conducted in this area needs to be treated with care utilising personnel who have suitable training and credibility. It needs to be emphasised that the outcomes from any action must reduce the risks and this reduction should be identifiable*." (ibid. p. 220).

CRM related hazards can be identified through systems as Line Operations Safety Audit (LOSA), which is a tool in aviation to collect safety data from observations in regular flight operations. LOSA is a part of proactively working with safety, where LOSA's aim is not only to measure flight crew performance, but also be able to identify hazards and mitigate risk before adverse events takes place (International Civil Aviation Organization, 2002, 2009). LOSA is closely linked with CRM, where data from LOSA should give insight into the focus or refocus of the CRM training (Civil Aviation Authority, 2014; International Civil Aviation Organization, 2002). CRM hazards can also be identified during CRM training, by event investigation and reporting. However, that means hazards outside of CRM are challenging to discover (Civil Aviation Authority, 2014).

5.4 Sumburgh Helicopter Accident Investigation

The 2013 accident near Sumburgh airport with the CHC-operated Super Puma is already described both in the introduction under section 1.1 and 2.5. The investigation report by AAIB has been analyzed and the findings are presented in this sub-chapter. Note that the findings presented here do not reflect the full report. Only the parts relevant for this research are included, therefore for a complete understanding of the accident investigation the whole report should be read.

On the day of 23 August 2013, the commander was the pilot flying. They were experiencing bad weather, which meant that they would have to make the final approach to Sumburgh Airport

as an instrument approach. When conducting an instrument approach there is a given minimum altitude to where the aircraft may descend before attaining visual references. If visual references are not made, the pilot should not under any circumstances go below the Minimum Descent Altitude (MDA) (Air Accidents Investigation Branch, 2016, p. 95). The pilots did not acquire visual references at MDA but continued the approach. Unbeknownst to the pilots the air speed was decreasing and at the latter stages the airspeed was below 35 kt. The helicopter was then in a critically low energy state. By the time the pilots noticed the airspeed they were past the point where they could make a recovery. The helicopter then struck the sea, filled with water and rolled over (Air Accidents Investigation Branch, 2016, pp. 1-2).

The immediate causal factor identified was both pilots' inability to effectively monitor the helicopter's instruments. Both pilots also failed to follow the operator's standard operating procedure (SOP) for the approach. The investigation found that the operator's SOP was ambiguous and that there was a lack of standardization of approach profiles which would affect the crew's workload. Further, the report found some contributory factors. Due to the ambiguity of the operator's SOP the pilots did not achieve a shared situational awareness. In the Human Factors report by the Royal Air Force Centre of Aviation Medicine (Appendix I in the AAIB report) issues with communication was also identified: the pilots did not use standard callouts according to the SOP. They also did not apply the rule of two-way communication where non-standard callouts were not challenged. There was a crew gradient between the co-pilot and commander which might have affected the co-pilot in questioning the commanders callouts and assertiveness (Air Accidents Investigation Branch, 2016, pp. 223-244).

PART 2: Team Resource Management project at CHC

5.5 Team Resource Management at CHC

TRM is a project initiated within CHC. It was designed to improve safety by "*helping each of us to recognize our behaviors and how they impact upon how we can work together as a team*" (CHC TRM module). It was developed by CHCs CRM expert. He discovered that there was overlap between the Human Factors training the engineers received from a hired contractor and what they were teaching themselves at the CRM training. He claims that, even though the terminology was a little different, about 80% of the content was identical. This discovery led the CRM expert to think that it would be more cost efficient and beneficial for all to develop a generic module that would be applicable to all company employees. With that rationale the

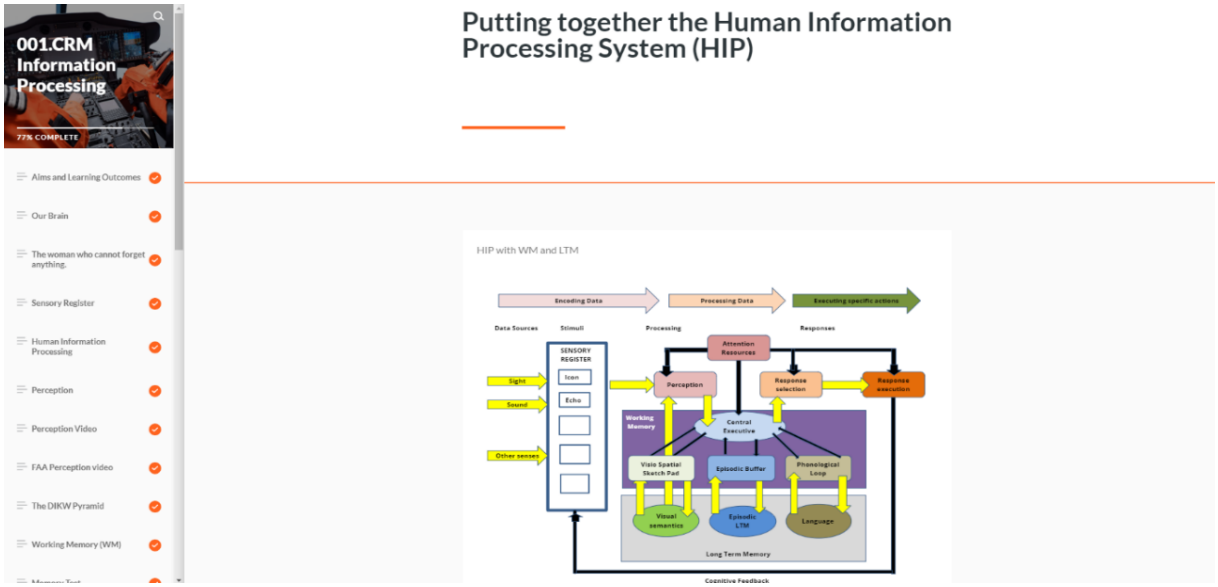
TRM project was born. TRM consists of eight modules, which are the same as the first eight of the twelve competencies mentioned in chapter 5.2. The project has been developed in collaboration with researchers and professors at the University of Aberdeen Department of Industrial Psychology. Attendance at the TRM course is annually for a half day in the classroom. They strive to have a mix of employees from operational and non-operational parts of the organization in the classroom, which means that they aim to have pilots, managers, financial advisors etc. together in the same classroom doing the course. The course consists of theory, group exercises and group discussions. Everyone is encouraged to share good and bad experiences they have in their daily work, where the aim is to develop a mutual understanding of how company operations are influenced by each other and group behavior. CHC calls it "*breaking down the silo mentality*" of the company. CHC defines it as: **"***TRM is the concept of Team Resource Management where appropriate Safety CRM (Crew Resource Management) principles established over 40 years and a mandatory EASA requirement for pilots are shared with everyone in the Company to improve mutual understanding and improve Safety consciousness*." (From internal documents CHC). In the following sections the content that is taught in TRM is described. The whole TRM course is presented in eight modules, where each module consists of several lessons connected to the theme of the module. The content is only described superficially, as it refers to much of the similar literature outlined in the theoretical framework under the non-technical skills chapter 3.7. This part only covers the content that is taught, in addition the TRM course consists of various group exercises and classroom discussions.

Information processing

The first part of the course is about information processing. The stages of information processing are encoding data, processing the data, and executing specific actions. This part of the course covers perception and shares various exercises illustrating how our perception works. The Data, Information, Knowledge and Wisdom (DIKW) pyramid is described (see Hey (2004)), where data is processed into information and through our cognition that information becomes knowledge. Through our evaluated understanding knowledge can become wisdom. It goes on to describe long-time and short-time memory and its factors. Arousal is described and the connection between performance and arousal is illustrated by the Yerkes-Dodson Law

(Teigen, 1994). The module ends with connecting the previous content with situation awareness and refers to Endsley (1995b).

Figure 9 Print screen showing TRM course example (from TRM online module)



Decision Making

This module covers theory about decision-making, different types of decisions, how workload affects the decision-making process and both group and individual influence on decision making. The module proposes methods of mitigating the probability of making inappropriate decisions that could affect safety. It also covers subjects such as attention and vigilance and how those factors can influence decision-making. The module consists of a pre study that should be done in advanced so the participants can be prepared for the classroom session.

Communication

The communication modules start by stating that communication is the biggest threat to companies as it can cause misunderstandings and create problems. The module is designed to make the participants able to critically evaluate how they communicate and how it can impact the ability to interpret information accurately. The communication module also consists of a pre-study. The module in the classroom consist of analyzing and discussing practical solutions to communicate better and mitigate misunderstandings.

Human Error, Skill, and Reliability

The aim of the human error, skill, and reliability module is to give the participants the ability to critically analyze why humans make errors and what types of errors people make. It introduces the field of human factors and is based upon the knowledge of non-technical skills. It continues by covering human error and reliability. References are made to Rasmussen (1997), Reason (1990) and Hollnagel (2004) among others. The Technique for Human Error Rate Prediction is presented (Swain & Guttmann, 1983), which is a technique used in assessing human reliability. The module consists of several videos and incident analysis that are conducted in the classroom. One example of a video included and used in classroom discussion is "*Just A Routine Operation*" by Laerdal Medical AS (2011).

Figure 10 QR code to Just A Routine Operation video

Personality and Cultural Differences

This module aims to give the participants understanding of how differences in personalities, cultures, and generations may impact safety in the organization. Reflections on personality differences is in focus and participants take personality tests as a part of the course. However, this part of the course is under development since CHC is currently working with a PhD student at the University of Aberdeen who is researching cultural challenges and integration of new crews.

Integrated Safety Management Systems

The learning outcome for this part of the course is to make the participants familiar with the basic principles and terminology used in CHCs SMS (as outlined in chapter 5.1.). The module covers how aviation safety has improved in CHC with incorporating the SMS. The twelve elements of the SMS are critically analyzed and discussed. It includes a video from CAA about Just Culture, based on Reason (1997) and his theory on safety culture.

Figure 11 QR code to CAA Just Culture video

Management

This module covers the differences between leadership and management as well as different styles of leadership. Components and behaviors needed for effective leadership is critically assessed and discussed. It also assesses cooperation skills, as covered in the NOTECHS (Flin et al., 2003).

Stress in aviation

Even though the module is named "Stress in aviation" it covers stress in general and especially how stress affects people's ability to perform at work. The difference between good and bad stress (eustress and destress) is analyzed. The participants discuss how to recognize stress in oneself and others, and that it might vary a great deal from person to person. It presents the stress calculator that allows participants to "calculate" one's current stress level in life. It covers practical guides for stress management and how to cope with fatigue, as well as how to collectively reduce stress at work. It also consists of a pre-study part.

