Measuring the Effects of Strategic Change on Safety in a High Reliability Organization

Eric Arne Lofquist

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In Memoriam

This study is dedicated to the memory of my father, Gerald Earl Lofquist. He introduced me to the world of strategy at the age of eight, and bought my first car when I turned sixteen. These gifts formed my future and guided me to where I am today.

Abstract

This study explores how strategic organizational change affects safety as an outcome variable in a high reliability organization (HRO). High reliability organizations are defined as organizations operating in high-risk industries that achieve exceptionally high levels of safety performance. Based on the assumption that HROs achieve these high levels of safety performance through stable safety processes produced by common organizational structures such as: learning environments, highly regulated activities, redundancy, local ownership of tasks, and strong supporting safety cultures, I will study how potentially destabilizing deliberate change processes affect safety as an outcome, over time, in a live single longitudinal case study. This study sets out to answer two questions:

> (1) How does the interaction between leadership choices and actions, and organizational culture type affect attitudes towards change in a high reliability organization?
>
> (2) How do the relationships between leadership choices and actions during strategic change, safety climate in place, and employee attitudes toward change, affect safety as an outcome variable?

A deliberate strategic change initiative known as corporatization is studied over a three year period in the Norwegian air navigation services provider - Avinor - with particular focus upon four embedded units that experience three different phases of a common deliberate change process. The findings indicate that the individuals at each embedded unit experience the change process differently regarding both the local leadership and the safety climate in place with varying effects on attitudes and perceptions. However, the findings also show that the attitudes and perceptions toward the top leadership, and the top leadership's commitment to safety, in particular, are consistently reduced during the time period studied and do not vary across the embedded units.

This study focuses on how a mismatch between organizational culture type and strategic change type affects change implementation success. Furthermore, the study shows how this mismatch affects individual attitudes and perceptions toward change, and how these, in turn, affect perceptions of safety for front-line employees directly responsible for safety outcomes. It is argued that different organizational culture types demand specific change types to ensure success. It is also argued that a mismatch between culture and change types can lead to a loss of trust in the leadership and resistance to change that can, in the worst case, lead to the collapse of the change process.

Propositions on how changes in perceptions and attitudes affect safety are presented in a structural equation model, and show that individual perceptions of the leadership's commitment to safety and safety climate have strong positive causal relationships to both attitudes toward change and perceptions of safety. The findings indicate that individual perceptions of the leadership's commitment to safety have important implications to both change success and safety as an outcome.

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LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIXES

LIST OF ACRONYMS

ANSP - Air Navigation Services Provider
AC – Attitude toward Change
AGFI - Adjusted Goodness of Fit Index
ATC – Air Traffic Controller
ATCC - Air Traffic Control Center
AVINOR – AVIation NORway
BFU - Federal German Bureau of Aircraft Accident Investigations
CANSO - Civil Air Navigation Services Organization
CEO – Chief Executive Officer
CFA - Confirmatory Factor Analysis
CFI - Comparative Fit Index
CNS/ATM - Communications, Navigation, and Surveillance/Air Traffic Management
DAMU - Air navigation services division's working environment representatives group
DNV - Det Norske Veritas
DP – Sub-project
DP7 – Sub-project seven (en-route services)
GAIN - Global Aviation Information Networks
HRO – High Reliability Organization
HSE – Health, Safety and Environment
HSLB – Norwegian Transportation Safety Board
ICAO - International Civil Aviation Organization
IFI - Index Incremental Fit Index
LC – Leadership Commitment to Safety
MESYS – Automated Incident Reporting System
NARDS - Norwegian Airspace Radar Display System
NATCON - Norwegian Air Traffic Control
NFF – Norwegian Air Traffic Controller union
NHH – Norwegian School of Economics and Business Administration
NNFI - Non-normal Fit
NOK – Norwegian Kroner
NRK - National Norwegian Broadcasting Company
PS – Perception of Safety
TMA – Terminal Area

PART I: INTRODUCTION

This part of the dissertation consists of two chapters. The introduction chapter presents the background for the study, the problem definition, and the organization of the dissertation. The phenomenon chapter explains why studying the effects of strategic change on safety is an area of interest considered worth studying, as well as, to provide an understanding for the boundaries of the study, and justification for the structure.

"Aviation in itself is not inherently dangerous. But to an even greater degree than the sea, it is terribly unforgiving of any carelessness, incapacity or neglect. "

— Captain A. G. Lamplugh

1 Introduction and positioning

1.1 Purpose

The purpose of this study is to explore the effects of strategic organizational change on safety as an outcome variable in a High Reliability Organization (HRO). It focuses on how leadership choices and actions in the context of large-scale organizational change, moderated by organizational and environmental dynamics, affect safety outcomes in high-risk, *socio-technical* organizations that require highly reliable processes to ensure stable performance.

1.2 Background

In this study, I follow the Norwegian Air Navigation Services Provider - Avinor – a High Reliability Organization (HRO) operating in the high-risk civil aviation industry during a volatile, strategic change initiative called Take-Off 05. A project that was abruptly aborted after a long period of internal and external conflict resulted in the sudden resignation of the Director of the Air Navigation Services Division, the dismissal of the Chief Executive Officer (CEO), and the subsequent replacement of the Chairman of the Board. This collapse occurred despite the fact that the change implementation process was over 80% completed, economic results reported by the leadership were well-ahead of planned targets, and no significant change in safety levels were recorded based on traditional safety metrics. All seemed to be going according to plan. So what went wrong?

1.2.1 Strategic Change

This study examines deliberate strategic change in a high reliability organization where maintaining stable operational processes have been the traditional norm for achieving and maintaining safe performance (Rochlin et al., 1987). These stable processes are often achieved by minimizing destabilizing change environments through highly regulated and bureaucratically administered programs that are often costly to maintain, inefficient, and

many are reaching performance limits due to aging structures (Shin, 2005). However, recent privatization initiatives for improving business performance in high-risk industries have increased, and this includes the international civil aviation industry's strategic change initiative known as *corporatization* that sets the background for this case.

Strategic change refers to large-scale changes that aim to change the competitiveness of the firm and to increase performance (Stensaker, 2002). But these changes are sometimes *frame-breaking* in nature (Rajagopalan and Spreitzer, 1996; Sanchez and Heene, 1997), and often disruptive to stable internal environments that conflict with the designed stability of high reliability organizations (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Reason, 1997; Weick and Sutcliffe, 2001:2006). Strategic change is, in most cases, a deliberate choice in response to a new vision, reaction to an external threat, or even, as in the Avinor case, a combination of the two.

And, as a deliberate choice, leaders responsible for strategic change normally perform a series of tasks that include: creating a vision for change, communicating the vision to the employees and stakeholders, building consensus for the change, planning change, and, eventually, implementing the planned change process (Elsmore, 2001; Meyerson and Martin, 1987; Bluedorn and Lundgren, 1993; Lines, 2004; and Meyer and Stensaker, 2005). Each phase of the strategic change process is an important contribution for achieving a desired change result. Yet, there are many ways to bring about strategic change and a miscalculation in any one of the phases can lead to mistrust, resistance to change, and eventual failure (Dasborough, et al., 2003).

Strategic change can take many forms, including: the introduction of a new business model, reorganization and restructuring, downsizing, relocation of key strategic business units, introduction of new technologies, and/or the adoption of new business management systems (Lines, 2004). Any one of these types of change is considered demanding in itself, and, as we will see in this study, all of these forms of strategic change were implemented simultaneously in the Take-Off 05 project. But for Avinor, as a high reliability organization operating in a high-risk industry, increasing competitiveness and performance through deliberate organizational change were goals that had to be accomplished while maintaining and/or improving safety as an outcome (SNF Report Nr. 06/04, 2004).

1.3 Problem definition

1.3.1 Measuring safety during periods of deliberate change

The focus of this study is measuring changes in safety in an HRO during periods of strategic organizational change. But what is safety? To be safe means freedom from danger or harm; or the state of being protected from harm (Merriam-Webster online, 2008). These are *normative* definitions – but the real issue is how do we know when we are indeed safe? And it is not valid to say that we are safe because we have not had an accident – because the risk or probability of an accident, or any undesired event, is not known. The term safety, as we will see, is a complex concept without a universally agreed definition within the academic community, and without a definition, measurement becomes problematic.

That safety is an important issue in the civil aviation industry is unquestioned. Yet, measuring safety levels, or more importantly for this study, changes in safety as an outcome variable over time, is still primarily based on statistically analyzing historical events that often only indicate changes in safe processes after a high-profile failure. These failures often occur after long incubation periods (Turner, 1978), and usually occur without warning -- or do they? Investigations conducted subsequent to disastrous events usually find a chain of organizational actions that contributed to the failure that should have been noticed and acted upon, but were not (Perrow, 1984, Shrivastava, 1987; Weick, 1993a.:1993b.; Vaughn, 1996; Snook, 2002; Gehman, 2003; Johnson, 2004). However, after a closer inspection in most cases, the signs were, in fact, noticed but not acted upon, at least not on an organizational level. High-profile examples include: the Three Mile Island nuclear reactor accident (Perrow, 1984), the Bhopal gas leak (Shrivastava, 1987), the Challenger (Vaughn, 1996) and Columbia (Gehman, 2003) space shuttle disasters, and the Überlingen mid-air collision (Johnson, 2004). The Überlingen mid-air collision is particularly interesting for this case study in that this disaster occurred after the Swiss Air Navigation Services Provider (ANSP), Skyguide, completed a *corporatization* process similar to the process studied in this case.

Accordingly, this study will contribute to safety research by looking beyond the traditional metrics for measuring safety in a high-risk environment by focusing on safety in a broader business context than previous safety studies in that I am not studying safety in the context of a past disastrous event: Three mile island nuclear reactor accident (Perrow, 1984), Bhopal poison gas lead (Shrivastava, 1987), Tenerife runway collision (Weick, 1993a), Challenger Space Shuttle launch explosion (Vaughn, 1996), Friendly Fire Blackhawk Helicopter

shootdown (Snook, 2002), Columbia Space Shuttle re-entry explosion (Gehman, 2003), and the Überlingen mid-air collision (Johnson, 2004), or even how an organization performs under steady-state conditions, such as the original work in high reliability organizations based on grounded theory from studying US Navy aircraft carrier operations (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Weick and Sutcliffe, 2001:2006; Reason, 1997).

Instead, I will focus on how safety, as a critical business outcome in a dynamic, high-risk environment, is affected by deliberate, strategic-level organizational change processes over time, and will look for "*other types of indicators*" (HSLB, 2005: p. 6) that are proactive in nature, and can supplement traditional historical-based metrics. To do this, I will study how leadership decisions and actions in the context of a deliberate, large-scale organizational change in an HRO affect employee attitudes toward change and, ultimately, perceptions of safety. It has been shown in prior studies that changes in perceptions of safety have a direct causal effect on individual cognitive processes which, in turn, directly influence safety behavior (Zohar, 1980; Cox and Cox, 1991; Clarke, 1999; Flin, 2007).

But as experienced early during this study, safety is an elusive concept with little academic agreement as to its definition. In his opening address to the safety as an emergent quality panel at the 2007 High Reliability Organization conference in Normandy, France, Professor Erik Hollnagel stated that the first unspoken assumption for panel discussion would be that "*we all know what safety is, hence, do not need to define it*." It was understood that this was a practical approach for avoiding a well-known problem within the safety community. The problem, in effect, being that we all know what safety is not, but few would agree to a unifying definition as to what safety actually is. Accordingly, in this study I have chosen to look at safety as a latent dependent variable reflecting the *emergent* quality of a complex system under changing conditions. And I will also attempt to expand the understanding of safety in a system context as a "*process rather than a product*" (Hollnagel, 2008, p.63).

1.3.2 Corporatization

The Avinor case is considered academically interesting because the focus is on a contemporary phenomenon within a real-life context (Yin, 2003). The change initiative studied in this case is part of a larger international civil aviation change initiative within the field of New Public Management called *corporatization*. Although corporatization is not unique to the civil aviation industry, the International Civil Aviation Organization (ICAO) defines this form of corporatization as a program encouraging a systematic approach for the

privatization or semi-privatization of national civil aviation activities within the international civil aviation industry. The specific goal of corporatization in the international civil aviation context is to make national civil aviation activities more competitive and cost effective, while simultaneously maintaining and/or improving upon ultra-safe levels of flight operations (ICAO, 2002).

An essential outcome for any corporatization process within the civil aviation industry is the emphasis upon maintaining and/or improving safety performance, and this was a stated goal of the Avinor leadership during the Take-Off 05 process. It was also a formal demand and expectation from the owners, stakeholders, and society as a whole (SNF Report 06/04, 2004). Yet, despite an extended period of internal and external turbulence observed within the organization during the change process leading up to the eventual aborted Take-Off 05 project, no changes in traditional safety measures were recorded within the organization, or within the Norwegian aviation industry as a whole. This gave the impression that the turbulent changes that were taking place within Avinor were not affecting safety in any direction. And this was confirmed by the Norwegian National Transportation Safety Board (HSLB, 2005) in a study entitled "*Flight Safety in the Norwegian Civil Aviation Industry during Reorganization Processes*", by concluding that safety levels within the air transport sector (and within Avinor) remained high -- but the report also qualified this conclusion with the following disclaimer:

> "*The generally high safety level, and the correspondingly low number of accidents and serious incidents, makes it difficult, if not impossible on a national level, to utilize accident statistics to 'measure' or prove that flight safety has become better or worse due to the prior years reorganization/changes. Research and experience from other countries show that eventual negative effects of flight safety-related consequences seldom materialize in the form of accidents for several years after changes are implemented. It is, therefore, necessary to use as a basis, other types of indicators to be able to evaluate how flight safety is evaluated.*" (HSLB Report, 2005: p. 6).