5.6 TRM project objectives

The description of the TRM project says that the aim of the project is to restructure training to avoid overlap, duplication and waste of resources. Further, the objective of the project is "*to deliver the pilot compliant CRM/HF/SMS training in the company, irrespective of their background. Both generic and job specific*." (informant 5). However, it does not state clearly what the objective of the project is or what the company wishes to achieve with it. When informants were asked about the goal or objective of the project, or what they think it should be, most of them talk about understanding each other, across departments and seeing the bigger picture. When asked what the goal of the project should be, informant 2 replies: "*All departments coming together. All departments understanding what everybody else does*.", informant 4 puts it: "*For me it is to create a safe operation, so everyone has an understanding of how they all fit in with the operation, because everybody has a part to play*". Informant 3

says: "*The goal should be to have an understanding of what the company is trying to achieve and how we can achieve that as a team, what we can add to it".* None of the informants at CHC, except for the TRM developer, is familiar with the objectives of the project but all of them have their own thoughts about what it should be.

5.7 Implementation of TRM in the organization

The written documentation of the TRM project states that participation at the TRM course is currently compulsory for all employees in the EMEA region, including the Aberdeen office. However, so far it has only been rolled out in the Aberdeen office. The course does not require attendees to take any final exam or test, but participants that are interested are offered to enroll in the CHC Award in Aviation Safety Studies, which is an internal award program for those exceptionally interested in safety issues. The participation in CHC Award in Aviation Safety studies is not compulsory. The TRM course is conducted in the same days as the CRM course for the pilots. The first part of the day is generic and is considered as the TRM course. The second part of the day is more pilot-specific CRM; however, all participants are encouraged to stay for both parts. Several courses are conducted, and employees enroll themselves. As discovered in the interviews, not everybody signs up. It is said to be compulsory, although there is no system put in place that registers who completes the course and who does not. There are therefore no repercussions for those who choose not to participate.

5.8 Possible benefits

All informants talk about possible benefits that can come from the project. CHC started with this project because they believed that it has potential benefits for their overall safety and efficiency. In this chapter the possible benefits mentioned in interviews will be presented. Some of the informants have already participated and can add valuable examples of how it has given them a greater understanding of others.

5.8.1 Seeing your part of the jigsaw puzzle

Two of the informants spoke about "*seeing the big picture*" or as one of them put it:

"*If people took it seriously and came in and really took it to heart, they would realize that their one little bit in the jigsaw puzzle, isn't just a little bit in the jigsaw puzzle, but it is a part of the big picture. And if that one piece isn't there, the rest of it doesn't work. If they take that little piece of the jigsaw away, it messes my life up. I want that piece of the jigsaw there*" (informant 3).

Other informants spoke about breaking down the silo mentality, similar to being able to see the big picture where the organization is viewed as a whole and not fragmented pieces. Informants were asked if they were familiar with the goals of other departments of the organization. One informant said that some departments, or even individuals, easily can get sucked into their own work: "*You know some people have like a tunnel vision, concentrated on their own goals, and nothing else matters. I think it's a lack of understanding the importance of it"* (informant 4). All the informants said that they had little knowledge about what the goals of other departments were. They were familiar with the organization's goal, which they said was ultimately to make money in a safe manner. Understanding what everybody does and how their job affects others within the company seems to be an issue. All informants mentioned improved communications, both within departments and between departments, as something they would like to see as a result of the project. Informant 3 pointed out that one benefit would be that the organization would look at and handle risks more holistically: "*We have a flight time limitations scheme, and it is supposed to support you from fatigue, but then you can introduce fatigue management systems. They don't work together*". He further gave an example from one course he was attending together with employees from the corporate department. In his words:

"*The actual flow of information is limited. Between us and corporate – nothing really. We have had a couple of guys attend the courses and it is fantastic when they start explaining their problems and what the customers want... it's fantastic! The information you get from them and the lessons we can learn as pilots is fantastic, but that is stuff that normally wouldn't happen. Inter-departmental communication is minimal*".

By sharing information about what problems and challenges each department has, they found that they could reach better solutions together with a deeper understanding of both the problem and the possible solutions. Two of the informants bring up the challenges with communication and point out that they have all sorts of electronic platforms like e-mails, the safety system and the Landing Pad (the company's intranet) that enable communication. However, as one informant says, sending one e-mail is not necessarily considered as a good way of communicating: "*I think we as an organization is still very fixated on e-mails, and we send out an e-mail and we think that we have communicated. To me that is not communication, it is information*" (informant 2). By saying that sending out information is not communication, she at the same time implies that one-way communication is not considered good enough. Another

informant also talks about one-way communication: "*Especially with the Landing Pad, they put it out there, but it is just one-way communication. They assume everyone has read it, but there is no guarantee at all*" (informant 3). They both mention how important it is to meet people in the organization and that knowing someone in real life helps when communicating electronically. Both informants believe that communication should be more than one-way.

5.8.2 Proactive reporting and uncovering risks

Informant 2 pointed out that one of the benefits of the project would be improved safety, but also considered the problem of measuring improved safety. The informant continued to say an increase in reporting, and especially proactive reporting could be an indicator of success from the course: "*I would like to see it improve safety. But by that I don't mean reduction of accidents, because I don't think it is that simple, but make people have an understanding of how they fit into it. I'd like to see more reporting, and more proactive reporting."* The informant continued: "*To me improved safety is more proactive reports, so stuff hasn't happened so we can fix it before it happens. It is fewer reactive reports, so we are not having the things happen*". Informant 7 supported this claim, where he said proactive reporting is one way to measure effects from safety initiatives as proactive reporting is closely linked to a good safety culture.

Informant 8 used an iceberg as a metaphor to known and unknown risks to the company, where more reporting, and preferably proactive reporting, would help make more of the iceberg visible, i.e. reveal risks, and that initiatives like TRM can lead to increased reporting. Informant 7 referred to the article "*Beyond Safety Management System"* (Evans & Parker, 2008) and the F-111 jet fuel exposure scandal in the Royal Australian Air Force. Between the years 1973 and 2000 maintenance workers in the Royal Australian Air Force were exposed to toxic chemicals that led to poor physical and mental health, as well as cognitive problems such as memory problems, depression, and anxiety. The great attention to flight risks and safety led to the downplay of the risks of exposure to hazardous chemicals (The Parliament of the Commonwealth of Australia, 2009).

5.8.3 Deeper understanding of each other

Informant 4, who had participated at the TRM course, works closely with the pilots, and gave an illustrative example of how it gave the informant better understanding of the pilots, and them of her. In her work she must keep the medical records and licenses for the pilots up to date. She used to call them at all hours to remind them to hand in their papers but after participating at

the TRM course together with some pilots, she said she gained a deeper understanding of their workday. She said that it made her realize how mentally exhausting flying a helicopter is and how important it is that the pilot is in his right mindset. This led to her making a rule for herself to never call and nag on the pilots if they are flying soon or if they have just returned from flying. She said, before the course she never thought anything of it, but after the course she realized that she in fact could impact how they do their job. Not only did it result in her having a greater understanding of the pilots workday, she also said that the pilots realized the pressure she was under as well and they understood *why* she so badly needed those medical records and to check that their training was up-to-date. It is a regulatory requirement and if something happens the first thing an investigative authority will check is if they have all the requirements in place. The potential benefits mentioned, such as improved communication and cooperation between departments, can also lead to increased efficiency: "*They have to see that being a part of the project might help the productivity and then ultimately help the company*" (informant 5).

Another example of how the blunt end can affect the sharp end of the company, was about making sure that pilots get their expenses refunded on time, so it does not cause any financial worries for them that might affect them when flying. As informant 2 said: "*They all have an impact on the people touching the controls and touching the aircraft*". Informant 3 also thinks TRM can lead to better understanding of other departments goals: "*Because the more you talk and listen and everyone is the same, you will know how everybody is feeling in their departments and roles. How they feel about work and other people. It's not about finger pointing, just about situations that are in their department*".

5.8.4 The team in TRM

The informants were asked what their understanding of a team was and if they considered CHC a team. Informant 5 said that a team has to "*be managed by a system or structure which allows the task to be completed first of all safely but also profitably*.". Informant 4 also thought that the structure was important and mentioned that a team has to have a leader and a goal: "*A group of people aiming for the same goal. Well, hopefully. There also needs to be a leader, to make sure the focus is in the right place*". Informant 3 had a wider understanding of the concept team:

"*Anyone who is involved in your work, in any shape or form. So, everyone within the company, anyone I may have contact with. People that write manuals, I might not meet them personally, but their work is stuff I have to work with too. Engineers, the pilots, the operations staff, people*

I deal with a day to day basis. But yes, also people I wouldn't normally see. They rely on information I give them. I would say anyone within the company".

Informant 2 believed that supportive behavior was an important part of being a team: "*People that work together, they are there for each other for the work side of things, having each other's backs*.". When asked if they considered CHC to be a team none of the informants had any clear-cut answer. Most of the informants said that parts of CHC was a team, where some departments were considered to be a team. But none of the informants believed that CHC was a team but that they have the potential of become more of a team. Informant 2 indicated that there was a divide between the levels of the organization: "*(..) you got the little people that do the most work, and are the team, and then you have the bigger people that don't see the little people that makes up the big picture. So, I think the lower end is the team, I think."*

Informant 1 said that his understanding of a team was people working together and having an efficient interaction with each other to accomplish a shared goal. Further, he said that a team works together, but a crew does not necessarily work together even though they work in the same place. A crew indicates that they follow orders, and do as they are told, whereas a team manages to use the available resources to work safely and efficiently together. The informant outside of CHC was asked if an organization is considered a team. He said that optimally the whole organization should function as a sort of expanded team, where you have smaller teams within the organization but that all teams should communicate and cooperate, both vertically and horizontally within the organization. This horizontal and vertical cooperation will enable the organization to utilize all resources and at the same time increase the likelihood of employees seeing how they fit in with the bigger picture and the overarching goals of the organization.

5.9 Inhibitors for success

The enrollment of employees in the course been poor, according to the informants in CHC. They indicate that there are several challenges concerned with the implementation of the project. In this chapter the identified inhibiting factors will be presented based on the interviews with the informants from CHC. Informants outside of CHC are used to either strengthen the claims from CHC or to challenge it.

5.9.1 Management's commitment

The barrier all the informants agree on is management, where it seems that the project has not gotten the support they expected from the management. Informant 2 say that it seems that the managers are not really that interested in what is going on in the company, and therefore choose not to participate. The informant realizes that this might be because they are very busy but says that this signals that their time is not worth spending on the project, or "*it signals that they are too good for this. That's the impression it gives*" as the informant puts it. Another example with managers being a barrier was some managers actually refusing to release their employees and give them the time to participate in the course. Some departments have had managers being positive to the project, where the whole departments have enrolled. However, the informants agree that the senior management say they support the project, and that they want "*to see it done*" but do not partake in it themselves. As informant 3 say: "*Maybe they are just too busy. Because they are doing their own work, away from everybody else they don't see what is going on in the lower end. So, I think they would understand more, and we would understand more as well*". According to the informants, no one from senior management has participated so far. "*The higher up the management chain you go, the harder it is to get them to give up their valuable time to spend a day in the classroom*" (informant 3). Informant 5 said that he felt that the project has been getting more attention and interest outside the company, compared to the traction it has gotten within the company. Informant 4 also speaks about the possibility of expanding the project to also include customers as well, because the customers really like the project.