These findings, though comforting for the Norwegian government responsible for the civil aviation infrastructure, did not adequately explain whether or not safety had, in fact, been affected in one way or another on an industry level, only that the traditional safety metrics of incident and accident reporting showed no significant variation over the 5-year time period studied. However, it was also noted within the report that a majority of all respondent groups within the industry (leaders, regulators, pilots, cabin crew, ground crew, mechanics, flight

engineers, and air traffic controllers/ATC Assistants) felt that the change process in Avinor had negatively affected flight safety within the industry. And one important finding from this study showed that over 60% of air traffic controllers believed that flight safety had been significantly reduced (TØI Report, 2005).

1.3.3 Deliberate change in an HRO

I have chosen to study the Avinor corporatization process, as a single longitudinal case study, as I consider it a critical case that is also potentially revelatory (Yin, 2003). A story of *frame-breaking* change in a high reliability organization operating in a complex, high-risk industry that included many simultaneously implemented strategic-level change initiatives as part of a new *corporatization* business model. High Reliability Organizations (HROs) are organizations operating in high-risk industries that have achieved superior safety performance through common management structures, supportive organizational cultures, and learning environments (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Weick and Sutcliffe, 2001:2006; Reason, 1997). Avinor, responsible for safety outcomes in the civil aviation industry in Norway, is one such organization.

Further, I have chosen to study safety as an outcome variable during the corporatization process in Avinor not only because it is both relevant and timely from an academic perspective, but also because this is an area of great interest within the broader civil aviation industry currently experiencing widespread deliberate organizational change. This is also an area of real concern for other high-risk organizations and industries during change processes, and is an area that has received little academic attention.

With this in mind, this study's primary audience is the academic community focused on studying safety and safety management in high-risk industries experiencing deliberate organizational change, particularly from a business perspective within a *socio-technical* high-risk industry. And by *socio-technical* industries, I am focusing on organizations where man-machine interface and human variation are often cited as contributing factors in system failures. The secondary audience are business leaders and regulatory agencies in high-risk organizations responsible for managing complex *socio-technical* systems during large-scale change processes.

And finally, this study will contribute to the safety literature in several ways. First, I will study an HRO during deliberate organizational change. Second, I will examine how a

mismatch between organizational change type and the organizational culture, in place, affects change implementation success. Third, I will propose a theoretical framework for expanding the concept of safety as a *process* in a complex system into three temporal phases within a robust safety management system that shifts the focus away from traditional metrics to the interactive phase of a socio-technical system. And fourth, I will introduce a conceptual safety measurement model using structural equation modeling that will show how causal relationships between several key safety-related latent constructs interact during deliberate organizational change to affect safety as an outcome.

1.4 Organization of dissertation

The overall presentation of this study will essentially follow a chronological structure using a temporal bracketing strategy (Langley, 1999) based on a mixed-method approach. This will be done by providing a combination of process data and quantitative data from a planned organizational change process over a three year period. I will focus primarily upon two specific change decisions imbedded within the larger change implementation plan that resulted in an intense internal disagreement between the leadership and strong sub-cultures represented by the air traffic controller union. This internal struggle caused significant disruptions in national civil aviation services and gained near-daily national media attention, and eventually led to the sudden departure of several top leaders and the collapse of the deliberate change process known as Take-Off 05.

More specifically, the thesis is organized as follows:

Chapter 2 addresses the phenomenon of measuring safety during strategic change processes in a high-risk industry, and is considered important for positioning the study and clarifying the reasoning for the research design. This chapter will include the definition of key constructs used in the study and will also present the research questions.

Chapter 3 will present a broad overview of the research literature used in the study, both to orient the reader, but also to map out a framework to be filled in by a structural equation model used to take a *snapshot* of safety presented in Chapter 7.

Chapter 4 will present the methodology used in the study, and will include the choice of design and justification, research setting, data collection and analysis methods, and will discuss the relative strengths and weaknesses of the design chosen.

Chapter 5 is a three-year chronological presentation of the strategic change process known as Take-Off 05. This chapter will briefly present the industry circumstances creating a need for change, followed by a chronological account of the strategic change process from initial planning to implementation. I will focus specifically on leadership decisions made throughout the Take-Of 05 process and employee reactions.

Chapter 6 will analyse front-line individual reactions to leadership choices during the implementation phase of the strategic change process, and how these reactions affected attitudes toward change and perceptions of safety during the final turbulent 12 months of the Take-Off 05 project. This analysis will be done by triangulating quantitative data from two internal operational climate surveys taken before, and mid-way through the organizational change process, and qualitative data taken during the same timeframe as the second internal survey. I will then use these two data sets in a mixed-methods analysis approach to fine-tune the key constructs of interest for the safety measurement model presented in Chapter 7.

Chapter 7 will present a safety measurement model using structural equation modeling to show how perceptions of the leadership's commitment to safety and safety climate affect individual attitudes of front-line personnel towards the change process, and how these three constructs directly and indirectly affect individual perceptions of safety.

Chapter 8 is a summary of the empirical findings from Chapters 5, 6, and 7.

Chapter 9 will present a discussion of the contributions of this study and conclusions drawn from the study. I will then present an in-depth presentation of the implications of the findings, limitations of the study, a practical approach for further studies, and finally some concluding remarks.

2 The Phenomenon: Measuring the effects of strategic change on safety in an HRO

This chapter discusses the phenomenon to be studied – specifically, how large-scale organizational change, also known as strategic change, affects safety as an outcome variable in high reliability organizations where internal process stability and predictability have been the traditional norms for ensuring reliable outcomes in high-risk environments. I will begin by defining the problem of measuring safety in high reliability organizations. Next, I will present a model of a typical Safety Management System (SMS) that introduces safety management as a complex safety process in three temporal phases, and I will discuss the parts of the model where current management systems place the most emphasis. I will then argue for a shift in focus to include a part of the model that has only recently begun to draw academic interest by high reliability organizations, and explain where this study intends to make a contribution based on this model. And finally, I will present some of the key concepts and constructs considered important in this study, as well as, to explaining why these academically dispersed areas of interest are deemed relevant in the case chosen. The purpose of this chapter is to provide background for why this is an area of interest considered worth studying, as well as, to provide an understanding for the boundaries of the study, and justification for the structure of this report.

"Safety is measured more by its absence than its presence"
- James Reason, 1997

2.1 The art of measuring nothing

In the quote above, James Reason has captured the essence of a problem that has confronted business leaders and managers responsible for safe outcomes in high-risk environments for decades - how to detect and measure changes in safety processes in high-risk organizations prior to disastrous outcomes. And, as these organizations achieve *ultra-safe* levels of performance (Amalberti, 2001) fewer and fewer traditional indicators are available to reveal changes in safety processes upon which to take proactive corrective action. Amalberti (2001: p. 109) defines *ultra-safe* as a mythical barrier of one disastrous incident per 10 million events (10^{-7}). However, sometimes failures do occur with disastrous effect as evidenced in high profile accidents, such as: the Three Mile Island nuclear reactor accident (Perrow, 1984), the Bhopal gas leak (Shrivastava, 1987), the Tenerife runway collision (Weick, 1993a), the Challenger launch explosion (Vaughn, 1996), the Columbia re-entry explosion (Gehman,

2003), and the Überlingen mid-air collision (Johnson, 2004). Some of these accidents were determined to be *normal* in nature in that they were potential outcomes within normally functioning complex systems (Perrow, 1984). Yet, others were caused by evolutionary changes in complex processes described as *cultural deviance* (Vaughn, 1996), *incubation periods* (Turner, 1976), *procedural and organizational drift* (Rasmussen, 1994; Elsmore, 2001; Dekker, 2006), *routine drift* (Snook, 2000), or an accumulation of *latent conditions* leading to failure (Reason, 1990).

One common factor in each of the accidents above, was that the organizations involved were operating under relatively stable business conditions exposed primarily to evolutionary changes in response to internal and external environmental factors. And, in each of these cases, post-accident investigations revealed that the traditional safety metrics of incident and accident reporting had failed to adequately capture the warning signals leading to disaster. However, it was also found, in retrospect, that clear warning signs had been present in every case, only to be overlooked by those responsible for noticing and acting upon these indications. For example, in the days before the Challenger space shuttle launch explosion, engineering concerns for the reliability of the main engine O-rings under freezing conditions were addressed in numerous internal memos prior to the actual disaster (Vaughn, 1996). And in their book Engineering Ethics, Pinkus et al. (1997) found that the NASA and Thiokol engineers lacked the statistical knowledge to enable them to make a proper O-ring performance decision (p. 319). Yet, with the space shuttle program suffering from many delays, these signals were not considered serious enough to post-pone the mission. In addition, managers were self-assured and confident in their managerial authority to overrule engineers without the necessary expertise to support the decision (Pinkus et al., 1997). And this was described by Vaughn as *cultural deviance*, where organizational pressures gradually allowed managers responsible for safe system operations to deviate away from earlier standards.

And 17 years later, the space shuttle Columbia disintegrated upon re-entry from damage sustained from a collision with insulating foam lost during launch. The subsequent investigation discovered that the loss of insulating foam during launch was a continual problem, and the potential dangers had been addressed on many occasions. However, over time, this particular problem was gradually accepted (deviance), and was eventually downgraded from a safety of flight issue to an after-flight inspection issue (Gehman, 2003)

which the investigation board blamed on an eroding organizational culture. Surprisingly, there had been a study conducted in 1994 that specifically addressed the risks of debris hitting the shuttle during the launch sequence, and essentially predicted the Columbia accident (Paté-Cornell and Fischbeck, 1994).

2.2 Safety

This leads us to the real problem, and the focus of this study. The problem is what I would describe as *the paradox of measuring nothing*. Providing a meaningful measure of safety in high reliability organizations during periods of deliberate organizational change based on *nothing to measure* (Weick, 1987), at least not by the traditional measures of incident and accident reporting, does not give a clear picture of an evolving safety system. In addition, focusing on *disastrous events* alone places too much weight on the magnitude of the consequences, and precludes unintended outcomes that could have, but did not, produce such devastating results. And this was also reflected in the findings of the Norwegian Accident Investigation Board (HSLB, 2005) in their study of the Norwegian civil aviation industry, where growing concern over aviation safety due to deliberate and environmental changes were not reflected in measurable changes in traditional safety metrics during the 5-year period studied.

But measuring safety is elusive because it is a *dynamic non-event* where a stable outcome is produced more by constant change rather than continuous repetition (Weick and Sutcliffe, 2001). And this is particularly true for HROs where stable processes, within mindful, learning environments (Weick, 1987; Weick and Sutcliffe, 2001) ensure reliable outcomes that are safe. Nothing to measure, at least not by current industry metrics, often equates to no change in safety, which is counterintuitive in a strategic change environment where there are many examples of organizational change contributing to a sudden, and often unexpected, system failure (Weick, 1993a, Vaughn, 1996; Gehman, 2003; Johnson, 2004). When accidents do occur, we have a measurable indication that things are not safe, but when nothing happens, or there is nothing to pay attention to (Weick, 1987; Weick and Sutcliffe, 2001), we do not know if this is due to properly functioning safety processes, or due to good fortune.

One problem is the focus upon what organizations label as *errors*, which are often associated with visible or measurable non-acceptable consequences instead of what psychologists define as *erroneous acts*, whatever the consequences, or level at which they are detected or recovered (Amalberti, 2001). This subtle difference often masks the true state of an eroding

safe system until previously defined unacceptable events occur, often with disastrous consequences. If this is true for stable systems, then this is particularly relevant for HROs experiencing potentially destabilizing deliberate organizational change. And this is exactly what is happening if we consider the international aviation industry initiative known as corporatization. The civil aviation industry has achieved *ultra-safe* performance and stability through continuous incremental change, organizational learning, and implementation of stable processes. But through the corporatization initiative it is suddenly encouraging air navigation services providers to implement new management models requiring deliberate large-scale organizational change that can, in the worst case, disrupt stable processes and adversely affect safe systems. And these disruptions may or may not produce measurable changes in traditional safety metrics, at least not in the short-term (HSLB, 2005).

2.3 Safety Management Systems

But before I can address how I will approach the problem of measuring safety as a process in this study, I must first present how typical Safety Management Systems (SMSs) function based on a SMS model that depicts safety management as a complex process in three temporal phases. This model represents safety management systems already in use throughout the civil aviation industry today. However, I will argue that the current industry focus upon the *proactive* and *reactive* phases of the model, described in Figure 2-1, though important, often fails to reveal eroding safety processes prior to failure. To improve this process, I will argue that there needs to be a shift in focus away from purely historical metrics and risk analysis, and more toward the gap between these two temporal phases, which I have labelled the *interactive phase* in Figure 2-1.