CRM is a regulatory requirement for pilots so there is no question if the pilots should do it or not. TRM on the other hand, is in practice voluntary and therefore dependent on employees wanting to participate and their managers being willing to release them for the half day it takes. As mentioned in chapter 4, there were some changes and cuts going on in CHC. The employee who initially developed the project was let go. He was initially going to work until August 2020 but circumstances with COVID-19 led to his release in April 2020. All courses were also cancelled because of COVID-19 and per today it is uncertain when or if they will start up again.

5.9.2 Lack of understanding or belief

Another barrier the informants mentioned was that employees and managers seem to lack belief in the project. Most pilots are very positive towards it, while others are more skeptical. The lack of belief might be because they do not know what CRM or TRM actually is, and that there are

misunderstandings about what it is like to participate. "(…) *the majority of the pilots that do CRM would appreciate what the TRM really is about. But the ones that haven't done CRM don't know what it is and has a negative view of what is in the classroom."* (informant 3). Informant 7 supports this, when he says that some non-pilots are not aware of CRM and similar concepts and some pilots do not see how applicable the concepts are outside the cockpit. While others think it is about sitting in a classroom complaining, according to informant 3. Informant 5 also thinks that people might not know what they could get out of participating and therefore do not prioritize it: "*People have to see that they get something in return. They have to see that being a part of the project might help the productivity and then ultimately help the company*". Informant 2 talks about a specific department in CHC and says: "*They were coming to TRM, but their manager told them to stop doing it because it had nothing to do with their job. So, I think it is a lack of understanding. (..) it's a lack of understanding the importance of it*".

5.9.3 Time and resources

All informants agree that time and resources to prioritize the project is a challenge, which is also connected to the factors mentioned above in this section. Informant 4 says: "*I think time and resources. Getting people out of their jobs and get them sit in to do it. Getting over the buy-in from some people thinking: 'this is absolutely stupid; I don't need to be here. Safety is not in my rule', or others thinking they know everything about it already*". She also says that one course is not going to make all the difference and that it is "*only valid for a certain time*".

Informant 2 also mentions the fact that employees are already under time pressure and do not have capacity to take part in the course, even if they were interested. Informant 3 mentions a combination of lack of belief and time constraints: "*You know, senior management is too important to spend a day in a classroom chatting. They have more important things to do. So, we need to convince them it's worth a while. It is benefits for them, and for their employees and for their teams. But how? Someone has to do a lead of faith."*

Saturation point

Informant 3 thinks that the level of regulations in the aviation industry can function as a barrier for implementing safety projects that are not regulated. He thinks that people might be so "fed up" with all the mandatory courses and systems, that doing something extra becomes quite challenging. On the other hand, he says, it should not be a massive step for a company in the

aviation industry to expand from CRM to TRM. He believes the level of regulations is a barrier, when it in fact should be an enabler making the implementation go smoother. Informant 7 also touches upon this, stating that there would be a saturation point when it comes to safety campaigns and measures. When employees in the organization reaches this saturation point, they stop taking in and accepting measures.

5.10 Relevance of non-technical skills at the blunt end

The details of the program have been outlined in chapter 5.5. The informants at CHC were all asked how the KSA's taught are relevant in the blunt end. Only one of the informants at CHC had participated in the TRM course. The other informants were very familiar with the content of it, as one was a pilot who had experience with CRM since its start, one of them was the developer of TRM and the last informant said she had been thinking of starting a similar program earlier when she was in a different position in CHC.

Having knowledge about how both acute and chronic stress affects people can help employees have more understanding and tolerance with each other, one informant said. She said that the course was an eye-opener when it came to the effects stress can have on people. "*If your colleagues don't have a great attitude towards you, it might not be because they don't like you but maybe they have something going on at home*" (informant 4). Informant 2 said that it was beneficial to learn how to recognize stress in oneself as well and know that the company has resources that can help if an employee is under a great deal of stress.

Informant 3 has been in aviation for decades and said that the non-technical skills, or the 12 CRM competencies in CHC, are skills that anybody can relate to. He claims that the skills came from management theory when CRM first was developed and had to be adapted to the sharp end. With TRM they are now taking it back to the blunt end again. As he says:

"(…) *there are more things specific to pilots, but even situation awareness. You can be very specific in an aircraft reading the instruments and translate what is going on. But the basic principles, the theory behind it, being aware of what is going on in your office and how that affects you... in the air or in the office. The basics are all the same, and when we start discussing this, we talk about different aspects of it, but the core is the same*".

Informant 5 goes on to claim that CRM or non-technical skills is applicable outside the crew as well when he explains the rationale behind the TRM subjects: "*What are the basic needs that*

everybody has? For pilots it was to maintain compliance for them and what they needed to do, and from that there are 12 subjects. And from those 8 are applicable to anybody. Doesn't matter what industry or what background".

Informants 1, 7, and 8 comment on the relevance of non-technical skills, or CRM skills in the blunt end. Informant 7 provides an anecdote about a pilot who was puzzled during their training and had an epiphany. What they were calling safety leadership was in his mind just like applying much of his CRM skills on the ground. The informants 1, 7 and 8 emphasize that people in the blunt end often are promoted to managers based on their technical skills or performance, not their soft skills, or sometimes simply based on seniority. Therefore, they will often have issues understanding the relevance and importance of CRM. Informant 1 says: "*Because a good leader per definition is not just a manager, but someone who manages to use all the available resources in a team and in line with the company's culture, which again is based on CRM*".

5.11 Experience with similar concepts

The informants from the consulting companies and from HeliOffshore have conducted similar seminars/projects. Informant 7 spoke about one similar project, but the biggest difference was that it was *only* for managers and supervisors. The thought behind that was that if the managers adopted the right KSA it would "drip" down on the employees lower down as well. Also, the managers are the ones employees look up to and they set the standard for acceptable behavior. They had workshops with leadership skills, safety decision-making exercises, accident case studies, SMS principles as well as a physical team exercise. Informant 8 speaks about a similar concept he was involved with in a previous job. They had a course based on CRM rolled out in the whole organization and started with the executives. He continues to emphasize the importance of commitment from the top management. Informant 1 talks about a slightly different approach, more similar to TRM, where they insist on having the blunt and sharp end together in the courses. He says:

"*We always encourage them to gather key personnel so everyone is under one roof so we can discuss challenges. It is no use in having the sharp end there when they are telling you that they have to do this because that is the procedure, and the people writing the procedure is not there. Then we cannot solve it and we cannot find out what that person giving that instruction or*

procedures intentions is. Is the procedure or instructions as it is perceived, or is it incorrectly perceived? Well, perception is the reality."

He continues to talk about the problem they often face in implementing it in the blunt end. He claims that the sharp end is easy to get on board because it is their life on the line. While the blunt end is more challenging to bring on. He goes on to claim that if they do not get the blunt end onboard, they will only end up doing what they have always been doing. The blunt end is where the authority is and implicitly or explicitly decides how operations are conducted. The informant also talks about how the management often wants them to "fix" their culture, however he has a clear message to those managers: "*If you believe that a workshop changes the organization, then you have totally misunderstood the whole thing. The workshop is not the end, it's the beginning.*"

Informant 8 says that concepts like TRM are about empowering human performance, which is applicable to everyone regardless of where in the organization they work. However, he also emphasizes that TRM and concepts alike is only one tool in the toolbox – it should not be viewed as the silver bullet to all problems related to safety. He further spoke about how important it was to empower the employees so they would feel comfortable about speaking up and asking stupid questions that sometimes can save lives. He references a situation where a new flight attendant saw something sticking up from the wing as the airplane was taxing for takeoff. Instead of thinking that the pilots surely know what they were doing, she communicated to the pilots that something is sticking up from the wing. The pilots said that their instruments said that flaps were down, however, air traffic control could confirm that one flap was up. They aborted the takeoff. Later, the same situation was tested in simulation and the airplane crashed in takeoff. The flight attendants' "stupid" question saved the lives of everyone aboard that airplane that day. Empowering human performance is about empowering them with the confidence to speak up and fostering a culture where it is encouraged.

CHAPTER 6: DISCUSSION

This chapter transitions from the specific findings presented in chapter 5 to a more general level by using the theoretical framework presented in chapter 3. The literature review on prior research will also be included where fitting in this discussion. This chapter is structured in three subchapters where each chapter answer one of the research questions outlined in chapter 1.2 and leads up to the research problem that will be answered in chapter 7.

The discussion starts with addressing the current environment CHC operates in. In 2013 CHC experienced a fatal helicopter accident. That accident revealed that safety margins were eroded. Considering the expanded understanding of the phases of a crisis, CHC is currently in a "new normal" where they have a changed understanding of the world, and they are no longer the same as they were in the pre-crisis phase before the accident in 2013 (Kruke, 2012). Therefore, the TRM project is understood as a part of that new normal, where it can be viewed as a result emerging form the accident in 2013. In the light of NAT, this accident was unavoidable. The offshore helicopter industry is an industry that can be defined as an intractable system (Hollnagel, 2017) that has high complexity and tight coupling (Perrow, 1999). Therefore, organizations like CHC should expect these normal accidents from time to time and according to Perrow (1999) it will happen again. Nevertheless, very few organizations accept this realization, and strive to become more of a high reliability organization through various measures. TRM can thus be understood as an initiative to increase the organizations reliability, as understood by Weick et al. (2008).