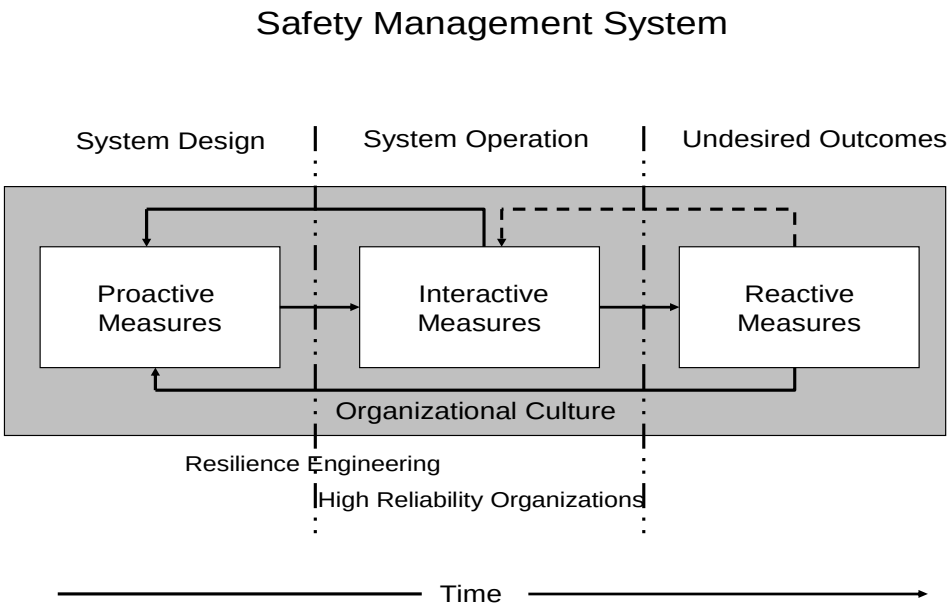

Figure 2 -1 Illustration of a typical Safety Management System

By placing more emphasis on leading indicators based upon inputs from the human element within a complex, socio-technical system under actual operating conditions, we increase the opportunity to detect *emergent* changes in safety processes, described by Reason (1997) as latent conditions, before they develop into undesired events or active failures.

To do this, I will argue for greater emphasis on the development, and regular use of, analytical tools that are both qualitative and quantitative in nature, and fill the gap in the processes described above. Focusing on leading indictors within the *interactive phase* will allow leaders to detect changes in safety processes earlier in their developmental phases by exploiting both the *mindfulness* and *sensemaking* cultural attributes that already exist in high reliability organizations (Weick, 1993 a; Weick and Sutcliffe, 2001: 2006). This does not suggest that historical metrics and risk analysis processes are not important in their own right, only that experience has shown that systems that evolve away from original design parameters are difficult to evaluate using risk analysis and historical metrics, alone. And these methods often fail to uncover eroding systems prior to disastrous outcomes (Cabrera and Isla, 1998; Pidgeon, 1997). The proposed safety management system model looks at safety as a complex system *process* in three temporal phases embedded within a supportive organizational culture, as depicted in Figure 2-1.

Not pictured in this model are the effects of the external environment which can introduce significant factors in their own right, and many of these types of factors will be addressed in the findings portion of this study.

On the left side of the model, we find proactive measures which include system design and redesign, and this phase sets the desired performance parameters for the safety processes intended to produce safe outcomes. This is also an area where the systems approach of Resilience Engineering (Hollnagel et al., 2006) makes a significant contribution to safe systems. However, this phase is often limited by the mental models in use (Senge, 1994), and the specific paradigms of those responsible for system design which ultimately determine operational assumptions. And, as complex and dynamic *socio-technical* systems, these systems tend to evolve away from original design, over time, due to both internal and external environmental dynamics.

On the right side of the model, we find *reactive measures,* sometimes described as *trial and error learning* (Weick, 1995) that detect undesired performance outcomes based on pre-defined system design requirements, and these undesired performance outcomes are often defined as incidents and accidents. As this is the area of the model most fully developed and in use today, I will not go deeper into this section other than to mention that this is an area where the cost of failure is often unacceptable, and drives the need for new measures that allow proactive response prior to failure.

The center portion of the model, and the key to this study, represents the *interactive phase* of the safety process, and is the heart of the operational *socio-technical* system where humans interface directly with complex processes of the designed system to achieve desired outcomes that are safe. This is also the area of a safety system where high reliability organizations are most effective, and the area where monitoring safety processes is least developed. It is this portion of the model that is the focus for this study.

The arrows within the model represent actions taken by management to adjust safety processes in response to some perceived deficiency in system design or performance. The dotted arrow from *reactive measures* to *interactive measures* depicts artificial changes, in the form of changes in procedures, rules and/or regulations, either on a local or system level, that limit operational exposure to undesired outcomes, and can be either internally or externally initiated. These changes modify or artificially limit the human interaction with the designed

system, but do not change the physical design of the system, itself. It is important to mention that these types of modifications do not remove the problem, but introduce artificial barriers to reduce the risk of the undesired event occurring. These artificial barriers often introduce latent conditions that can mask potential failures under changing conditions. The solid arrow from *reactive measures* to *proactive measures*, on the other hand, indicates a completely different process that introduces system redesign, based on reactive measures that effectively alter the process that allowed the failure to occur in the first place. These types of changes are, unfortunately, often taken in response to a disastrous event, such as, both space shuttle accidents (Vaughn, 1996; Gehman, 2003).

And finally, the solid arrow from the interactive phase to the proactive phase represents changes that are made to system processes based on *mindful* actions (Weick and Sutcliffe, 2005), where deviations in safety processes or latent conditions (Reason, 1994) are both noticed and acted upon before they develop into undesired events. It is this process within the interactive phase of a safety management system that this study intends to make a contribution.

2.4 High Reliability Organizations

Until now, I have focused primarily on the problem of measuring changes in safety processes in highly reliable systems exposed only to continual incremental or evolutionary change. Organizations that have achieved these high levels of reliability are often referred to as High Reliability Organizations (HROs). In this study, I follow one such organization (Avinor) during a deliberate strategic change process that introduces instability into the normally stable routines. HROs have been described as organizations operating in high-risk environments "*that are already performing at an extraordinary level of safety and productive capacity in the face of very demanding circumstances*" (La Porte, 1996: p. 60). The types of organizations falling into this category vary greatly, and include, among others: nuclear power generation plants, electrical power generation grids, chemical plants, health care providers, US Navy Aircraft Carrier Flight Deck Operations, and, important for this study, civil aviation (Rochlin, La Porte and Roberts, 1987; Weick and Roberts, 1993; Klein, Bigley and Roberts, 1995; Roberts, 1990; Weick and Sutcliffe, 2006). However, despite the fact that these HROs differ significantly in the complexity of operational contexts and nature of exposure to risk, these organizations all share similar structures and processes for achieving safe outcomes (La Porte, 1996; Weick and Sutcliffe, 2006; Roberts, 1990; Bierly and Spender, 1995).

2.5 Organizational Change

As a backdrop, this study examines why organizations change, how change is formulated, how change is implemented, and finally, why these change processes can fail due to a mismatch between organizational dynamics and the change implementation method selected by the leadership responsible for change. But more importantly, I look at how leadership choices and actions affect employee attitudes and perceptions that affect key performance outcomes over time. One reason for failure of many change initiatives is the lack of understanding of the *overwhelming* impact that organizational cultures have on the change process (Wilkins, 1983). Another key concept in implementing change is matching change implementation strategies to organizational culture types as introduced by Meyerson and Martin (1987), and further explored by Bluedorn and Lundgren (1993).

2.5.1 Corporatization

In this study, I focus on one HRO (Avinor) during a deliberate strategic change process. As I have described above, HROs have achieved high levels of reliability through common organizational structures, strong supporting organizational cultures, and stable learning environments. However, since the late 1960's, there has been a gradual deliberate liberalization of the international civil aviation industry through an initiative known as *corporatization*. The International Civil Aviation Organization (ICAO) describes corporatization as "*creating a legal entity outside the government to manage airports and/or air navigation services, either through a specific statute or under an existing general statute, such as company law*" (ICAO, 2002: p 2).

The specific goal of corporatization is to make national civil aviation activities more competitive and cost effective, while simultaneously maintaining and/or improving upon ultra-safe levels of flight operations. This has placed an increased burden upon the organizational leaders and managers who find themselves responsible for managing a new strategic business model in a high-risk environment with potentially conflicting goals. These leaders must now balance highly visible and verifiable financial performance results with less visible, and even less quantifiable, safety outcomes in an *ultra-safe* civil aviation industry where incidents and accidents are rare by design. This often leads to conflicting organizational goals requiring leaders to make hard business choices that can have a direct negative impact upon safety outcomes, over time. An impact, that often does not manifest itself in the form of incidents and accidents until long after the changes have progressed to the

state where safety margins can no longer ensure safe outcomes, and can lead to disaster. These disastrous consequences were alluded to in the HSLB report, but also observed in the Überlingen mid-air collision (Johnson, 2004).

2.5.2 The Überlingen mid-air collision

The Überlingen mid-air collision is an appropriate example for our case of how an accumulation of organizational decisions in a corporatization process within the civil aviation industry can lead to disaster. In the mid-air collision that took place over the town of Überlingen, Germany on the 1st of July, 2002, two sets of experienced flight crew, aided by an experienced air traffic controller, and backed up by state-of-the art collision avoidance equipment known as TCAS (Traffic Alert and Collision Avoidance System), tried desperately to avoid a collision at 35,000 feet for just under 2 minutes only to fail at the task, destroying both aircraft and killing all 71 persons onboard.

The initial accident investigation conducted by the Federal German Bureau of Aircraft Accident Investigations (BFU Report, 2004) placed the *root causes* of the accident squarely on "*aircrew responses to TCAS advisories in the face of possibly conflicting instructions from Air Traffic Service personnel, and also on safety management issues surrounding the staffing and operation of the Zurich ACC during major maintenance and upgrade operations*" (Johnson, 2004: p. 1.). However, in a follow-on review of the BFU final report, Johnson (2004) expanded the focus of the accident investigation beyond the *so-called* root causes of the accident by examining the wider organizational contributions to the accident.

The findings of Johnson's follow-on report reflect that this was, in essence, a system failure where an accumulation of undetected latent conditions/failures, over time, effectively reduced safety margins to create a *window of vulnerability* for disaster. A window of vulnerability that the investigation revealed had been opened on several occasions before, in the form of near misses, only to be overlooked or misinterpreted by the safety management system in place to detect and close them (Johnson, 2004). It should be mentioned that the Swiss Air Navigation Services provider, Skyguide, is recognized as one of the first air navigation services providers to complete the corporatization process (Skyguide Corporatization Report, 2002). However, it was also noted that although "*the Swiss authorities had initiated well-documented procedures and principles that would encourage the development of a sound Safety Management System, and that these principles were in accordance with ICAO and EUROCONTROL guidelines, the Swiss ATM organization lacked the experience and the personnel to implement those*

procedures" (Johnson, 2004: p. 1). Many of the organizational factors uncovered in the Überlingen accident investigation were also observed in the study of Avinor, including: recent restructuring during a corporatization process and a shift of focus to cost effectiveness, over tasking of personnel, and implementation of a new safety management system. All of these areas will be addressed in the findings section of this study.

2.6 Managing deliberate change in an HRO

Based on the need for strategic change argued above using the ICAO corporatization model, this study will focus upon the leadership's role in making organizational change choices, and the consequences of mismatching change implementation choices with organizational culture type. One area of research that I will use in this study will focus upon the cultural paradigms described by Meyerson and Martin (1987), and I will combine this with the concept of matching culture to implementation methods and change types as described by Waldersee and Griffiths (2004), and others, and apply this combined approach to the Avinor case. It is argued that different cultural paradigms require different change implementation types to ensure success.

2.7 Summary

This chapter has presented an overview of the phenomenon of interest for this study, specifically, how large scale organizational change affects safety as an outcome measure in a high reliability organization. I have introduced the paradox of measuring *nothing happening* as an indication of changes in emergent system processes in a civil aviation industry where the traditional metrics of incident and accident reporting are becoming less and less useful as an indication of system performance. And this is becoming increasingly relevant as the civil aviation industry reaches *ultra-safe* levels of performance.

I then presented a safety management system model in three temporal phases, and argued that there needs to be a shift in focus away from the historical metrics of incident and accident reporting to include the natural interactivity and potential strength of the human element in a socio-technical system embedded within an organizational culture. But finding new methods to measure changes in safety in the interactive phase of operations requires the introduction of new tools that are both qualitative and quantitative in nature that can give organizational leaders *leading indications* of emergent safety processes, enabling them to take proactive measures before system failure. These new tools will be presented in Chapter 7.

I then introduced the concept of high reliability organizations and how these organizations have historically achieved reliability, and that organizations that achieve such high levels of reliability rely primarily upon similar management structures and develop similar supporting organizational cultures. But then I addressed the problem of introducing potentially destabilizing strategic change into the stable processes that enable highly reliable performance, where continual incremental change and learning are the processes that create stable outcomes. And maintaining stable outcomes during periods of change is particularly relevant as the civil aviation community implements the corporatization process on a global scale where maintaining, or improving, safety levels is a priority. But the change process is not without risk as evidenced in the Überlingen mid-air collision where conflicting goals in a corporatization process can open *windows of vulnerability* that are often missed by the traditional aviation safety metrics of incident and accident reporting. And finally, I briefly describe the problem of mismatching organizational change methods with organization cultures types which I will argue is the underlying dynamic for the Avinor case.

Part II: LITERATURE REVIEW

In this chapter, I will present an overview of the academic literature relevant to the Avinor case based on two research questions with particular focus on: organizational change in high reliability organizations, leadership issues in the context of change; organizational culture; and safety and safety measurement. The chapter ends with a brief summary of the literature and the conceptual framework of the study.