6.1 The expansion of Crew Resource Management

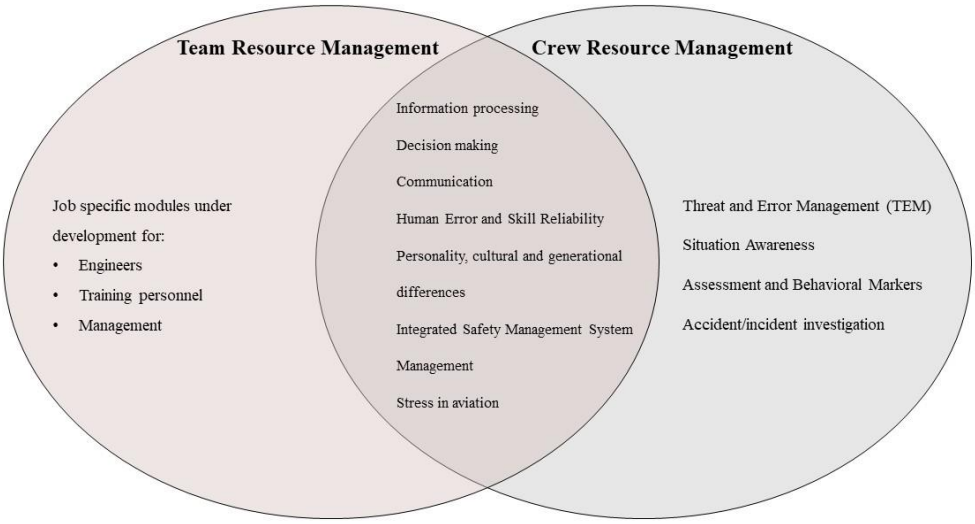
CRM is a well-known training concept and has been expanded to many other industries (Flin & Patey, 2011; Flin, Winter, Sarac, Raduma, & Organization, 2009; O'Connor & Flin, 2003). The literature review and theoretical framework outlines what CRM is and its history. TRM and the rationale behind it is described in the empirical data presented in chapter 5. In this subchapter TRM will be discussed in relation to CRM, what the differences and similarities are. This subchapter will answer the following research question: **What is the relation between Team Resource Management and Crew Resource Management?**

The literature review and the theoretical framework show that CRM has gone through an evolution and that we are currently at the 6th generation of CRM (Helmreich, 2006). Even

though the 6th generation is said to have started in the early 2000's, we are currently in 2020 and therefore it is somewhat surprising that CRM has not evolved in almost 20 years. One part of CRM that has changed a great deal over time is the realization of the importance of other factors from outside the cockpit on safety at the sharp end. First, the aim with CRM was to reduce pilot error within the cockpit. After a while, it was expanded to the whole crew. From there it was again expanded because it was evident that factors outside the aircraft also influenced sharp end safety, so the concept expanded to maintenance and air traffic controllers. However, it is relevant to point out that the same concept was developed for maintenance and air traffic controllers; they were not a part of CRM training with the crew. The 6th generation CRM further expands the focus outside the aircraft and covers threats to safety that come from the outside. The results show that threat and error management (TEM) cover latent threats. In the 6th generation CRM, the organizational perspective with latent threats, as described by Reason (1997), has received more attention (Helmreich, 2006; Helmreich & Foushee, 2010). TRM brings the whole organization on board, which indicates that it continues in the same direction as the development we have seen in the previous generations of CRM. However, TRM cannot be claimed to be the 7th generation CRM, as CRM is regulated and TRM is only a CHC initiative. It can, on the other hand, be the beginning of the transition towards the 7th generation where the whole organization is involved, if the regulators act on it. However, it must be commented on the discrepancy in the literature (see 1.3.3), where Helmreich et al. (2010) in the book "Crew Resource Management" end with stating how heroic initiatives like TRM are and call it an interesting development. The 2019 edition of the same book (Kanki et al., 2019), such concepts (organizational resource management, management resource management) are only mentioned briefly in a chapter that claims these concepts were a part of the 3rd edition CRM. It seems like there are different understandings of the concept, as it cannot be a new and heroic development in 2010 if it became a part of CRM already in 1993. Therefore, TRM, or concepts alike must be understood as a separate concept, until they officially become a part of CRM through regulation and defined so operators are speaking of the same concept. CRM is occasionally referred to as simply the application of human factors in aviation (Helmreich & Foushee, 2010), so the TRM project can be understood as introducing human factor awareness and training in the whole organization. Both concepts are concerned with improving human performance and increasing the organization's reliability.

When it comes to the content of TRM and CRM, the findings show that TRM today has an overlap with CRM as practiced in CHC. The project is still under development where job-specific modules will come. However, today the content of TRM is identical to parts of CRM as illustrated by Figure 12. Out of the twelve core competencies of CRM in CHC, eight of them are on the curriculum for TRM. Those eight were selected because, as the findings show, they are claimed to be applicable to everyone. They are also taught in the same classroom with a mix of pilots and non-operational employees.

Figure 12 Venn diagram TRM and CRM (own)



So far, the results have demonstrated that there is a clear overlap in content. That does however not mean that CRM equals TRM or vice versa. The findings show that there are some clear differences. CRM is a training concept applied to the crew, and the content is decided by regulators, based on research and feedback from the member airlines, which means it is standardized. TRM is a CHC initiative, and therefore not regulated nor required. CRM skills are also trained and assessed in both simulators and LOSA where the crew is observed and assessed. This data feeds into CRM and thus continually improves it. TRM does not have any program where employees will be tested or assessed on the development of their KSA.

The results further show that there is one essential difference and that is *where* the program is applied. CRM and concepts alike have been developed for the sharp end, as the literature review discloses. To understand the difference between TRM and CRM, it is necessary to understand the differences between the sharp and the blunt end. The sharp end is where in the past all the mistakes happened, in accordance with the old view as Dekker (2006) describes. Even though

he calls it the old view, it is still a view some people have today. One of the reasons for it still being a popular view can be explained by the margins of error in the sharp end. If an operator presses the wrong button or a pilot follows the wrong procedure, the consequences of those actions will shortly follow. The margins of error in the sharp end are often small. Very often the time between the action and consequence will be short. In the blunt end however, the situation is different. There is a clear causality between the action and consequences which leaves little room for insecurity about cause and effect. According to Turner and Pidgeon (1997) disasters can take years to develop in the socio-technical system, which means that decisions made in the blunt end can make the way for a disaster years down the road, for example writing an ambiguous procedure. That kind of time delay between action and consequence makes it more challenging to see the causality between action in the blunt end and its consequences. The expansion of CRM into the whole organization indicates a transition from the old view to the new view as understood by Dekker (2006), where latent conditions are treated more holistically. The margin of error is one significant difference between the sharp and the blunt end.

Another significant difference is the type of risk they are facing, as illustrated in Figure 3. The pilots are facing the risk of losing their own life as well as the passenger's life if something goes wrong. The blunt end is facing risks concerned with the organization's reputation and financials. The risks they face in everyday work will affect their risk perception, as Sjöberg (2000) outlines. Risk will be perceived differently from person to person based on various factors. One of those factors are concerned with how close the person is to the risk. How the difference in risk perception can affect TRM is further discussed in chapter 6.3.

Considering that the content is the same, it might not feel as relevant for the participants as the job-specific parts. On the other hand, the findings show that the informants do think the content is relevant and that the skills focused on in CRM are just as applicable to the blunt end. Pilots are usually selected based on their CRM skills (Helmreich & Foushee, 1993), whereas in the blunt end, as the findings indicate, people are often hired or promoted on the base of their technical skills, performance or simply based on time in the organization. This indicate that training of KSA for both team and safety behavior might be something lacking in the blunt end. Having that said, the lack of training of KSA in the blunt end does not automatically mean there is a need for it. The findings in this paper, however, indicates that there is. In light of this, there will be a clear difference in competences between the participants that are pilots and the

participants from the blunt end, because first of all the pilots have undergone CRM training earlier and a part of their educational program as well, while participants from the blunt end might be introduced to the various themes for the first time.

In the theoretical framework several definitions and understandings of CRM are presented. The common factor in most of them is the team aspect. Salas, Wilson, Burke, Wightman, et al. (2006) highlights the KSA needed for a team to be successful. The name of the project "Team Resource Management" also indicates that the team aspect is vital, just as in CRM. One apparent difference is that crews have clearly stated roles and is rather rigid, as opposed to teams in the blunt end. Teams in the blunt end are often more dynamic and with less predefined tasks and specific roles. This means that the structure and dynamics of the team in the blunt end will most likely be different, compared to sharp end teams.

Summary of subchapter

This subchapter has discussed the relation between CRM and TRM and found several differences and some similarities. In light of the theory presented by Dekker (2006) with the old and new view of human error, the TRM project can be understood as an extension of CRM based on the realization of how latent conditions affect the safety in an organization. The results show that there is an overlap of content of CRM and TRM, where the TRM part is identical to parts of CRM. The course is also taught together in the same classroom. Despite this, some vital differences have been identified:

- CRM is regulated, TRM is a CHC initiative.
- CRM has feedback system and is continually assessed and trained together with technical skills in simulators. There is no program for assessing TRM skills in CHC.
- Where it is applied: there are clear differences to be found in the blunt and sharp end.
- Teams (crews) in the sharp end are rigid, while teams in the blunt end tend to be more dynamic and with less defined roles.

6.2 Empowering the human factor within the organization

As the literature review discloses, there are several aviation industries that have developed similar concepts as CHC's TRM (Anca, 2010; Dowd, 2010), which indicates that there is both an interest and a need for such concepts. Salas, Bowers, et al. (2001) claim that CRM training concepts can enhance organizational effectiveness and decrease human error in organizations.

The empirical material will in this chapter be tied up with the theoretical framework to finally answer the research question: **What are the possible benefits from Team Resource Management in CHC?**

6.2.1 Making the Safety Management System come alive

In a safety management context, the biggest difference between CRM and TRM is that CRM is a requirement regulated by CAA and EASA, whereas TRM is the company's own initiative, as pointed out in the previous subchapter. The SMS is a system used in CHC to manage safety by reducing, controlling, and keeping risks at an acceptable level for the industry. The four components outlined chapter 5.1 shall help the organization to do so.

Management's commitment to safety

Reason (1997), Flin and Yule (2004) and Heinrich (1959) all have linked the management's commitment to safety with safety outcomes. The quote by the former NTSB member also supports the clear link between management's commitment to safety and effective risk management. An important part of SMS is therefore the management's commitment to safety from the top. Having a document like SMS stating that the management is committed does not necessarily prove that that is the case. Flin and Yule (2004) states that one way of *demonstrating* commitment to safety is to provide resources for safety programs and initiatives and being clear in their support for safety. The management in CHC has provided resources for the TRM program and enforcing it and participating in it is a way of demonstrating commitment to safety. SMS is a way of stating it, TRM is a way of showing it. Having managers participate in the course would not only show commitment to safety but could also increase the trust and communication between employees and managers across the organization. This also relates to the part of SMS concerned with safety promotion and safety assurance. Ideally, within a year the organization will have had all their employees sat down in a classroom for half a day to discuss matters related to safety. There are some findings that indicate challenges with the management's commitment to safety. These findings are discussed in chapter 6.3.