3 Literature review and research model

This chapter reviews the current literature within four key areas of academic research of interest to this study based on the research questions, specifically: *organizational change; leadership in the context of organizational change, organizational culture and climate, and safety and safety measurement in high reliability organizations.* First, I will introduce the research questions for this study followed by a presentation of the literature review based on the research questions. Then I will present a summation of the most important literature based on the literature review to be used in this study. And finally, I will present a tentative research model that defines the areas of interest for this study. The purpose of the tentative research model in an exploratory study is to draw on existing research as much as possible to guide data collection (Stensaker, 2002). The tentative nature of the model indicates that this is only a first draft of a final model where I will use a grounded theory approach to refine and develop the constructs of interest over the life of the study.

3.1 Research questions

This study focuses on the effects of strategic change on safety as an outcome variable in a high reliability organization. To study this phenomenon, I have formulated two research questions:

> *1) How does the interaction between leadership choices and organizational culture type affect attitudes toward deliberate strategic change in a high reliability organization?*
>
> *2) How do the relationships between leadership actions during strategic change, safety climate in place, and employee attitude toward change, affect safety as an outcome variable?*

Based on these questions, I have identified four academic areas of interest for this study, specifically: organizational change; leadership in the context of organizational change; organizational culture and climate; and safety and safety measurement. In the following sections, I will present a review of the literature in each of these areas followed by a brief summary of the relevant research and a tentative research model based on the results of the literature review.

3.2 Organizational Change

Organizational theory has long recognized the topic of change as an important sub-discipline in its own right, and that the concepts of, and approaches to, change permeate virtually every aspect of organizational behavior and organizational analysis (Wilson, 1992). Organizational change is a normal and often required process for organizations in an ever-changing environment. How one approaches change from an organizational perspective is critical to the eventual success of change, and the effects transmitted throughout the system. Strategic change should be regarded as a continuous process which occurs in given contexts (Pettigrew 1985), but we find it impossible to comprehend such changes as separate episodes divorced from their historical, organizational and economic circumstances from which they emerge (Pettigrew et al., 1989). Organizational change in regards to history, organization and economic circumstances are particularly valid in this study.

It is widely accepted that organizations need to change, over time, to remain competitive, and, in many cases, simply to survive. In this light, organizations can be viewed as *living* entities in the Darwinian sense where change is not only healthy, but required for long-term viability and survival (Aldrich, 1999). Organizations that do not change in response to changes in environmental demands risk facing degrading performance over time, or even sudden, and often unexpected, life-threatening crises that can lead to early extinction. Much of this change happens naturally, and comes in the form of *evolutionary* change that takes place without conscious thought or effort within the organization, and its model is algorithmic in nature in that outcomes occur if certain conditions are met (Aldrich, 1999). Evolutionary change can also be problematic, in that, due to its insidious nature, it often goes unnoticed and can interact with deliberate change processes in unexpected ways. Deliberate change, on the other hand, is a conscious change effort where decisions are made and implemented in response to recognized threats or challenges.

In addition, there is an important distinction between deliberate change, and the *emergent* or *evolutionary* properties of normal change that co-exist within the greater change context, and often produce counterproductive, or unexpected, effects on desired outcomes (Aldrich, 1999; Snook, 2000; Vaughan, 1996). In this study, I will distinguish between incremental change and *frame-breaking* change that is often termed strategic change (Rajagopalan and Spreitzer, 1996; Sanchez and Heene, 1997). Strategic change often involves changes in product-market

domains, followed by changes in structure, systems, and processes (Lines, 2004), and by its complex nature is usually a more demanding and traumatic experience for an organization.

Strategic change is also change based on deliberate choice, and is highly visible within the organization, and sometimes externally driven, as well. This tends to activate strong emotions, both positive and negative, which are deeply associated with organizational culture (Piderit, 2000), and can produce strong reaction to change. Reactions stemming from emotionally enabled bias associated with change, are often manifest by clashes between an organization's culture and its organizational leadership, and can significantly affect strategy implementation (Dasborough, et al., 2003). It is further argued that these reactions to change are caused by emotional bias toward change linked to attitudes formed early in the change implementation process, and can either facilitate or hinder the change implementation process depending upon how attitude is activated (Lines, 2004). And this is one of the relationships that will be presented in the safety management model in Chapter 7.

Studies addressing how leaders approach the entire organizational change process often focus on strategy implementation, and are limited in their coverage of the early phases of the change decision-making process (Isabella, 1990). One reason may be that large-scale changes, most reflective of strategic change, tend to require extensive attention, and take focus from other organizational matters (Meyer and Stensaker, 2005). This can often lead to accelerated decision-making processes and premature final strategy decision choices. Yet, organizational change, and strategic change in particular, is characterized by high levels of complexity and ambiguity with regard to their causes, content, and consequences (Isabella, 1990). This demands more attention devoted to the formulation phase of change, and not less, which is often the case (Meyer and Stensaker, 2005). Several authors (Elsmore, 2001; Meyerson and Martin, 1987; Bluedorn and Lundgren, 1993; Lines, 2004; and Meyer and Stensaker, 2005) have recently increased the focus upon a broader spectrum of integrating change activities, and have actively considered how organizations need to prepare for change, in addition to how the change process is carried out. It can be argued that the shift in emphasis from the implementation phase of change, to the formulation phase of change, is largely culture-driven, and caused by a general move away from *monolithic*-type organizations that are homogenous in their cultural makeup, toward more heterogeneous organizations exemplified by complex and embedded sub-cultures with differentiated needs (Meyerson and Martin, 1987).

One key aspect for change reflected in the change literature addresses employee reaction to change (Starbuck, Greve, and Hedberg, 1978; Bovey and Hede, 2001; Huy, 2002; Dasborough et al., 2003; Kickul et. al., 2002; Gopinath and Becker, 2000), and can be summarized by Lines (2005) who states that *"a key challenge for managing change is to control the attitude formation processes in the organization so that positive attitudes toward change are formed early in the change process, and the formation of negative attitudes toward change avoided*" (p.17). This is analogous to what has been termed the *golden hour* in crisis management, and is essentially the time between when management controls the information regarding the deliberate change process, and the employees form attitudes toward the change.

Others claim that forming positive attitudes early in a change process, when organizational members are first exposed to information about a pending change, improves an organization's capability of implementing the change in such a way that important objectives are met (Armenakis et al, 1993; Isabella, 1990). But attitudes toward change are not always only based on the information presented by leaders, and Starbuck, Greve and Hedberg (1978) argue that employee resistance to change is often not a result of negative attitudes toward change but from a well-grounded understanding of the implications of change that are different from management, and that management can make poor change decisions. In these respects, attitude, and more importantly, attitude formation are tightly linked to culture, increasing the importance of the formulation phase of change implementation, particularly during emergent change.

It can be argued that even the simplest of organizational changes is complex and dynamic requiring a well thought out plan for successful change implementation. But the leadership role does not end with the act of taking a decision, and approving a plan. Yet, this is exactly how many leaders define their role in the change implementation process (Isabella, 1990). Change is often initiated without the deliberate thought processes essential for mapping the decisions relating to successful implementation of strategy, and are well-founded in exemplars of organizational change such as: deliberate strategic change (Mintzberg and Waters, 1985; Korsgaard et al., 1995), downsizing (Allen et al., 2001; Brockner et al., 1994), process aspects such as communication or participation (Gopinath & Becker, 2000; Lines, 2005), research concerned with specific reactions to change such as emotional reactions (Dasborough et al., 2003; Huy, 2002), structure and function of attitude (Lines, 2005), and

procedural justice (Brockner et al, 1994). However, with change often follows confusion, mistrust and a lack of confidence in the decisions taken by the leadership, and these types of reactions in a high-risk environment can have direct effects on an organization's safety climate at a minimum, and safety culture over time. For high-risk industries, perceptions of senior managers' attitudes and behaviors in relation to the safety and well-being of the workforce will form the basis for the safety behavior of workers, and, therefore, the safety performance of the company (Clarke, 1999). Individual perceptions of safety, as affected by individual perceptions of the leadership's commitment to safety in the context of deliberate organizational change, will form the basis for the safety measurement model presented in Chapter 7.

3.2.1 New Public Management

Strategic change in the public sector presents a particularly interesting set of challenges. New Public Management is a term evolving in the early 1980's addressing a new administrational public management direction characterized by the following attributes (Reichard, 2001):

- Increased market-orientation and focus on competitiveness;
- Corporate management concepts adopted from the private sector;
- Separation of strategic (political) and operational (administrative) responsibility;
- Ideas derived from management by objectives and by outcomes, and
- Decentralized, semi-autonomous structures.

This movement was, in effect, "*a revolt against values of traditional bureaucracy and a belief that the public sector can be transformed by the power of leadership, the introduction of market mechanisms, and a focus on results and decentralizing power*" (Osborne and Gaebler 1992). The New Public Management model focuses on two complementary perspectives (Reichard 2001):

- External perspective: a new profile of tasks and duties, a new policy on vertical integration of service-provision, the shift from being a provider of services to the role of "guarantor", increased orientation to markets and to the competitive environment, improving the delivery of services to citizens (customers), and
- Internal perspective: fundamental reorganization of structures and processes, decentralization, increased accountability, focus on outcomes and results, improvements to personnel and financial management, etc.

3.2.2 Corporatization

The transition from public to private administration of services is one area of particular interest within New Public Management. Corporatization is the evolved term for this process used to describe the international civil aviation initiative stemming from an International Civil Aviation Organization (ICAO) policy "*urging governments to explore the possibility of establishing autonomous authorities to operate their air navigation services, where this is in the best interest of providers and users*" (Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services [Doc 9082/5] (2000). ICAO has chosen the term *autonomous authority* to reflect the fact that the commercialization of air navigation services does not necessarily mean that the organization has to move out of the scope of government jurisdiction. Quite the contrary, the government cannot abdicate its responsibility for provision of air navigation services as laid down by the Convention on International Civil Aviation (the Chicago Convention - which is the charter of ICAO). However, ICAO specifies that an *autonomous authority* should have financial and managerial autonomy from the government. In practice, however, the initiative has developed into a New Public Management-like concept called corporatization, and although corporatization is not a term used exclusively by civil aviation, its practice is quite unique. Participating States have formed an international trade organization, CANSO (Civil Air Navigation Services Organization), which describe the corporatization process as:

> *"The blanket term covering a range of commercial models adopted with differing levels of independence, from direct government control extending to the extreme case of privatisation. In all cases the government concerned retains responsibility for the provision of services but licences or contracts the corporatized body to perform the task on its behalf. The new bodies are required to perform the services safely and efficiently and have freedom to manage their businesses to achieve these objectives."* (Graham, 2003)

The corporatization initiative became popular due to the fact that governments worldwide were becoming increasingly cash-strapped, largely due to growing demands on Treasury resources for services that the individual States had traditionally been responsible. In addition, increasing demands for implementation of international air navigation requirements, such as CNS/ATM (Communications, Navigation, and Surveillance/Air Traffic Management); have placed an increasing strain on already limited availability of public funds. Normally, ownership of the corporation remains with the government. However, in a corporatized body, private sector participation is possible. "*It depends upon the provisions of the statute under which it is established and the policy of the government*" (ICAO, 2002: p. 3).

In short, *corporatization* is a systematic approach for the privatization or semi-privatization of national civil aviation activities within the international civil aviation industry. Corporatized bodies are those that lie outside of government civil service providing certain commercial freedoms to act in the provision of services. The process of establishing *legal status* as a corporatized body normally requires the passage of primary legislation by the State concerned. This legislation was enacted in Norway in effect from 1 January 2003, with the transition of air navigation services from the government body "Luftfartsverket" to the corporatized entity "Avinor". The Norwegian safety monitoring function continues under the government agency Luftfartstilsynet.

However, even without the added pressures of corporatization on management, civil aviation has experienced a long history of continuous and, often, *dramatic* incremental change processes, for example: the gradual transition from propellers to jet engines, deregulation in the US and European markets, security changes post-911, introduction of low-cost airlines, increasing fuel prices, focus on the environment, the introduction of "small" jets for short-haul transport, and finally, projected significant increases in air traffic volume that will potentially exceed the current air traffic control system design in the next twenty years (Shin, 2005). These continual, evolutionary changes that gradually alter the operational challenges, often go unnoticed, and place an additional burden on leaders and managers, particularly combined with deliberate organizational change processes. Evolutionary changes, that are often exogenously driven, place different levels of stress upon organizational decision-makers and organizational outcomes, and often have unexpected influences on deliberate change implementation processes (Aldrich, 1999). And as we will see in the findings portion of this study, external factors can significantly affect deliberate change processes and outcomes.

3.3 Organizational Culture/Climate

A review of the literature indicates that organizational culture appears to be even more complex than the change process itself, with numerous areas of disagreement. For example, Smircich (1983) raises important issues regarding the conceptual confusion over the use of the term organizational culture, stating that "*the concept has been borrowed from anthropology, where there is no consensus on its meaning*" (p. 339). In addition, there does not appear to be a universally accepted definition of organizational culture. Schein (1985) offers a rather simple approach to understanding the concept of organizational culture. For him, it is:

> "*A pattern of shared basic assumptions that a group learns as it solves its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems*".

However, Schein later revises and expands this definition to:

> *"Culture [is about]... (a) a pattern of basic assumptions, (b) invented, discovered or developed by a given group, (c) as it learns to cope with its problems of external adaptation and internal integration, (d) that has worked well enough to be considered valid and, therefore (e) is to be taught to new members as the (f) correct way to perceive think and feel in relation to those problems. The strength and degree of internal consistency of a culture, are, therefore, a function of the stability of the group, the length of time the group has existed, the intensity of the group's experiences of learning, the mechanisms by which the learning has taken place, (i.e., positive reinforcement or avoidance conditioning), and the strength and clarity of the assumptions held by the founders and leaders of the group".* (Schein, 1990)

Sergiovanni and Corbally (1984), on the other hand, approach (organizational) culture more prescriptively by stating:

> "*A standard definition of culture would include the system of values, symbols, and shared meanings of a group including the embodiment of these values, symbols, and meanings into material objects and ritualized practices.... The 'stuff' of culture includes customs and traditions, historical accounts be they mythical or actual, tacit understandings, habits, norms and expectations, common meanings associated with fixed objects and established rites, shared assumptions, and intersubjective meanings*".

And finally, Meyerson and Martin (1987) take the position that "*organizations are cultures,"* and this is echoed by Pacanowsky and O'Donnell-Trujillo (1983) who believe that "*organizational culture is not just another piece of the puzzle, it is the puzzle. From our point of view, a culture is not something an organization has; a culture is something an organization is*" (p. 146).

Underlying all of these arguments is the premise that cultures are socially constructed realities (Berger and Luckmann, 1966) and, as such, the definition of what culture is, and how cultures change, depends on how one perceives and enacts culture. For this study, I will conform to the Sergiovanni & Corbally (1984) definition above, with the added caveat that unitary or monolithic cultures rarely exist, and that corporate culture can vary between different departments or layers within an organization, explaining why managers often misinterpret their employees. It is from this academic point of departure that I will attempt to capture the concepts of change and culture with the intention of positioning this study to evaluate the

relative contributions of culture to attitudes toward the change implementation processes in this study.

Organizational culture is the set of values, beliefs, customs, and systems which are unique to an organization (Wilson, 1992). Safety culture in the context of this study would be considered a sub-culture within an overarching company culture, and will be covered later in this chapter. Using Handy's (1986) well-known distinction between four typologies of organizational cultures (power, person, role, and task cultures), corporatized companies would normally fall into a *role culture category - which is appropriate to bureaucracies, and organizations with mechanistic, rigid structures and narrow jobs. Such cultures stress the importance of procedures and rules, hierarchical position and authority, security and predictability.* In essence, role cultures create situations in which those in the organization stick rigidly to their job description (role), and any unforeseen events are referred to the next layer up in the hierarchy (Handy, 1986).

In relationship to organizational change, a rapid change in a company's structure can lead to a situation where the company's culture is out of step with changes that are taking place in the environment, structure and practices of the organization (Handy, 1986; Allaire and Firsirotu, 1984). This change can lead to general uncertainty within the organization where changes in cultural norms are challenged. A major shortcoming for many theories on organizational change is the tendency to assume a unitary frame of reference in which worker's and manager's interests either coincide or can be easily reconciled (Burnes, 1996). Leveraging culture is but one of a number of key leadership tools available to managers responsible for implementing change, but by actively managing culture, an organization will be more likely to deliver on its strategic objectives over the long run (Chatman and Cha, 2003).

3.3.1 Organizational culture types

Meyerson and Martin (1987), in their paper "*Cultural Change: An Integration of Three Different Views",* describe three distinct organizational culture types requiring three different change implementation approaches based upon the effects of culture on change. These types, or paradigms, are described as: Integration (consisting of one overall culture), Differentiation (a culture consisting of several distinct sub-cultures, or anti-cultures, with various degrees of connectivity to the main culture), and Ambiguity (a loosely connected organization consisting of numerous unconnected and potentially unrelated cultures). In this study, I will only address change implementation concerning paradigm 2 type cultures (differentiation) that I will argue

are the more common organizational culture type found in complex organizations today, and is the cultural paradigm that best describes Avinor.

The differentiation culture type can range from *monolithic-like* to nearly fragmented and ambiguous, and anywhere in between, and this is due to the fact that complex organizations reflect broader societal cultures and contain elements of occupational, hierarchical, class, racial, ethnic, and gender-based identifications (Beyer, 1981; Trice and Beyer, 1984; Van Maanen and Barley, 1984). These sources of diversity often create overlapping, nested sub-cultures, and can also include *outliers* which do not conform to the dominant overall culture. In cultural terms, this means that this type of organization would probably be composed of a diverse set of sub-cultures and anti-cultures that share some integrating elements of a dominant culture (Martin et. al., 1985), but not necessarily all integrating elements. The differentiating factor in this type of culture is that it is composed of a collection of values and manifestations, some of which may be contradictory (Meyerson and Martin, 1987), and is reflective of many large, sometimes international firms, where large sub-cultures co-exist within a larger cultural framework. It is also possible that the lines separating these individual sub-cultures are poorly defined, with many members belonging to more than one recognized grouping, further confusing cultural homogeneity.

3.3.2 Matching change implementation type with organizational culture

An increased focus on culture during deliberate change processes is considered a significant step forward in that it gives a rather prescriptive account of how to classify different organizational culture types, or paradigms, and then how to match implementation strategies tailored to these types to achieve better change outcomes. But I would also argue that failing to match implementation strategy with culture type can adversely affect attitudes toward change, which have a direct moderating effect on change outcomes, and often lead to failure. And in the Avinor case, I will argue that changes in attitude toward change also have direct affects on perceptions of safety.

Based on the work of Meyerson and Martin (1987), Avinor would be characterized as a paradigm 2: differentiation culture (p. 630) that experiences a mixed-type change where both *participative* and *unilateral* change types are used in a complex change process that include both *structural-technical* and *behavioral-social* elements (Waldersee and Griffiths, 2004). I would describe a differentiation culture, as used in this case, as an organizational culture composed of multiple sub-cultures (and anti-cultures) imbedded within a weak main

organizational culture. This is not unusual considering the diversity and geographical separation of the various business units contained within the Avinor organization. And although one could argue that a mixed-change process would be the most appropriate approach for strategic change in a complex, differentiated culture, I will also show that leading such a mixed approach is highly demanding from a leadership perspective, and requires specific leadership skills for success.

It is believed that matching organizational change methods with organizational culture types affects change outcomes (Meyerson and Martin, 1987; Waldersee and Griffiths, 2004; Bluedorn and Lundgren, 1993). These outcomes are often based on issues such as: change type (Leavitt, 1965; Powell and Posner, 1980), failures in the implementation process (Beer et al., 1990; Dunphy, 1996; Weick and Quinn, 1999), executive commitment (Schein, 1983), culture as an integrating mechanism (Geertz, 1973; Schein, 1983), formal and informal practices (Ouchi, 1981; Schall, 1983), cultural persistence (Zucker, 1977), participative vs. unilateral implementation (Beer and Nohria, 2000; Chapman, 2002), ambiguity (Meyerson and Martin, 1987), and strategy matching (Slater, 1989; Gupta, 1984; Hambrick and Mason, 1984). Most notably, it is assumed that a mismatch between organizational culture type and organizational change method will increase organizational resistance to change and, thereby, decrease organizational support for the change initiative, potentially leading to failure of the change process.

It is also becoming more and more apparent that culture and change are inexplicitly entwined, or *tightly coupled* (Perrow, 1984), both in the way they interact, and in the way they need to be approached within the strategic change process. Also, cultural matching has been argued to produce better change outcomes (Meyerson and Martin, 1987), though most studies have focused either on clearly defined culture types, or paradigms (Meyerson and Martin, 1987), or change types, such as, participative or unilateral change (Beer and Nohria, 2000; Chapman, 2002). Yet, few studies have looked at how mixed-culture types react to mixed-change processes. Most studies look at change as either structural or behavioral. Waldersee and Griffiths (2004) argue that the relationship between attitude and behavior are two opposing assumptions and underlie the participative and unilateral approaches. Dunphy and Stace (1990), on the other hand, propose that it is the size of the change that determines the appropriate change type where large-scale changes are less likely to be supported by employees due to complexity and uncertainty, and where top-down methods are more

appropriate. But according to Waldersee and Griffiths (2004), the studies carried out by Dunphy and Stace tended to be more structural in nature involving management restructuring, downsizing, re-engineering, and outsourcing (P. 427), and that behavioral-type changes were limited in nature.

Up to this point, very little empirical evidence has been provided to show how complex organizational cultural settings react to mixed-change types, and how this interaction moderates change outcomes. And by mixed-change types I refer to organizational change processes in complex organizations where both structural and behavioral changes are attempted simultaneously. Waldersee and Griffiths (2004) defined mixed-change types as those involving introduction of new management systems, such as TQM (Total Quality Management), as well as socio-technical changes. One reason for the lack of study in this area may be that complex organizational changes are more difficult to categorize into either/or types, and in complex cases, where organizations may also be geographically separated, even organizations with relatively strong overarching organizational cultures may develop distinct sub-cultures and anti-cultures that complicate change implementation processes, or even disrupt the entire change process.

Research on the moderating effects of culture types on change implementation processes have been mostly carried out by focusing on historical results from multiple case studies (Dunphy and Stace, 1990; Govindarajan, 1989; Miller and Toulouse, 1986; Miller et al., 1982) where culture types and change methods are relatively controlled, and most of these studies also focus on changes that are relatively successful. In addition, most studies focus on either identifying culture types (Meyerson and Martin, 1987), or change type, such as unilateral or shared (Beer and Nohria, 2000; Chapman, 2002: Lawler, 1992). Unilateral changes tend to be top-down in nature using prescriptive, control and authority-based techniques, are procedural, and focus on a reallocation of resources (Waldersee and Griffiths, 2004). Shared changes, on the other hand, also described as the participative approach (Beer and Nohria, 2000; Chapman, 2002: Lawler, 1992), are argued to be absolutely essential for successful change implementation, especially in organizations where socio-technical and behavioral changes are desired (Lawler, 1992; Dunphy and Griffiths, 2002; Emery and Emery, 1993).

3.4 Leadership in the context of change

One area of related interest for culture matching is strategy-style matching theory (Slater, 1989) that focuses primarily on managerial styles, and how personality characteristics of key

leaders affect change outcomes. Just matching change implementation strategy to culture is not enough to ensure success. For example, other important factors in change implementation, such as: consensus formation during strategic change (Markóczy, 2001), how to engage organizational participation in change (Lines, 2004), creating internal change capacity, and pacing, or how varying the speed of change can effect implementation (Meyer and Stensaker, 2005), are all key elements in ensuring successful change strategy implementation. And this is true even after correctly matching organizational culture types to change implementation strategies. And these are all specific leadership responsibilities.

Although this is not necessarily directly linked to change implementation types, leader effectiveness in managing change is contingent upon locus of control (Govindarajan, 1989; Miller and Toulouse, 1986; Miller et al., 1982) which is directly related to organizational culture. Change within differentiation-type cultures requires that leaders pay more attention to inconsistencies, lack of consensus, and non-leader centered sources of cultural content (Meyerson and Martin, 1987). And this emphasizes the importance of various subunits, including groups and individuals (Louis, 1983; Nord, 1985) who represent constituencies based within, and potentially outside, the organization. It also often requires more time devoted to the strategy planning phase where different types of sub-cultures can be distinguished (Louis, 1983), and for identifying sub-cultural differences that may represent disagreements with an organization's dominant culture, as in a counter-culture (Martin and Siehl, 1983). This is particularly important as these sub-cultural identifications may be orthogonal to a dominant culture, reflecting functional, national, occupational, ethnic, or project affiliations (e.g. Gregory, 1983; Van Maanen and Barley, 1984).

Failure to consider these differences can lead to sub-culture or anti-culture resistance which can threaten success of planned change, depending upon the relative strengths of such internal entities (Brown, 1995). This is also an area where Lines (2005) would argue that "*participation is believed to have a number of positive effects on the strategy process, most notably in that it is assumed that involvement of those affected by a change in strategy will reduce organizational resistance and to create a higher level of psychological commitment among employees towards the proposed changes*" (p. 193). I will take this argument one step further by arguing that participation within a differentiation-type culture is not only a positive initiative, but an absolute requirement for differentiated cultures containing strong, reactive, and potentially combative, sub-cultures.

3.5 Safety and safety measurement

Why have I chosen to focus upon safety as an outcome variable? The term safety is an often used but little understood concept that lacks a clear definition, yet is the stated highest priority outcome in the Avinor case. In addition, safety is a major cost driver for most high-risk businesses, and for some businesses, safety is not only the primary cost driver but also the absolute goal by which performance, and potential survival, is measured. Safety performance, or lack thereof, can easily define the difference between success and failure for a company. This is evidenced in the fact that airline travel drops after large accidents; and airframe companies suffer if one of their models appears to have more than its share of accidents (Perrow, 1994). However, lacking a clear and precise definition of safety makes it difficult to measure at any given point in time, or to predict future safety performance. So how can safety levels be defined and measured based upon actual safety states rather than being analysed after an accident? More importantly, how can changes in safety levels due to deliberate strategic change and the potential formation of latent conditions, be identified, measured and corrected, breaking the accident causal chain before an accident occurs? These are the questions that this study is trying to answer.

There is growing interest in understanding the influence on safety outcomes due to organizational factors like commitment to safety, safety culture, and safety climate (Ciavarelli, 2003), however, little research focusing upon the direct impact of deliberate strategic change on safety outcomes. Achieving a better understanding of the causal relationship between deliberate strategic change and safety as a measurable outcome variable is an area where this study intends to make a contribution.