Identifying risks in the organization

One of the key elements of the safety management system is the ability to identify and handle risks. Based on how ICAO defines risk and safety, it is evident that the focus mainly is on the operational part of the organization. Operational risks are often in focus, which is natural since

accidents that happen in the sharp end often lead to fatalities, as with the Sumburgh accident. However, the F-111 jet fuel exposure scandal in the Royal Australian Air Force serve as a comparable example. The focus on flight safety can lead to a fixation that downplays the risks in the rest of the organization, as it did in the Royal Australian Air Force for over 20 years. As CAP 737 states, organizations are not successfully identifying and assessing human factor risks in the whole organization, even though it is required by their SMS. As established in chapter 6.1, TRM is a human factor training and awareness program for the whole organization. Having operational and non-operational employees together in a classroom for half a day where the themes human factors and safety are discussed could provide new insights into overlooked human factors risks. This claim is supported by Weick (1987). He says that one way of increasing reliability in an organization is to have groups together with divergent employees and that they will look for different things and therefore collectively see more. Which in turn indicates that a program like TRM with a mix of employees is likely to see things from different sides, and therefore collectively identify risks that might not have been identified before. Thus, TRM can prove to be a way of discovering and identifying human factor risks in the organization. Informant 3 provides an example where they had people from the corporate department explaining their problems and what the customers wanted to the pilots. The pilots could then provide valuable information that they could bring back into solutions for their customers. This example shows that it can not only provide insights in risks, but also insights that could increase profitability and efficiency in the organization.

CRM interfaces with SMS where the operational training is centered around selected hazards based on the information from its safety monitoring and assurance. SMS is for the whole organization, while CRM is just for the operational part. With TRM however, everyone is involved. Not only can it be argued that TRM is a way of making SMS “alive”, also it goes the other way as well, where TRM can feed valuable information into SMS.

Safety assurance and promotion

The twelve elements of SMS are in the TRM curriculum and give the employees an opportunity to familiarize with their organizations SMS. Most employees are unlikely to be very familiar with the elements of SMS as it often is given as an introduction when starting in the company. Reason (1997) identifies “learning culture” as one of the components of safety culture. A

learning culture is concerned with observing, reflecting, and analyzing safety data. An important part of having a learning culture, is about finding the safety data which can be more than just identifying risks. As the SMS states, an important part of the SMS is continuous improvement. The TRM course gives a good opportunity to find reliable and timely data that can lead to improvement in SMS, as a "snapshot" of the current situation in the organization. That way TRM can feed data into SMS, but also the other way around. Just as there is a link between safety data, CRM and SMS, there should be a link between TRM, SMS and safety data. If that is achieved, the organization is well on its way towards a learning culture.

Therefore, the results show that if implemented successfully, TRM can be a way of managing and promoting safety, as well as identifying new hazards and risks in real time. TRM is a way of making the safety management system more alive and interactive. A senior manager in the classroom together with employees shows more commitment to safety than a pre-recoded movie shown once a year to employees. TRM operationalizes SMS and can serve as a localized and customized implementation of SMS that will be formed by feedback from the employees. In other words, TRM can serve as a bottom-up approach to safety management.

Holistic approach to safety

Using the theory proposed by Dekker (2006) with the old and new view of human error can help understand the evolution of CRM. CRM has gone from focus on error reduction in the sharp end to the focus of threats that come from outside of the aircraft. However, as the results show with threat and error management, these latent threats are mainly handled within the crew, which resembles more the old view as Dekker describes it, where the symptom is treated, not the problem. As informant 3 pointed out in 5.8.1: systems for managing fatigue are put in place, rather than working on solutions to reduce fatigue among pilots and employees. Attempts to enhance safety in an organization by only applying measures in, or "fixing", the sharp end seams rather outdated, which Dekker (2006) supports. Applying measures in one small part of the organization but expecting results in the whole organization seams unrealistically optimistic. Nevertheless, this is what the airline industry is doing with CRM and according to the literature, the same thing is done in other high-risk industries. Similar concepts are applied in the sharp end, while expecting results in the whole organization. The organizational factor is not forgotten, just as the 6th generation of CRM illustrates. The realization that the blunt end

affects the sharp end is there, however the focus is to stress-proof, fatigue-proof etc. to make the sharp end resilient to outside factors rather than working on the problem from both ends. With the TRM project, the organizational factor is included so the distance between the sharp and blunt end is minimized, which can lead to a better understanding of what risks the organization face and how to mitigate risks more holistically. Therefore, the TRM project can be understood as the start of a transition from the old view to the new view, towards a more holistic approach to safety.

Building a reporting culture

Having a reporting culture is one of the elements of achieving an informed culture (Reason, 1997). A reporting culture is where near-misses, incidents and concerns are reported. As Reason describes it, is more in line with the safety I-thinking according to Hollnagel (2014). However, two of the informants talk about proactive reporting as a result of TRM. One informant from CHC says she wants to see employees waking up and reporting things so they can pick up on things before they go bad, as well as reports on things that go right. Informant 7 also spoke about proactive reporting as a result from similar projects as TRM. More proactive reporting resembles a move from safety I to safety II as Hollnagel (2014) describes as the future of safety management in intractable systems. Proactive reporting is something that can be measured as well, and therefore could serve as a way of measuring the results from the TRM program on level three and four as described by Kirkpatrick (1967).

One factor that is prerequisite for reporting is identifying and acknowledging the risk or situation that should be reported. Another factor is the willingness to report. Vik and Løge (2016) found that the level of trust and communication between the technicians and the management affected the technicians' willingness to report. Their findings indicate that better communication and a higher level of trust between the sharp and the blunt end will increase the willingness to report. Weick (1987) points out that face-to-face contact makes it easier to build trust and trustworthiness, and that increasing face-to-face contact is a way of increasing reliability. TRM allows for face-to-face contact with a mix of employees from various departments and levels, which will increase the chance of building trust between levels, and thus increase willingness to report. Trust is one of the important factors in building a reporting

culture, as identified by Reason (1997). Ergo TRM can through an increase in trust and communication, lead to a better reporting culture in CHC.

6.2.2 Becoming a team

Groupthink is a group bias that leads to poorly discussed and reasoned decisions where the group is more focused on consensus than the quality of the decision (Jones & Roelofsma, 2000, pp. 1140-1141). The results show that CHC has a silo mentality it is trying to break down. As informant 3 pointed out, inter-departmental communication was minimal. This does not resemble the qualities of a team as outlined in chapter 3.8. The informants all agreed on that CHC as an organization was not to be considered a team, but it should be able to move more in the direction of becoming one. If each department has a silo mentality, it can also be the victim of groupthink that leads to low quality decisions, with limited knowledge of how those decisions affect others in the organization. Encouraging inter-departmental communication through TRM can help break down the silo mentality, where groupthink turns into "teamthink" where the organization manages to effectively use all the resources to achieve the highest possible level of safety and efficiency (Federal Aviation Administration, 1991). A prerequisite for achieving this is creating a reliable flow of information within the organization.

6.2.3 Creating a reliable flow of high-quality intelligence

There are many reasons why communication in an organization is important. Employees need to be able to communicate with each other to both receive and transfer information within teams and departments. Information transfer is also important in building a shared situation awareness and goal achievement. Communication between departments is also essential in achieving a shared situation awareness in the organization and reaching its overall goal. Communication is an important part of CRM and is one of the subjects covered in TRM. The findings show that effective communication across the organization is a challenge in CHC today.

Communication is essential for coordinating an organization and the goal is to send information to another part and making sure that information is understood correctly. There are several factors influencing how successful the communication is, as Berlo's SMCR-model in Figure 7 shows (1960). Communication KSAs influence both the source's and receiver's ability to communicate. If the KSA of the sender is very different from the receiver, that can lead to the receiver not understanding the information as intended. An example of this is found in the empirical data concerning the accident at Sumburgh where one of the causal factors were

ambiguity in the standard operating procedure for the instrument landing the pilots attempted. One way of viewing it is that the people writing the procedure did not manage to communicate as intended. Communication as a subject in CRM is mainly concerned with communication within the team to ensure information transfer, team relationships, predictable behavior, shared situational awareness and effective workload management in the crew (Kanki, 2010). However, the Sumburgh example shows that factors outside the cockpit can lead to fatal accidents and that decisions in one part of the organization affect another. As presented in chapter 3.6. about various definitions of CRM, KSA is a central part where the aim is to develop the right KSA for efficient teamwork. Having a common ground where employees can develop the desired KSA can aid in communication, as supported by the SMCR-model.

Communication is essential as it serves the function of information transfer between employees and departments. The transfer of information also lays the foundation of achieving a shared situational awareness (Crichton et al., 2013; Kanki, 2010). Shared situational awareness is usually a term used in human factors when talking about teams having the same understanding of the situation at hand. If the team does not have the same understanding of the situation it can lead to accidents (Crichton et al., 2013; Endsley, 1995a, 1995b). Turner and Pidgeon (1997) uses the term "variable disjunction of information" about the same problem found in organizations. Variable disjunction of information arises when employees within an organization are unable to either obtain or understand the same information about one thing, and therefore several interpretations of the same thing develops. These variable disjunctions of information can be the starting point for disasters, as a part of the incubation period as described by Turner and Pidgeon (1997). Establishing a reliable flow of information can therefore lead to a shared situational awareness, and thus increased safety. How exactly to establish a reliable flow of information does not have a clear-cut answer. Weick (1987) claims that organizations who foster a culture that prefers face-to-face communication will increase their reliability. There are several reasons for that, one being it builds trust as mentioned earlier, the other reason is that face-to-face communication allows for information thickness. He explains that systems that are complex often require thick and rich information that is easier attained face-to-face, compared through other media. As Turner and Pidgeon (1997) problematizes, it is not necessarily the lack of information that leads to accidents, but rather the problem in either interpreting it or communicating it effectively. Information is just data until it is interpreted and understood correctly. Wilensky (1967) calls this for high-quality intelligence, where

information is clear, timely, reliable, valid, adequate, and wide-ranging. Because humans create complex systems that rely on human performance, it is crucial to create high-quality intelligence in order to safely operate in a complex socio-technical system. Picking up on and understanding thick and rich details in the system or situation is essential in achieving a correct situational awareness. In light of this, it is evident that TRM can increase the chance of acquiring a shared situational awareness of the current state of the organization, and thus stop or decrease the variable disjunctions of information by creating a reliable flow of high-quality intelligence. A reliable flow of high-quality intelligence indicates that information is not only conveyed, but it is interpreted correctly and reliable, which increases the chance of achieving a shared situation awareness of the current state of the organization.

Sumburgh accident happened because the pilots did not monitor the helicopter instruments effectively, and the ambiguity of the standard operating procedure (SOP) was identified as a contributory factor. The SOP led to confusion and a lack of shared situational awareness. The SOP was written by someone in another department of the organization with the best intent. However, the fact that the pilots flying found it ambiguous and that it was identified as a contributory factor to the accident is an example of Turner and Pidgeon (1997) theory of how the information process in organizations can lead to a disaster. Informant 1 said in chapter 5.11 that concepts like TRM needs to have both the people that write procedures and people that utilize the procedures together. Informant 1 is in fact talking about reducing the chance of variable disjunctions of information within the organization. As shown with the Sumburgh accident in CHC it can contribute to accidents. However, it is also important to point out that it does not mean that the results conclude with that TRM would have prevented the Sumburgh accident. There is not enough evidence to claim that. The situation is also much more complex than that. Turner and Pidgeon state that just because something was unforeseen, does not mean it is unforeseeable. On the other hand, Perrow does claim that such accidents are unforeseeable in tightly coupled and complex systems. Regardless of which view one takes, organizations must continually strive to foresee the unforeseeable, and one way by doing that is to reduce the chance of variable disjunctions of information within the organization by creating a reliable flow of high-quality intelligence.