3.5.1 Safety

Safety has long been a key performance measure for industries in high-risk environments. And this is evidenced by the amount of safety literature based upon grounded theory from high-profile accident investigations (Perrow, 1984, Shrivastava, 1987; Weick, 1993a.:1993b.; Vaughn, 1996; Snook, 2002; Gehman, 2003; Johnson, 2004). These studies are based on dramatic *system failures* where much of the emphasis is devoted to showing *post facto* the structural and behavioral causes and precursors of operating failure (La Porte, 1996: p. 60). Bourrier (1998) argues that "*too often, organizational analyses are carried out only after a catastrophe has occurred. While very interesting, this perspective has serious limitations and it is always easier to explain and reconstruct events after they have taken place*" (P. 133).

And the literature also reflects that there is a general lack of proactive safety theory derived from longitudinal case studies of "*safety management systems in companies being subject to reorganization in the wide-open business environment*", and is even described as "*a black hole in research and literature*" (Hale et al., 1998: p. 11). But this trend also seems to be changing as the concepts of High Reliability Organizations and Resilience Engineering begin to dig deeper into system approaches to safety management in high-risk industries where accidents are rare by design, but potentially disastrous (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Weick and Sutcliffe, 2001:2006; Reason, 1997; Hollnagel et al., 2006). These types of studies, in particular, are highly relevant for the *ultra-safe* (Amalberti, 2001) civil aviation industry that continues to evolve in its attempt to *corporatize*, and provides a unique opportunity to observe, and to gain new knowledge from deliberate change processes in high-risk environments that can have potentially devastating consequences, prior to an actual disaster.

In the past, most studies in safety management have been conducted primarily by scientists in the fields of sociology, psychology and engineering (Roberts and Bea, 2001), all with their own particular scientific paradigms, and all with their own specific approaches for defining and measuring safety and/or safety culture (Perrow, 1984, Shrivastava, 1987; Weick, 1993a.:1993b.; Vaughn, 1996; Snook, 2002; Gehman, 2003; Johnson, 2004). But there has not been a great deal of interactivity between academic groupings. These same academic disciplines have also been involved in studying safety system behavior based on multiple case studies that have introduced new safety concepts, such as: man-made disasters (Turner, 1978), normal accidents (Perrow, 1984), high reliability organizations (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Weick and Sutcliffe, 2001:2006), organizational accidents (Reason, 1997), and resilience engineering (Hollnagel, et al., 2006).

And, although all of these academic contributions have increased our understanding of the underlying organizational dynamics of how eroding *safe systems* contribute to unacceptable outcomes, all fall short of defining a true systems perspective for measuring safety as a process within high-risk industries that captures all of the essential parts of a robust operative safety management system. And this is particularly relevant when defining safety within an expanded strategic business context where safety is one, but not necessarily the only, priority affecting business decisions.

Rasmussen (1994) has contributed with the notion of organizational drift towards accidents under economic competitive pressures. This describes the threat to safety outcomes in business settings, but leaves business leaders and managers responsible for managing these complex systems with little prescriptive guidance on how to design and support proactive management structures that can help detect and identify potentially unsafe conditions in their developmental phases. And, more importantly, how and when managers should take appropriate *proactive* corrective actions based on *leading* indicators that fall well outside of the traditional historical metrics of incident and accident reporting. And this is particularly true during periods of demanding deliberate organizational change within a complex and changing environment where developing latent conditions (Reason, 1997) might be masked by competing priorities.

One problem for the civil aviation industry is the excessive focus upon incidents and accidents as extraordinary events. Perrow (1984), for example, studied the Three Mile Island accident and found that accidents in complex, socio-technical systems are, in reality, *normal* outcomes within system design specifications that are often unanticipated due to system characteristics, such as, interactive complexity and tight coupling. This is considered an important point in that by being *normal* outcomes within a system's design parameters, accidents are, in fact, just undesired outcomes from an otherwise properly functioning system. And although the consequences of such undesired and unexpected events are often dramatic, their causes are similar to non-dramatic, undesired events that could have developed into disaster but did not. This often leads to artificial *fixes* based on detected errors in the form of rules and regulations that attempt to limit the risk, and potential adverse consequences of undesired system outcomes, without really fixing the process that allows the undesired outcome to occur in the first place. This requires an expanded focus on what constitutes a *safe system* that goes well beyond the overly simplistic elimination of "*breakdowns and errors"* (Amalberti, 2001), even when conceptual designs generate systems with high theoretical performance (p. 110).

Turner (1978) showed us how some accidents are caused by sloppy management, and can be dealt with through different types of control, but that others are caused by disaster preconditions created by normally functioning managerial and technical systems through the formation of *incubation periods* (p.215.). This is also reflected in Reason's (1997)

accumulation of latent failures popularly depicted in the famous Swiss Cheese Model illustrated in Figure 3-1 (EUROCONTROL, 2006).

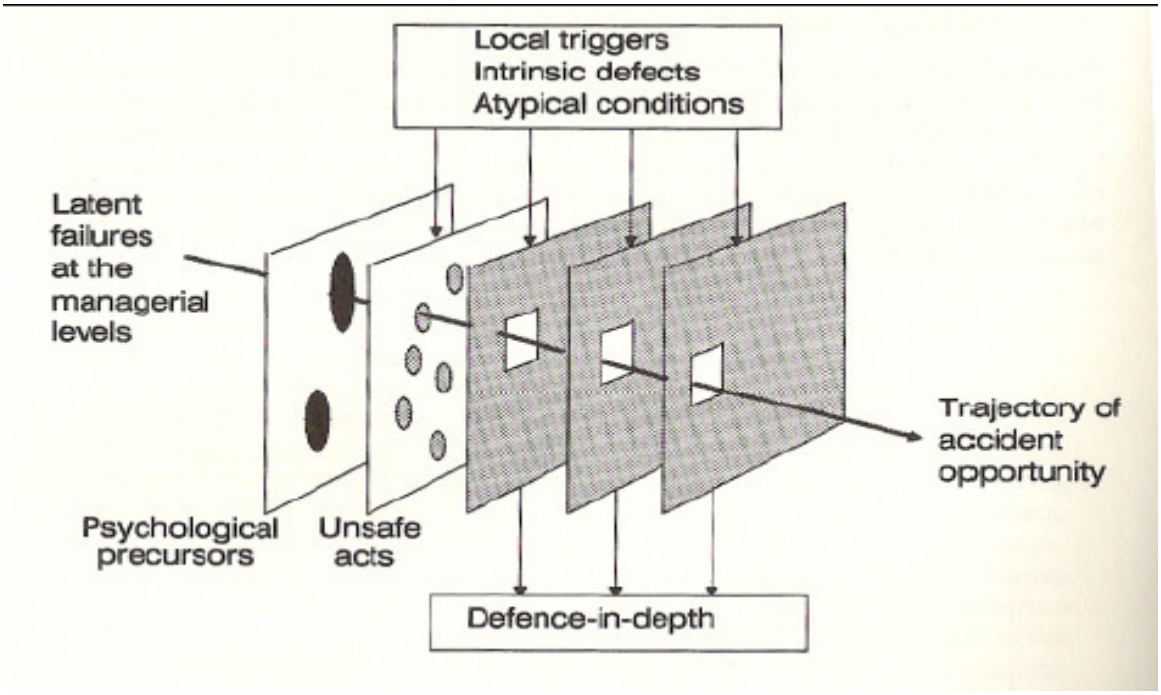

Figure 3-1 James Reason's Swiss Cheese Model

The Swiss Cheese model is a conceptual model of leadership attempts to provide various defenses-in-depth (square grids) as barriers designed to prevent undesired events. The holes represent weaknesses in the barriers, sometimes referred to as latent conditions (Reason, 1997). In reality, the holes appear, expand and contract independently, and can also change position so that this is, in effect, a dynamic presentation of an emergent system. The trajectory of accident opportunity occurs when holes align, usually in response to managerial actions, over time, such that a final active failure can lead to disaster as evidenced in the Überlingen mid-air collision. Dekker (2002, p. 119-120) adds that:

> *"The layers of defense are not static or constant, and not independent of each other either. They can interact, support or erode one another. The Swiss cheese analogy is useful to think about the complexity of failure, and, conversely, about the effort it takes to make and keep a system safe. It can also help structure your search for distal contributors to the mishap."*

Still other literature focuses on *man-made* disasters such as: Bhopal gas leak (Shrivastava, 1987), Three Mile Island nuclear reactor accident (Perrow, 1984), the Tenerife runway collision (Weick, 1993a), the Challenger (Vaughn, 1996) and Columbia (Gehman, 2003) space shuttle accidents, the "*friendly*" downing of two Blackhawk helicopters (Snook, 2002),

and the Überlingen mid-air collision (Johnson, 2004). In all of these disasters, organizations played a significant contributing role leading to undesired outcomes. The space shuttle accidents, in particular, demonstrate both the importance of organizational *soft variables*, such as organizational culture in safety outcomes, as well as, the difficulties in changing culture within socio-technical organizations over time (Gehman, 2003).

Recently, there have been "*a few studies which have started to use organizational learning theory to look at the introduction, development and integration of safety management systems but even these have, up to now, been very limited and have only occasionally taken a longitudinal perspective to explain how the change works and what aids or hinders it*" (Hale et al., 1998: p. 10). This is emphasized by Baram (1998) who states that "*such deep organizational changes in a company which uses hazardous technology can reduce the effectiveness of its process safety management system unless the implications of change are consciously and carefully addressed*" (p. 191). This finding was also clear in the Überlingen mid-air collision (Johnson, 2004).

These studies indicate the need for a systems approach to studying safety management systems in high-risk industries that goes beyond *trial and error learning* (Weick, 1987), and actively integrates reactive, interactive and proactive safety measures from both organizational and individual perspectives as presented in Chapter 2. And although the consequences of organizational change have often been identified as significant contributing factors in accident investigations (Vaughn, 1996; Snook, 2002, Gehman, 2003; Johnson, 2004), little of the safety literature focuses specifically upon how deliberate change, in particular, affects safety - over time. And, more importantly, how organizational leaders responsible for making time-sensitive decisions based on conflicting organizational priorities should react to emergent safe systems prior to disastrous outcomes. This is an area where this study intends to make a contribution.

3.5.2 Civil aviation as a complex *socio-technical* system

By using an overall *systems* perspective in civil aviation, we are focusing particularly on a highly developed *socio-technical* system that is becoming increasingly business-oriented, and where the balance between human interaction and technical complexity is high. Weick (1987) describes the air traffic control system as a system that "*seems to keep the human more actively in the loop of technology than is true for other systems in which reliability is a bigger problem, and where the air traffic controller uses qualities such as discretion, latitude,*

looseness, enactment, slack, improvisation and faith - work through human beings to increase reliability" (p. 122). This places a greater reliance upon human operational strengths and weaknesses, and is, in fact, the human contribution to *resilience* in overall system performance.

The safety literature for high-risk industries is dominated by studies involving large machine-bureaucratic organizations, such as the nuclear power and chemical industries, often with a very considerable investment in sophisticated defense-in-depth management systems in safety and environment (Hale et al., 1998). Civil aviation, on the other hand, has generally received less focus, yet few industries can rival the growth, introduction of new technologies, and increase in complexity that the civil aviation industry has experienced over the past years, and will continue to experience in the future (Shin, 2005). The civil aviation industry can be described as a complex system of overlapping *socio-technical* systems embedded within a highly competitive business environment, where safety is a primary, but not the only, goal.

And this focus on safety is particularly relevant as international air navigation service providers corporatize, and become more economically competitive and, correspondingly, more vulnerable to conflicts of prioritization in a changing business environment. But unlike the tightly coupled machine-bureaucratic systems described by Perrow (1994) that lead to "normal" accidents, the civil aviation industry can be characterized as a system that is highly complex but loosely coupled, and relies more heavily on human interaction than most machine-bureaucratic organizations, and is highly influenced by human variation. In fact, Weick goes so far as to say that "*one striking property of air traffic control is that controllers are the technology*" (1987: p. 120) meaning that human variation is essentially an integral part of both the system design and system performance. But there are also benefits, in that, humans are also flexible and can accommodate subtle environmental changes real-time, and can also detect latent conditions or failures (Reason, 1990) that develop gradually over time.

Loose coupling within a complex system, similar to feedback with delay in system dynamics terms (Forrester, 1961; Sterman, 2000), increases the complexity in understanding how causal relationships interact and develop over time, and these complexities are often missed in mishap investigations that usually focus on finding the most observable *root causes*. This is particularly true during periods of deliberate organizational change in dynamic environments where system outcomes are based on systems that have evolved away from the original system design but, either due to operator accommodation, regulation or built-in resilience,

have not demonstrated measurable undesired safety outcomes using traditional metrics. And these causal relationships become even more complex and difficult to identify when examining over-lapping safety management systems where external actors can obscure or mask system deficiencies.

The civil aviation industry is an industry consisting of a system of interacting safety management systems, often described as High Reliability Organizations (Roberts, 1990; Schulman, 1993; Weick, et al., 1999) that provide overlapping safeguards that can both prevent, or contribute to, disaster. The so-called *safety nets* (Johnson, 2004) provided by these overlapping high reliability organizations, often lead to the development of latent conditions (Reason, 1984) that hide potential disaster in unexpected ways (Turner, 1976). Many authors have recognized that small events, that are not necessarily complex in themselves, can link together to create disproportionate and disastrous effects (Weick, 1993a; Perrow, 1987; Vaughn, 1996; Reason, 1997).