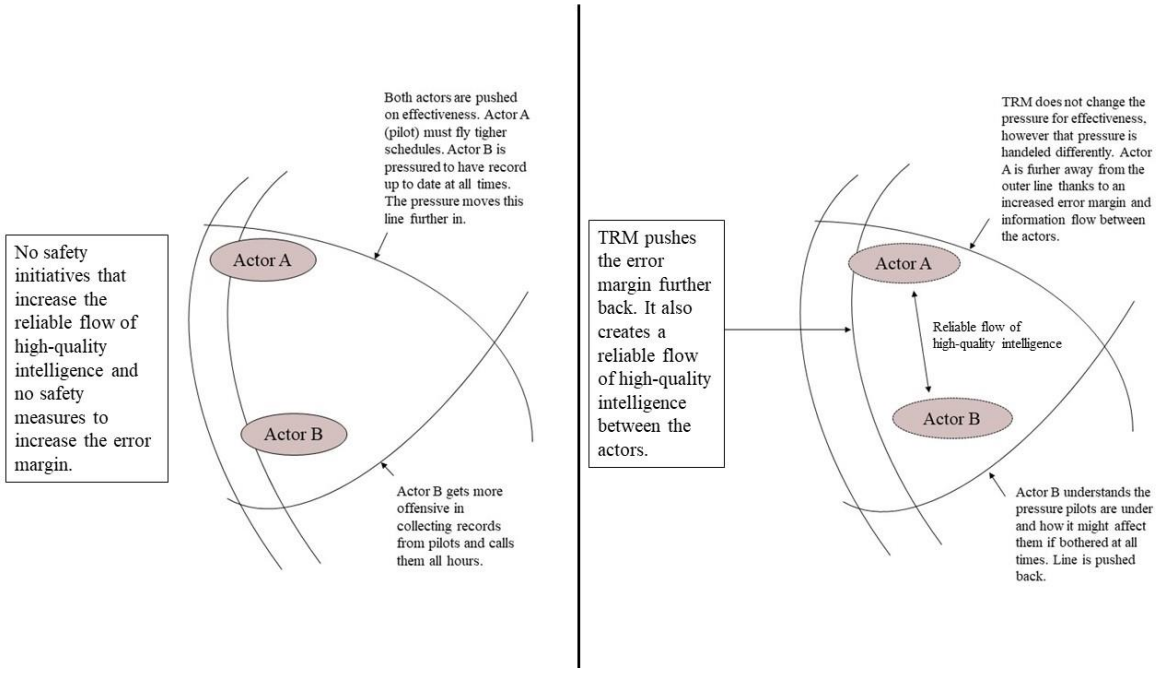
6.2.4 Seeing the big picture

Rasmussen (1997) introduced the migration model which illustrates some of the challenges in managing risks in a socio-technical system where there is aggressive competition where organization have to balance safety and production. Departments and teams will also experience this where they often will have conflicting goals and limited knowledge about each other. He illustrates this with the migration model with several actors (see Figure 4). Individuals and teams will strive for local optimization and as informant 4 says, it is easy to get a tunnel vision when concentrated on your own goals. One of CHC's goals with TRM is to break down the silo mentality, which indicates that there in fact is a silo mentality within the company and that it is undesirable.

When employees from different departments sit in a classroom together, they get the chance to learn about each other's jobs and challenges, which can lead to greater insight into their goals and how they affect each other. The example informant 4 gives illustrated how people can be focused on their goal without being aware of how it might affect others. When informant 4 used to call and often irritate the pilots right before and after flights to make sure they sent her the latest copy of their medical or training records, she did not do so to annoy the pilots. The pilots however, found this stressful and annoying as she would call at a time that was either high-stress or high-fatigue for them. In absolute worst case, it could affect the pilot's cognitive capacity, which in turn could affect the ability to handle an acute situation (Crichton et al., 2013). That means that as one actor was striving for local optimization, or simply doing her job as she would view it, it could affect another actor in the system and push that actor closer to the border of functionally acceptable performance as Rasmussen calls it. If an actor moves beyond this line in Rasmussen's model, an accident will occur. This serves as an example of how seemingly small issues in the blunt end can in the worst case affect the safety in the sharp end. By being in the classroom with pilots, the informant now understood her position in the system better and how her actions were perceived and received. She also explained why it was so important for her to have the records up to date, which received understanding from the pilots. Both parts gained a greater understanding of each other, and it shows that there was interdependence between them which they might have not been fully aware of before. They realized that they do have a common goal. They also found a better way to reach their individual goals and still work towards the common goal. The two actors managed to see how one affects the other, which in light of Rasmussen's migration model means that they are able to see if that

actor is moving too close to the border of acceptable state of affairs. This is illustrated by a modified version of Rasmussen's migration model in Figure 13. The arrow between the actors illustrate that they have established a reliable flow of high-quality intelligence between them. They used to communicate before the TRM course as well, however, they did not understand the situation the other one was in before they took part of the course together.

Figure 13 Illustrative example based on Rasmussen (1997)



In light of the findings, it seems that giving employees from different parts of the organization the chance to sit together and discuss various problems and issues is just as important as the actual content being taught in the TRM course. Whether or not the participants remember the definition of SA seems irrelevant as long as the participant knows where he or she can find the information needed to achieve a correct understanding of the situation or problem he or she is facing. In other words, being able to use all the resources available to achieve a high level of safety and efficiency. One prerequisite for being able to use all the available resources is knowing what resources are available.

Summary of subchapter

This chapter presented the results that are connected to the possible benefits that can emerge from the TRM project in CHC. Summarized, the benefits identified are:

- Increasing human factor awareness and empowering human performance, both individually and across departments in the organization.
- Identifying human factor risks in the whole organization, providing a holistic approach to safety management.
- Increasing the organizations reliability by creating a reliable flow of high-quality intelligence that creates a shared awareness in the organization, both within and across the departments that usually would not communicate.
- Organization working more like a team to be able to efficiently utilize the resources in the organization to achieve the highest level possible of safety and efficiency.

6.3 Inhibiting factors

The findings identify several factors that might inhibit the project's success, and therefore hinder CHC achieving the potential benefits outlined in the previous subchapter. The last research question will be answered in this subchapter. The question is: **Which factors can inhibit Team Resource Managements success in CHC?**

6.3.1 Lack of support from the top

The findings show that the SMS has a top-down structure where safety starts from the top, as the first component says: management commitment and responsibility. Senior management must commit to safety. However, the SMS is only an organized structure that say how to manage safety. A statement saying senior management must commit to safety is of little use, as Flin and Yule (2004) outlines: commitment to safety is about showing it. Safety is more about walking the walk, and less about structures, procedures, and talks. The literature supports that, claiming that the safety culture has to start from the top and work its way down (Flin & Yule, 2004; Heinrich, 1959). Civil Aviation Authority (2014) states that unsupportive management can act as a filter for effective CRM. All informants also agreed on the importance of involvement from the top. Therefore, it was rather surprising to find that there is a lack of support and commitment from the top in CHC. Lack of support might be a harsh statement, given that the project did get resources to start up. Since this case study started there have been several unexpected developments. First of all, the person responsible for the project at CHC was laid off and is as of April no longer with CHC. Secondly, all courses were cancelled due

to COVID-19. The latter one is naturally out of CHC's hands. The future of the project is currently unknown.

As the findings show, the TRM course is said to be compulsory but when there is no record of who completes it and no repercussions towards those who do not complete it, it is hard to argue that it is compulsory. Even though the written documentation say it is, information from the interviews revealed a different picture. That a system to register who takes part of it is not in place indicates that there is a lack of commitment from the top. The findings also revealed that very few managers have taken part in the course, and even fewer from senior management. When the top does not fully commit, it sends a signal down through the system saying that the course is not worth the time. This can be one of the explanations to why the project has been getting less coverage than anticipated. According to the findings there is a lack of belief in the project, both with employees and managers. As one of the informants said, it seems like the project is getting more interest from the outside than inside CHC. As the theory of safety culture indicate, culture must start from the top. When there is a lack of belief from the top, or the lack of showing their support towards the project by joining, it comes as no surprise that employees struggle to see the point.

Additionally, as two of the informants said, some managers have actually refused to let their employees to take the time off from normal responsibilities to take part in the course. These findings show that there is a variable disjunction of information within CHC when it comes to understanding the importance of TRM. The irony is that such a project might have the biggest challenges being implemented where it is needed the most. Implementation will be challenging without full support from the top. This claim is supported by informants 1, 7, and 8 as they had similar experience from other organizations.

The findings indicate that there is an "us and them" mentality in CHC. The quote from informant 2 in section 5.8.4 is formulated in a way that indicates a gap between the "little people" and the "bigger people" (employees and management) which will most likely only increase if the upper management refuses to take part or refuses their employees to take part in the TRM course. Such a gap also indicates that there is lack of trust and communication between employees and management. Vik and Løge (2016) found that trust and communication between the technicians and management affected the willingness to report. Therefore, the lack of

involvement from management might not only inhibit TRM's success, but it might also negatively affect the willingness to report. As having a reporting culture is a vital part of safety culture (Reason, 1997), a decreased willingness to report will thus hurt the organization's safety culture.

The picture is far from black or white. As in the field of human factors, there are many nuances to factor in which makes it hard to claim that one has found the correct answer to a problem. Perhaps if the course was made mandatory for everyone, CHC would experience so called "boomerangers" (Helmreich & Wilhelm, 1991). If forced to participate, they might show more negative effects than if they did not participate at all. Interestingly, some parallels can be drawn between safety culture, TRM, the global pandemic COVID-19 and herd immunity. Herd immunity refers to a form of indirect protection from infectious diseases when a large amount of the population either has become immune to the disease or have been vaccinated against it, and therefore stops the spread of the disease. In this case the infectious disease is unwanted safety behavior and the vaccine against it is TRM. Even if not all employees take part of it or rejects it, one can still achieve a positive result and stop the "spread" of unwanted safety behavior by having most of the employees "vaccinated". Therefore, the fact that CHC is not in practice making the course mandatory for everyone cannot be said to be an inhibitor of success with absolute certainty. However, as Flin and Yule (2004) found, leaders should support all safety initiatives fully, which means that the mangers refusing their employees time to participate do not show a safety leadership (Flin & Yule, 2004). If employees for some reason do not want to participate, managers should examine the reason behind this. Perhaps there is an underlying issue, such as too high workload or stress level making the employee refuse. This serves as an example of how TRM feeds into SMS, uncovering underlying issues that might not have been discovered otherwise.

It is also important to mention that the lack of support from management can be due to other factors that have not been identified in the findings. With that said, the informants from CHC all claim that the lack of commitment from management is a factor that can inhibit the projects' success, which is supported by the informants outside of CHC as well. Considering this study does not include interviews with higher management, that claim is left unchallenged. It might not be a true representation of the reality, where all managers in CHC might feel they are supportive and committed to safety. But as informant 1 said: perception is reality. If the

informants in CHC perceive management as such, it serves as an example of how one thing in the organization can be understood differently, thus having variable disjunction of information. CHC has not managed to overcome this and is likely not to do so either as long as management does not take an active part in the TRM course, as it is a safety initiative that can build trust and communication horizontally and vertically within the organization.

6.3.2 Risk perception in the blunt end

Offshore helicopter operators are considered to operate in a high-risk industry, according to both Perrow (1999) and La Porte (1996). Operators in high-risk industries are often divided into the sharp and blunt end. This means that employees within the same organization will face very different risks in their daily work, which will according to Sjöberg (1998, 2000) lead to a difference in risk perception. They not only face different risks in daily work but will also most likely view the same risks differently. And as Renn (2008) points out, when designing risk reduction measures it is important to understand how the risks are perceived. Employees operating close to the most dreadful risks such as risking death in a helicopter crash are most likely to adhere to the risk reduction measures put forward by the organization. Employees further from the risk, might have a harder time understanding why they should partake in activities such as TRM, since they are not actively exposed to that kind of risk or directly involved with people who are. The findings indicate that the distance from the hazard might affect employee's and manager's willingness to take part in the course, as informant 3 mentioned in section 5.9.1. Or as informant 4 (5.9.3) pointed out when employees do not work with safety in the company, they do not understand why they should take part. This indicates two things. First, that there is lack of understanding of how everyone in a high-risk industry is responsible for safety. Second, it indicates that they do not believe that their daily work could affect others in the organization. Which indicates disagreement with Reason (1997) and his findings of how latent conditions play a role in organizational accidents. Furthermore, Sjöberg (2000) claims that risk perception reflects the social context, or organizational culture, that the individuals find themselves in. Considering this, industries with this sharp/blunt end structure must take into consideration that the risk perception also is a reflection of closeness to the most hazardous risks. It also indicates that the social context, or organizational culture, might differ between the sharp and the blunt end, and that it is a factor that must be taken into account when developing safety measures and programs (Renn, 2008). Therefore, the results show that the difference in risk perception must be addressed to achieve success.

6.3.3 Allocation of resources and point of saturation

All organizations would like to be free from risk, however in real life there will always be a tradeoff between productivity of those activities creating risk and safety as problematized by Rasmussen (1997) and Reason (1997). There will also be a competition between which safety measures to implement. The findings show that CHC has allocated resources for the TRM project, but the future priority of the project is unknown since they have laid off the employee responsible for it. These findings strengthen the indication of poor safety leadership, where allocation of resources for safety measures is one part of good safety leadership (Flin & Yule, 2004). However, as informant 8 pointed out, there is no silver bullet or quick fix for achieving the highest level of safety. Concepts like TRM are one tool in the toolbox. It is also important to point out that there might be other safety measures that are more important and therefore gets prioritized. As Rasmussen (1997) highlights, organizations operate in an environment that is highly competitive where measures need to be evaluated in an economic perspective as well. On the other hand, the findings show that there was an overlap in human factors/CRM training and therefore TRM was developed because it would be cost efficient. Therefore, arguing that there is a lack of resources for seeing through the project is not sufficient. The level of regulation, number of safety measures and risk mitigation could also serve as a barrier because, as informant 7 mentioned, people will most likely reach a point of saturation. On the other hand, informant 3 pointed out; the level of regulation the aviation industry is used to should make the implementation of another safety measure seamless as it is something the organization is used to doing. The level of regulation could therefore serve as an enabler for implementation, but in this case, the findings indicate that it serves as a factor that can inhibit the success of the project.

Summary of subchapter

These identified factors will, based on the findings supported by the theoretical framework, hinder CHC in reaching the TRM projects' full potential. Therefore, it might not lead to a cultural change on the organizational level, but rather communities of practice where benefits will be found in some teams and departments, but not through the whole organization. The main factors identified are:

- The lack of support and involvement from management indicates a weak safety leadership and a factor that will inhibit the success of the project.
- Differences in risk perception especially between the blunt and sharp ends of the organization is also a factor that will have to be addressed in order to achieve success.

CHAPTER 7: FINAL CONCLUSIONS

This chapter will answer the research problem and provides the final conclusions of this study. Lastly, further research is suggested. The research problem that will be answered is:

Why should CHC prioritize Team Resource Management?

In chapter 6.2 potential benefits from TRM were identified, which all serve as reasons to prioritize TRM alone. Chapter 6.3 not only identified factors that can inhibit the potential benefits from the project, but also identified factors that might hurt the organization's safety culture. However, the research problem asks why CHC should prioritize TRM which shows to be a mix of potential benefits as well as potential negative effects of failing with its implementation. Based on the discussion in chapter 6, the conclusion presents three main reasons why CHC should prioritize the implementation and continuation of Team Resource Management.

The implementation process of TRM can be argued to be a test of the organization's current reliability. If implementation is seamless, there is a shared situation awareness, or a lack of disjunctive variables, in the organization and thus a high degree of reliability. If, however, there are issues, it is an indication of disjunctive variables of information, which not only decreases the organization's reliability (Weick, 1987) but also increases the risk of building up to an accident (Turner & Pidgeon, 1997). The paradox is, however, organizations that would benefit the most and need it the most, will have greater difficulty in implementing it and will need strong support from the top management. If the organization discovers issues in implementation, it opens for the chance to address those issues and break down the disjunctive variables of information as they become apparent. This means that the implementation process itself can reveal unknown risks in the organization. Luckily, programs like TRM are not a one-shot opportunity, but rather a long process which means that CHC still has time and opportunity to prioritize it.

Prioritizing an initiative like TRM, which Helmreich et al. (2010) call heroic, is a strong statement from the management that it does commit to safety and shows responsibility. The results show that there are several potential benefits, however, they are likely to be mitigated by the biggest inhibiting factor which is lack of commitment from the top. This lack of commitment will most likely result in a negative impact on the safety culture, strengthening the

distance between the blunt and sharp end, which can decrease the willingness to report. It can also act as a filter for effective CRM, meaning that a failed implementation of TRM can in fact lead to a less effective CRM and worsen the organization's safety culture. As Figure 13 illustrates, TRM will likely increase the organization's safety margin. The fact that TRM has revealed factors that might hurt the organization's safety culture, should be reason enough to prioritize TRM, which can increase trust and communication between the sharp and blunt end.

The third and perhaps most popular welcoming reason for prioritizing TRM is as the results indicate, it is cost-effective. First of all, TRM came about because it was a clear overlap in the human factor training CHC was teaching and the human factor training they used consultants for. Therefore, CHC can save costs by proving the training within the company, and the costs of opening it for all employees only seem to be the half day they spend in the classroom. The challenge is to realize this in a highly competitive environment with a constant pressure on economic sustainability. Few employees have participated so far, but the results already show benefits from it. Assuming other employees will experience similar benefits, it will eventually lead to a more efficient organization that manages to effectively use all the available resources in the organization to achieve the highest possible level of safety and efficiency. A more efficient organization is more likely to be a more profitably organization as well. TRM in CHC is a cost-effective safety initiative that can, and already has shown positive results in the organization. It is also a more holistically approach to safety that is more likely to identify human factor risks that might have been overlooked. Therefore, this serves as the third reason why CHC should prioritize TRM.

7.1 Further research

This case study has researched a training concept that has not been researched before, even though several aviation operators have conducted similar concepts. The literature indicates that CRM in organizations will lead to benefits, which this study also supports. However, it appears that there is little knowledge transfer between the operators implementing these concepts, which can lead to them making the same mistakes and not reaching its full potential. There are several topics that should be researched further:

- To better understand the implications of these results, future studies should aim to measure the actual effects from implementing CRM concepts in the whole organization.

- The content of CRM/TRM taught in the whole organization should be examined to see what is relevant for the non-operational part of the organization and which parts that should be adapted. For instance, is the teaching of CRM decision-making relevant for decision-making in the blunt end?
- Some of the informants reveal that they had a different approach than CHC, where two of them had trainings with the management only and one of them did a mix of operational and non-operational staff similar to TRM. It would be interesting to see if the different approaches would lead to different results.
- As with the field of CRM, there seems to be many different names to programs alike TRM, which makes knowledge transfer challenging. To mitigate this, there should be research on the conceptualization of programs like TRM, as well as a standardization of terms. This way it will be easier to offer guidance for best practices for other organizations and industries as well.

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APPENDICES

	DESCRIPTION
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APPENDIX C	Interview guide for informant 1
APPENDIX D	Interview guide for informant 2, 3, 4, and 5
APPENDIX E	Interview guide for informant 6
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APPENDIX H	Consent form for informants
APPENDIX I	List of changes made after the informants' review of draft
APPENDIX J	CRM training elements

APPENDIX A

	Description of the research process as conducted
January	I contacted CHC and asked if they would let me write about their TRM project and if they had any wishes with regards to the research. Final project plan and thesis proposal finished, with a detailed time plan for the project. Then the focus was to make a draft of the research questions. From there I started writing the first draft of the introduction and context. Received news from CHC that they would let me write about their project without applying any restrictions or limitations to what I could research. Received the dates of planned TRM courses. Decided to conduct interviews with employees at CHC in Aberdeen, take part as an observer at a TRM course and conduct a post-course survey to find out how the participants experienced the course. Also started searching for similar projects. Came across consulting company based in Stavanger, that works with implementing the CRM concept in other fields. Prepared interview guide before interview with informant 1.
February	Conducted the interview with informant 1 and found out that they had great experience with similar projects. Got confirmation from CHC that the participants of the TRM courses could partake in my survey. Got confirmation to book tickets for my trip to Aberdeen in early March. Later I received news about that the TRM course I was supposed to observe was moved. In the middle of February, I received the news that my contact had been terminated by CHC and that his employment with CHC would end in August. However, he assured me that it would not affect the project and my research. Decided to use Nvivo for transcribing, coding, and analyzing data and took part of Nvivo course at the University of Stavanger. At the same time searched for the best and easiest platform to use for the online surveys that would be compatible with Nvivo. Decided that SurveyMonkey would be the best platform to use for the surveys.
March	Conducted interviews in Aberdeen first week of March. Luckily, I left Scotland right before the COVID-19 situation put the world in lock down. Came home and was put in quarantine. After conducting the interviews in Aberdeen, they were all transcribed and coded in Nvivo.