Within the field of civil aviation, public knowledge and interest directs much of the attention to safety (Groeneweg, 2002). Safety to most is represented by accidents and near-accidents that by most standards reveal a lack of safety. Aviation safety has been traditionally measured in terms of accidents or incidents per 100,000 flight-hours (Amalberti, 2001). This measure is based purely upon historical data and does not provide a reliable indication of future safety performance. Quite the opposite, good safety records can lead to complacency based upon a false sense of well-being, leading to a diversion of essential operational and training funds and activities which shifts the focus from safety to other areas of interest. This will become more profound as aviation systems move further away from direct government oversight, and become more focused on the economic factors associated with privatization initiatives.

3.5.3 Measuring safety in civil aviation

Providing a meaningful measure of safety based primarily on disastrous outcomes is a difficult task considering that the likelihood of a *disastrous accident* in the civil aviation industry today is approaching an *ultra-safe* level where the risk of such an event is currently below one accident per million events (Amalberti, 2001, p. 111). This problem was probably best summed up by James Reason (1984) who stated that "*safety is defined and measured more by its absence than its presence".* And this was also reflected in the findings of the Norwegian Accident Investigation Board (HSLB, 2005) in their study of the Norwegian civil

aviation industry where growing concern over aviation safety were not reflected in measurable changes in traditional safety metrics during the timeframe of this study.

Though by most standards civil aviation is considered safe, there are many examples of production pressures, malfeasance, incompetent designs, and regulatory inaction (Perrow, 1984) that contribute directly to undesired events. And this is echoed by Amalberti (2001) who describes ultra-safe industries as having common system features which include:

> "*they tend to be ageing, are over-regulated, rigid and highly un-adaptive: accidents are different in nature from those occurring in safe systems: in this case accidents usually occur in the absence of any serious breakdown or even of any serious error. They result from a combination of factors, none of which can alone cause an accident, or even a serious incident; therefore, these combinations remain difficult to detect and to recover using traditional safety analysis logic; for the same reason, reporting becomes less relevant in predicting major disasters; and lastly, and not least, system managers work for their successors (over 8 years of inertia before being able to correctly assess the results of any new safety measure in the case of 5xl0^{-7} systems). The safety of these ultra-safe systems tends, therefore, to become a political rather than a scientific subject, with measures yielding visible results in the short term being favored over long-term measures*" (p. 112).

And these are exactly the issues currently being addressed by the Federal Aviation Administration in the United States where an aging civil aviation network based on 1960/70s technology is in jeopardy of collapse within the next 20 years if a major redesign is not successful (Shin, 2005). Therefore, a new theory on accident causation as a system function, or process, and not human error, must account for the shifts in interests and act on all fronts, providing a means of measuring the safety state, and set forth a sound basis for safety management (Groeneweg, 2002) embedded in a strategic business environment.

3.5.4 High Reliability Organizations

One possible explanation for nothing happening is that civil aviation is essentially a system of overlapping High Reliability Organizations (Roberts, 1990; Schulman, 1993; Weick, et al., 1999) that are also engineered to resist deviations from unexpected outcomes (Hollnagel et al., 2006), and where accidents are rare by design. But there is also evidence that these overlapping systems interact in the most unexpected of ways (Turner, 1976; Sagan, 1993; Perrow, 1994), and often evolve over time due to cultural deviance (Vaughn, 1996), incubation periods (Turner, 1976), procedural and organizational drift (Rasmussen, 1994; Elsmore, 2001; Dekker, 2006), or accumulation of latent conditions (Reason, 1984). Most of

which either go unnoticed, or noticed but not acted upon by the responsible actors in the system. Or even more common, latent conditions are noticed and acted upon locally without considering the negative system-wide implications prior to an undesired event (Weick and Sutcliffe, 2001; Johnson, 2004). Reason (1984) introduced us to the concept of organizational accidents based on the existence of latent failures, or gaps and weaknesses in safe systems that can align themselves in response to changes over time that create *windows of vulnerability* that can lead to disaster if certain active conditions exist (See Swiss Cheese Model, page37) . Latent conditions are most insidious in that their detection is both difficult and often masked by institutional pressures. Yet, latent conditions are thought to affect an organization's defenses, and, therefore, make human error at the operational end possible, and in some case more likely (Ciavarelli, 2003). This is often caused by a gradual reduction, or erosion, of a safe system that renders it increasingly vulnerable to particular combinations of accident-causing factors (Reason, 1984), and this was the case in the Überlingen mid-air collision (Johnson, 2004).

"*The concept of high-reliability organizations was originated by Dr. Karlene Roberts and others at the University of California, Berkeley, and was used as a point of departure for understanding how different organizations manage accident risk*" (Ciavarelli and Crowson, 2004). High reliability organizations are defined as organizations which require lower than average accident rates than other types of organizations (Roberts, 1990), and include, among others, organizations within civil aviation, nuclear power generation, off-shore oil production, and public transportation. They are also characterized by strong safety cultures developed over time to achieve high levels of safety performance (Ciavarelli and Crowson, 2004). HROs are those that are very successful at reducing risks associated with hazardous operations (Ciavarelli and Crowson, 2004), and are supported by highly evolved organizational cultures where *safety culture* may be perceived as a subset (Schein, 1992).

The study of high reliability organization structures and behavior started with the simple question: if accidents are *normal* (Perrow, 1984), "*why do some organizations succeed under trying circumstances, performing daily a number of complex technical tasks in which they cannot afford to fail"* (Rochlin et al., 1987: p. 98). The original study used US Navy Aircraft Carrier flight deck operations that were described as "*the closest one could come to the edge of the envelope for studying operations under the most extreme conditions in the least stable environment, and with the greatest tension between preserving safety and reliability, and*

attaining maximum operational efficiency" (Rochlin et al., 1987: p. 98). It was noted that while electrical utility companies and air traffic control rely on long training, careful selection, task and team stability, and cumulative experience, US Navy aircraft carriers operate with young, and mostly, inexperienced crew managed by a staff of officers that turnover half its complement each year. In addition, they operate in a hazardous working environment that must rebuild from scratch every 18 months, all within a volatile, ever-changing and deadly environment (Rochlin et al., 1987). The multi-year study brought about several surprising key findings that were initially considered counterintuitive, particularly as the military setting was expected to be a rigid and tightly controlled environment. However, the study concluded that the continually changing dynamics of the aircraft carrier environment, combined with the constant turnover of personnel, created a need for a *learning culture* that was dominated by a continual, incremental learning process where questions pertaining to operational processes and safety were essential for survival (Rocklin et al., 1987). The study also found that the complexity of the tasks performed by the organization, as a whole, were such that the formal and informal rules and relationships created were taken for granted, implicitly and almost unconsciously incorporated into the organizational structure to ensure reliable performance (Rochlin et al., 1987). In addition, individual members at all levels possessed local ownership of processes and potential problems, and could initiate changes or even stop processes at any time.

Follow-on studies, which have both expanded and improved the understanding of why high reliability organizations are successful, include: incorporation of strong safety cultures (Ciavarelli and Crowson, 2004), and cognitive processes critical for high reliability performance, such as, mental processes sometimes referred to *collective mind* in organizations (Weick and Roberts, 1993), organizational culture in HROs (Klein et al., 1995), and *mindfulness* (Weick and Sutcliffe, 2006) in operational settings. The concept of *mindfulness*, in particular, is a rich contribution based on the original work on *mindful organizing* (Weick and Sutcliffe, 2001), and is concerned with the clear comprehension of emerging threats (within a system) that interfere with comprehension. These qualities contribute even more to a safe system, if the system is resilient to failure through design (Hollnagel et al., 2006). Resilience engineered into a safe system gives a *mindful* organization more time to notice things happening, making sense out of these events in context, and to react in a proactive way (Weick, 1995). These cognitive processes, combined with the concepts of reporting and acting on an organizational level, are essential elements for successful high reliability

organization performance, and these traits distinguish these types of organizations from organizations that focus primarily on *trial and error learning* (Weick, 1995). HROs are also characterized by strong safety cultures and climates developed over time to achieve high levels of safety performance (Weick and Roberts, 1993). This is where new tools in measuring safety culture and safety climate are becoming more visible and provide proactive indications of change in evolving systems before undesired outcomes (Ciavarelli, 2003).

3.6 Safety culture and safety climate

As mentioned earlier, safety culture is a sub-set of organizational culture but focuses on institutional structures and mechanisms specifically designed to operate accident-free. Hopkins (2006) argues that "*every organization has a culture (or perhaps a series of sub-cultures), and that culture can be expected to impact on safety"* (p. 876). Safety culture is historically strong in organizations where safety is the primary goal, and where complying with safety standards are a normal and required part of operations. Safety culture is particularly strong in aviation-related industries due to the dramatic impact of accidents and public reaction. In addition, due to the historical frequency of aviation accidents and dramatic media coverage, measures were taken early in the development of civil aviation's development to address and ensure safe operation levels.

Safety climate has been described as a surface feature of an underlying safety culture that provides an understanding of the attitudes and perceptions of a supportive workforce at any given point in time (Schneider and Gunnarson, 1991; Cox and Flin, 1998). Namely, climate was viewed as a summary of molar perceptions that employees share about their work environments. (Zohar, 1980; p. 96). Williamson et al. (1997) defined safety climate as a summary concept describing the safety ethic in an organization or workplace which is reflected in employees' beliefs about safety, and is thought to predict the way employees behave with respect to safety in that workplace (p. 16). Neal and Griffin (2004) argue that safety climate has a direct influence on workers' knowledge and motivation, which in turn impacts on their safety behaviors, and ultimately on safety outcomes. Perceptions are particularly useful in that they have psychological utility in serving as a frame of reference for guiding appropriate and adaptive task behaviors (Schneider, 1975). However, James and Jones (1974) take this one step further by distinguishing between measures of organizational climate that are based on perceptions, and those based on structural features, including: size,

structure, systems complexity, leadership style, and goal directions (e.g., Forehand & Gilmer, 1964; Porter and Lawler, 1965). And these are precisely the areas of interest for this study.

Appropriately, Flin et al. (2000) have described safety climate as a *snapshot* of the state of safety in an organization, and that it represents the underlying safety culture of a group, unit or organization (p. 178). In addition, it has also been argued that safety culture, by its nature, is difficult to operationalize within a measurement instrument (Hale et al., 1998) but that safety climate, on the other hand, is a more valid measure using psychometric questionnaire studies. This also indicates that safety climate, in contrast to safety culture, is more sensitive to local conditions and will, thereby, provide a more timely measure of changing conditions. The distinction between culture and climate is often blurred in the literature but for this study I will focus on the local manifestations of culture under real-time conditions using psychometric measures developed within the literature. And these choices will be described in detail in Chapter 7.

One area of increasing interest in measuring emerging safe systems is the use of proactive measures based on qualitative and quantitative techniques that provide leading indicators that supplement the traditional measures of *trial and error* learning. This is supported by Flin (2007) who proposes that "*the study of worker expectations of behavior consequences probably needs to utilize more qualitative psychological approaches such as interviews, as well as questionnaire surveys.*" (p. 664). Measuring safety climate, as a proactive indicator, has been studied for over 35 years, but there is still little agreement as to the best mix of cultural dimensions to be included in a safety climate model (Williamson et al., 1997). The only unifying prescription for the composition of safety climate surveys is that the dimensions used in the evaluation of any organization are context dependent.

Many of the techniques mentioned above focus on studying organizational culture, and leveraging safety climate as a proactive measure (Zohar, 1980). But it has been argued that safety climate questionnaires have not been particularly successful in *exposing* the core of an organizational culture (Guldenmund, 2007), and have also been criticized for lacking a normative framework (Grote and Künzler, 2000). Others, however, have found that there is evidence that a strong safety climate contributes to better safety performance over time (Powell et al., 1971; Zohar, 1980, Glendon and McKenna, 1995; Diaz and Cabrera, 1997). And this supports the view that safety climate data, as a snapshot in time, is a potentially important contribution for evaluating evolving safety states within high-risk industries,

particularly during periods of organizational change where lagging indicators often miss the signs of evolving safe systems prior to failure. These coherent sets of organizational perceptions, when shared and summarized for individual employees, are defined here as organizational climates. (Zohar, 1980; p. 97). And this is especially relevant for high reliability organizations undergoing strategic change processes where safety climate indicators will react more quickly than the underlying organizational culture itself. These climate surveys are operationalized through safety audits (Ciavarelli, 2003) using a combination of psychometric techniques and qualitative processes to triangulate safety climate.

3.6.1 Leadership in the context of safety

A key feature of a company's safety culture/climate reflected in the literature, and one of the few areas of general agreement, is the importance of the shared perceptions amongst managers and staff concerning the importance of safety (Clarke, 1999). However, cognitions that guide behavior are largely related to perceptions of management attitudes about safety (Zohar, 1980), and these are often affected by the management's views of safety as a technical and independent aspect of the production process detached from other management operations (Zohar, 1980; p. 101). Consistent with the industry research, management commitment to safety emerged as the most frequently measured safety climate dimension in healthcare with nine of the studies including a measure of hospital management commitment to safety. (Flin, 2007: p. 662).