	Thereafter, I started writing out the first draft of the findings. Received news that due to the COVID-19 situation, all the TRM courses were cancelled and therefore the initial plan of conducting post-course surveys fell short. Because of this, the process of adjusting the research questions began. This work continued in April. I also saw that I would need to use more document analysis than initially planned.
April	Found an interesting article about a similar project in the Bristow Group, and contacted the author as a possible informant. He was positive being and we scheduled a meeting in early May. I also decided to reach out to Helioffshore to see if I could interview anyone there about their thought on the TRM project, since they work closely with all offshore helicopter operators. Landed an interview with their CEO in the middle of May. Wrote first draft of chapter 4 and 6 while continuing chapter 5. Discovered that I had to re-adjust me theoretical framework to involve theories on the organizational aspect in a greater deal, based on the findings from interviews. Started writing the first draft of the discussion. Re-adjusted the structure of my discussion several times, as well as research questions. Received news from my contact in CHC that his last day would be in mid-April, not in August as expected.
May	Conducted interviews with informant 7 and 8 and adjusted the structure of the findings and discussion thereafter. Finish re-writing the theoretical framework and finalized chapter 5 and 6. Started writing the final conclusions.
June	Finished writing the final conclusions. Proofreading and doing final adjustments. Sent out the final draft to three informants that agreed to review the draft in advance (informants 1, 5, 7). Received feedback and did some minor adjustments.

APPENDIX C

Conducting interviews

Individual semi-structured interview

Theme: Team Resource Management

Conduct: the interview is conducted in a place where the interviewer and the informant are alone and can conduct the interview without any disturbance. The interviewer takes notes during the interview and can ask follow-up questions. The interview is recorded.

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1. Frame
    a. Informal talk (2-3 minutes)
    b. Information about the thesis and the research question (5-10 minutes)
        - Background and purpose of the interview
        - Inform the respondent about confidentiality and anonymity
        - Ask if the respondent has any questions
        - Ask if it is ok to record the interview
        - **Start recorder**

2. Background information
    a. Job position, roles, and tasks
    b. Ask the respondent to talk a little about his/her work/experience
    c. Follow-up questions, if necessary

3. Focus:
    a. Ask key questions
    b. Follow up questions
    c. If it seems as if the informant has not understood the question, offer to repeat it or paraphrase it.
    d. Do not interrupt the informant. Remember to give extra pauses after they finish speaking in case they just pausing to think.

4. Finish
    a. Short summary of key points (3 minutes)
    b. Ask if there is anything else the respondent wants to add or clarify.

APPENDIX B

Interview guide for informant 1 (in Norwegian)

1. Hva legger dere i konseptet CRM? Definisjon?
2. Hva tenker du om overførbarheten av CRM til andre områder?
    a. I så fall, hvilke andre områder? Organisasjoner, team, avdelinger?
    b. Vil det være begrensninger i størrelsen på team/organisasjoner?
    c. I hele organisasjonene eller kun den «skarpe enden»?
3. Hva ligger i forståelsen av begrepene «crew» og «team»? Hva er forskjellen?
4. Hva er de sentrale utfordringer implementeringene?
    a. Læring/avlæring?
    b. Effekt? Måling?
5. Dersom man lykkes med implementering av CRM-konsept i en hel organisasjon, hvilke fordeler/ulemper kan det føre til?
    a. Kan det påvirke organisasjonens pålitelighet? Hvordan?
    b. Kan det påvirke organisasjonens informasjonsflyt? Hvordan?
    c. Forholdet mellom informasjonsflyt, situasjonsbevissthet og beslutningstaking – prosesser.
6. Hvordan kan man måle effekt av CRM på organisasjonsnivå?
7. Brukes Kirkpatricks evaluering av trening? (forandring i kunnskap, ferdigheter, holdning og atferd).

APPENDIX D

Question	Theme	Reason for asking
1. The TRM project is currently being rolled out in various departments of CHC. Can you tell me what you know about TRM and your thoughts on the project?	Understanding of TRM	To examine how the project is understood across the organization.
2. What is the goal of the project (or your thoughts on what it is/should be)?	Understanding and relevance of TRM	To examine how the projects goal is understood, or to hear what they mean it should be.
3. Are you familiar with the 12 CRM competencies in CHC? (hand them the competencies printed on paper) Are they relevant for your everyday work in CHC? Why/why not?	Relevance of TRM/CRM Transferability	To examine how the competencies are viewed and if they are considered to be relatable. This will give an indication of the adaptations that needs to be made in applying CRM into an organization.
4. What measures are used today to ensure god communication, cooperation and coordination in CHC today? Does this apply to teams, groups, department or across all teams etc.?	Today's situation	To find out if how todays flow of information is. To compare the findings with the

		characterization of a team.
5. TRM, uses the term “team”, what is your understanding of a team?	Conceptualization of team	Related to the research question asking if CHC is a team.
6. I assume CHC consists of several teams, groups and departments. Do they know of each other’s goals?	Rasmussen’s model with several actors	To understand how Rasmussen’s model with several actors might apply to CHC. To compare the findings with the characterization of a team.
7. How is the flow of communication between the teams, groups, and departments?	Communication in organizations	To find out if there is need for improvement.
8. Is information available to you when you need it?	Communication in organizations	Same as above.
9. In what way, if any, are you affected by the organizations various demands? Such as economy, cut downs, workload, demands for effectiveness etc.	Conflicting goals	To examine how they handle conflicting goals.
10. Can the goal of the organization come into conflict with your team/groups/department’s goals? If yes, how is this handled?	Conflicting goals	To examine how they handle conflicting goals.

11. Is there a shared understanding the organizations goals?	Teamwork and situation awareness	Examine the need for adaptation of "CRM skills"
12. Is there room to speak your mind, even though if it is to a superior?	Teamwork	Examine the need for adaptation of "CRM skills"
13. What are the factors that make decision-making in your daily work challenging?	Decision-making	Examine the need for adaptation of "CRM skills"
14. What are the stressors in your daily work? How do you deal with them?	CRM	To see how stress and fatigue management taught in CRM could be relevant.
15. What do you think TRM can contribute to in CHC as an organization?	CRM in an organization/enabler of implementation	Find factors that speak for implementation of TRM.
16. What are the challenges, in your opinion, in reaching these benefits with this project?	Barriers of implementation	Find barriers for implementing TRM.

APPENDIX E

Interview guide with informant 6

1. Are you as a researcher within the field of human factors/CRM familiar with any research on similar projects as TRM?
2. What are your thoughts about implementing CRM in the whole organization?
3. How are the non-technical skills in the blunt end?
4. Are there any adaptations that needs to be made?
5. What benefits do you think one can expect from the TRM project?

APPENDIX F

Interview guide with informant 7

The interview was unstructured, I had only written down a few questions before hand. The informant was the one leading the talk. I also had many follow-up questions and discussing the findings thus far.

1. You are familiar with the Sumburgh accident, how do you think organizational factors influence helicopter safety?
2. CHC is currently implementing their TRM project where they introduce CRM to everyone in the company. Do you have experience with similar concepts?
3. How do you think such a concept relates to the organizations safety management system (SMS)?
4. What benefits do you think such concepts can lead to?
5. What factors can inhibit the success?
6. How important is the managements' commitment to the project?

APPENDIX G

Interview guide with informant 8

In addition to these questions, follow-up questions were asked, and we also discussed some of the findings from CHC.

1. Are you familiar with CHCs TRM project?
2. Do you know of similar projects, in Helioffshore or other industries?
3. What do you think CRM can bring into the blunt end?
4. Are the CRM skills directly transferable into the blunt end?
5. What are the benefits one can expect from such a concept?
6. What are the challenges in reaching those benefits?
7. Do you know if other offshore helicopter operations are doing similar projects?

APPENDIX H

Participation in research project

"Team Resource Management in CHC"

Background and goal

This research project is a case study of the project "Team Resource Management" in CHC in Aberdeen, UK. The goal is to provide research about expanding CRM to TRM in CHC. This research project is the final thesis of a master's degree from the University of Stavanger in the master's degree program Societal Safety and Risk Management.

Interviews are conducted with various employees in CHC, CRM experts and informants with solid knowledge of safety in the aviation industry.

What does participation in this study mean?

No other data about the participant than given in the interview will be collected. Questions in the interview is about CRM, TRM and safety in the aviation industry.

What will happen with the information?

All personal information will be treated confidentially and not used in the thesis. Only the student will have access to the information and the data. The data presented in the thesis will not give away the participants identity. If the participant agrees, a short description of job title will be included.

The project is finished June 15th, 2020.

Voluntary participation

Participation in the study is voluntary, and you can at any time withdraw your consent without stating any reason. If you chose to withdraw the consent, all the data collected from the interview will be deleted immediately.

If you have any questions about the study, please contact me.

Student Marte Elverum, +47 93 29 10 84

Consent

I have received information about the study, and I hereby give my informed consent:

(Signature of participants, date)

APPENDIX I

List of changes made after informants' review of draft

Feedback from informant 7:

"I had a quick skim that section and search for 'Informant 7'. My only comments are on 5.9.2:

Informant 7 supports this, when he says that a lot of people do not know what CRM or similar concepts are. Some might think it is psychobabble, as in the earlier days of CRM.

Probably the first sentence should be:

Informant 7 supports this, when he says that some non-pilots are not aware of CRM and similar concepts and some pilots don't see how applicable the concepts are outside the cockpit.

That would then be more balanced and consistent with the anecdote about the puzzled pilot during our training who had the epiphany that what we were calling safety leadership was just like applying much of his CRM skills on the ground.

Plus the way the paragraph is structure suggests the second sentence is mine too. I don't think I'd have said psychobabble! Perhaps if you could make that a separate paragraph or replace "psychobabble" with '"a trendy fad" which is terminology I might well use in that context of how others might view it."

Informants 1 and 5 had no changes.

APPENDIX J

CRM training elements
General principles
Human Factors in aviation
General instructions on CRM principles and objectives
Human performance and limitations
Threat and error management
Relevant to the individual flight crew member
Personality awareness, human error and reliability, attitudes and behaviors, self-assessment, and self-critique
Stress and stress management
Fatigue and vigilance
Assertiveness, situation awareness, information acquisition and processing
Relevant to the flight crew
Automation and philosophy on the use of automation
Specific type-related differences
Monitoring and intervention
Relevant to the entire aircraft crew
Shared situation awareness, shared information acquisition and processing
Workload management
Effective communication and coordination inside and outside the crew compartment
Leadership, cooperation, synergy, delegation, decision-making, actions
Resilience development
Surprise and startle effect
Cultural differences
Relevant to the operator and the organization
Operators safety culture and company culture, standard operating procedures, organizational factors, factors linked to the type of operations
Effective communication and coordination with other operational personnel and ground services
Case studies