The main implication is that management commitment to safety, with its multitude of expressions, is a major factor affecting the success of safety programs in industry (Zohar, 1980). However, there are strong arguments for analysing perceptions of workplace safety at the individual level, and the debate centers on whether these should be described as a measure of climate (Flin, 2007). Grimaldi (1970) argues that safety should be regarded as an integral part of the production system closely related to the overall degree of control management has over production processes, and should create a general administrative control climate in which work is performed. This is often reflected in how management handles delegation of control when dealing with safety functions which is an important feature within high reliability organizations (Rochlin et al., 1987). All too often, management assigns all responsibility to specified safety personnel without delegating to them any executive power (Zohar, 1980; p. 101). This eventually affects shared perceptions of enacted policies and

practices that reveal the true priority of safety against other organizational goals (Zohar, 2003). And this is supported by Flin and Yule (2004) who argue that the behaviors of managers and supervisors, through their collective actions, signal their commitment to safety and the prioritization of safety against other organizational goals, such as: production and cost cutting. In this study, I will focus specifically upon individual perceptions of the leadership's commitment to safety instead of leadership commitment itself, as I will argue that it is the individual perceptions that affect cognitive processes and behavior. This means that the leadership must not only be commited to safety, but they must also communicate this further to their employees through words and actions.

3.7 Summary of theoretical perspectives

In the previous section, I presented a review of the relevant research for the research questions. A summation of the main contributions are listed in Table 3-1:

Table 3-1 Summary of relevant literature

Theoretical background	Specialization	Authors
Organizational change	**Strategic change**	Pettigrew et al., 1989 Rajagopalan and Spreitzer, 1996 Sanchez and Heene, 1997 Aldrich, 1999 Lines, 2004
	New Public Management	Osborne and Gaebler 1992 Reichard 2001
	Planning processes	Elsmore, 2001 Meyer and Stensaker, 2005
	Implementation	Isabella, 1990 Beer et al., 1990 Dunphy and Stace, 1990 Armenakis et al, 1993 Dunphy, 1996 Weick and Quinn, 1999 Beer and Nohria, 2000 Chapman, 2002 Waldersee and Griffiths, 2004
	Timing and pacing	Meyer and Stensaker, 2005
	Mixed-type change	Lawler, 1992

		Emery and Emery, 1993 Dunphy and Griffiths, 2002
	Strategy matching	Greiner, 1967 Miller et al., 1982 Gupta, 1984 Hambrick and Mason, 1984 Miller and Toulouse, 1986 Meyerson and Martin, 1987 Slater, 1989 Govindarajan, 1989 Bluedorn and Lundgren, 1993
	Participative approach	Lawler, 1992 Beer and Nohria, 2000 Chapman, 2002 Lines, 2005
	Attitudes/emotions	Piderit, 2000 Huy, 2002 Dasborough, et al., 2003 Lines, 2005
	Individual reactions	Starbuck, Greve, and Hedberg, 1978 Gopinath and Becker, 2000 Bovey and Hede, 2001 Kickul et al., 2002
Organizational Culture	**Definitions**	Berger and Luckmann, 1966 Smircich, 1983 Pacanowsky and O'Donnell-Trujillo, 1983 Sergiovanni and Corbally, 1984 Schein, 1985 Wilson, 1992
	Typologies	Beyer, 1981 Trice and Beyer, 1984 Van Maanen and Barley, 1984 Handy, 1986 Meyerson and Martin, 1987
	Effects of culture	Geertz, 1973 Zucker, 1977 Ouchi, 1981 Schall, 1983 Schein, 1983

		Burnes, 1996 Chatman and Cha, 2003
	Sub-cultures	Gregory, 1983 Louis, 1983 Van Maanen and Barley, 1984 Nord, 1985 Martin and Siehl, 1983 Brown, 1995
Leadership	**Context of change**	Slater, 1989 Clarke, 1999
	Consensus building	Markóczy, 2001
	Locus of control	Miller et al., 1982 Miller and Toulouse, 1986 Govindarajan, 1989
	Implementation	Meyer and Stensaker, 2005
	Executive commitment	Schein, 1983
Safety	**Grounded theory**	Turner, 1976: 1978 Perrow, 1984 Shrivastava, 1987 Bourrier, 1998 Sagan, 1993 Weick, 1993a: 1993b Vaughn, 1996 Reason, 1990: 1997 Bourrier, 1998 Snook, 2002 Groeneweg, 2002 Gehman, 2003 Johnson, 2004
	Safety Culture	Grimaldi, 1970 Powell et al., 1971 Schein, 1992 Weick and Roberts, 1993 Klein et al., 1995 Glendon and McKenna, 1995 Diaz and Cabrera, 1997 Hopkins, 2006 Guldenmund, 2007
	Safety Climate	Forehand & Gilmer, 1964 Porter and Lawler, 1965 Zohar, 1980

	Hale et al., 1998 Schneider and Gunnarson, 1991 Williamson et al., 1997 Cox and Flin, 1998 Grote and Künzler, 2000 Flin et al., 2000 Neal and Griffin, 2004 Flin, 2007
Perceptions of safety	James and Jones, 1974 Schneider, 1975 Clarke, 1999 Flin and Yule, 2004
Organizational drift	Turner, 1978 Rasmussen, 1994 Vaughn, 1996 Elsmore, 2001 Dekker, 2006
HRO	Rochlin et al., 1987 Roberts, 1990 Weick and Roberts, 1993 Schulman, 1993 La Porte, 1996 Weick, et al., 1999 Weick and Sutcliffe, 2001:2006 Ciavarelli, 2003 Ciavarelli and Crowson, 2004
Mindfulness	Weick, 1995 Weick and Sutcliffe, 2001:2006
Normal accidents	Perrow, 1994
Resilience Engineering	Hale et al., 1998 Amalberti, 2001 Hollnagel et al., 2006

3.8 Tentative Research Model

Based on the research questions, and the results of the literature review, several key latent constructs have been identified that will be used to guide the data collection during the study. The tentative research model is depicted in Figure 3-2:

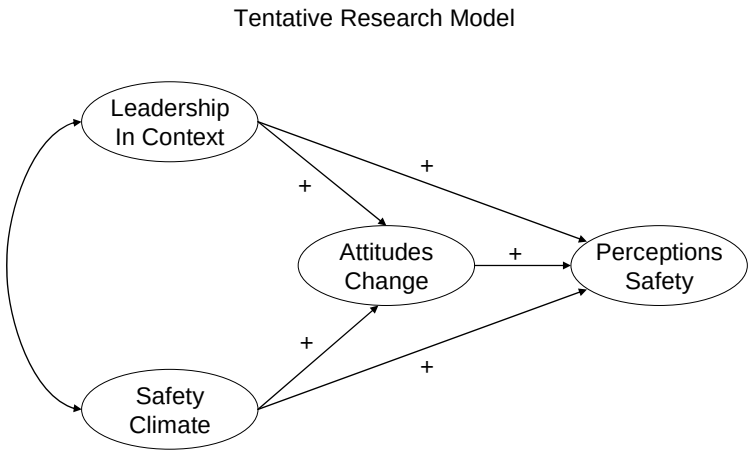

Figure 3-2 Tentative Research Model

This model depicts four latent constructs of interest for this study based on the research questions consisting of two latent independent variables (leadership in context and safety climate), one moderating variable (attitude toward change) and one dependent variable - perception of safety.

3.9 Discussion

Figure 3-2 shows the hypothesized causal relationships between the four latent constructs of interest for this study. It is hypothesized that the each of the three independent variables (leadership in context, safety climate, and attitudes toward change) will have a positive causal relationship to the dependent variable - perception of safety. It is further hypothesized that changes in perceptions of safety will have effects on both individual cognitive processes and behavior.

The literature reflects that leadership, and leadership commitment, in particular, have a strong influence on both attitudes and perceptions in both the change literature and the safety literature. The literature also reflects that safety climate, defined as the surface manifestation of a safety culture (Schneider and Gunnarson, 1991; Cox and Flin, 1998; Hale and Hovden, 1998) also influences attitudes and perceptions but in different ways. In this study, however, I am not interested in the leadership itself, or how they view their own commitment in the

context of change or safety, but more interesting for this study is how individual perceptions of the leadership and the leadership's commitment to safety affect attitudes and perceptions of front-line employees directly responsible for ensuring outcomes that are safe. This also applies equally to the perceptions of the safety climate. This is a departure from the literature and is an area where this study is expected to make a contribution.

3.10 Summary

This chapter has reviewed the relevant research for the processes and concepts central to this study, and the research questions. In particular, I have tried to tie together the key organizational dynamics within a deliberate strategic change process in the public sector that link both the internal and external environments, and addresses the leadership's role in the context of strategic change within a particular type of organization in a high-risk environment. I have argued that these organizations, known as high reliability organizations, have achieved high levels of reliability and consistently safe outcomes from similar organizational structures and strong supportive safety cultures. In addition, I have tried to show how high reliability organizations differ from other types of organizations, and why these types of organizations are interesting to study in the context of strategic change. But I have also shown that HROs are not immune to disaster, and have presented several high-profile failures that demonstrate the difficulty of measuring safety and predicting disastrous events.

The literature review began with a presentation of organizational change as an important area of academic research for this study. I also showed that there is a general lack of academic literature studying deliberate change processes in high-risk industries, and particularly for high reliability organizations. I then presented the review of the organizational culture literature which is even more complex than the organizational change literature with less academic agreement. The next section briefly addressed the literature regarding the leadership's role in the context of change.

The final section of the literature review looked at safety and safety measurement with a particular focus on high reliability organizations. Here I tried to emphasize why measuring safety is so problematic in an ultra-safe environment where unsafe events are rare by design, particularly based primarily on historical events. Nothing to measure often leads to a false impression of the actual state of an emergent safe system, and this can lead to further erosion of safe systems due to reprioritization of resources which is a real threat when safety competes with other highly visible key performance indicators. And, if this is true for stable

environments, then environments exposed to large-scale organizational change must also be affected. Another important issue is the effect of simultaneous deliberate change and evolutionary change that can produce unique and unexpected/unanticipated outcomes. This is particularly true if top leaders leave the monitoring of the implementation process to those directly responsible for implementing the planned change process.

I wrapped up the literature review with a presentation of the key literature contributions considered important for this case study, and finally, I presented a tentative research model to serve as a point of departure for the methodology and the research design, and will guide the data collection process to be described in the next chapter. The four latent constructs in the tentative model were: Leadership in the context of change, safety culture/climate, attitude toward change, and perceptions of safety. It is expected that these broad concepts will be refined and further focused based on the analysis of the data to be collected. The refined model will serve as the basis of the conceptual safety management model presented in Chapter 7 (See page 154).

Part III: METHODOLOGY

In this chapter, I will address the methodological issues of the study, and will briefly cover the research design, research setting, data collection sources and methods, and data analysis.

4 Methodology

In this chapter, I will address the methodological issues of the study, and will briefly cover the research design, research setting, data collection sources and methods, and data analysis. The choice of research design will be presented by first exploring the research problem and the specific design requirements needed to support such a complex study. Next, I will describe the unique research setting presented in this study, as well as, special handling requirements and choices made to address potential bias due to prior knowledge of the company and the industry. I will then examine data collection methods, and discuss the different sources of primary and secondary data gathered, as well as, a description of how these data were collected. Finally, data analysis will be described focusing on the data analysis methods used, and I will address some of the strengths and weaknesses of the research methodology chosen.

4.1 Research design

Yin (2003) describes research design as the "*logic that links the data to be collected (and the conclusions to be drawn) to the initial research questions of the study*" (p. 19). Accordingly, the research design of a scientific study begins with a research question(s), or in other words, a description of the phenomenon to be explained. In this study, there are two research questions that focus on how deliberate strategic change affects safety as an outcome variable in a high reliability organization. The research questions are:

1) How does the interaction between leadership choices and organizational culture type affect attitudes toward deliberate strategic change in a high reliability organization?

2) How do the relationships between leadership actions during strategic change, safety climate in place, and employee attitude toward change, affect safety as an outcome variable?

These research questions, though relatively straightforward and compact, describe a dynamic, real-world problem containing several complex theoretical concepts that have received little prior academic study within a strategic change context.

In addition to clear and unambiguous research questions, a good research design is also dependent upon the availability of existing theory to support the theoretical concepts of interest to the case. As evidenced in the literature review, there is a great deal of research available in all of the specific areas of interest regarding this study but surprisingly little research linking the key concepts of safety, as a latent dependent variable, and strategic

change processes in organizations operating in high-risk environments. This is one area where this study intends to make a scientific contribution.

To accomplish this, this study first aims to examine the phenomenon to be measured, specifically, safety as an outcome variable from a strategic business perspective within a high reliability organization during a deliberate change process. To do this, I will first need to produce a working definition of safety *as a process* in three temporal phases within a complex system that produces safe outcomes, and then to address the difficulties of measuring safety processes in an *ultra-safe* industry relying primarily on historical metrics that only measure unsafe outcomes. The next issue to be addressed are alternative measurement sources based on "*other types of indicators*" (HSLB, 2005: p. 6) that go beyond traditional historical event-based safety metrics. This will include the presentation of a robust safety management system model that depicts safety as an *emergent process* (Hollnagel, 2008) of a complex system in three temporal phases with particular emphasis upon leading indicators that allow business leaders to take preventive actions prior system failures.

As the study also aims to develop an understanding of the dynamics of deliberate strategic change in high-risk environments that are usually characterized by stable, incremental processes, I will investigate the background for why this type of change was attempted, and how the supporting organizational culture reacted to these types of changes. Another important aspect of this study will be to address the leadership's role in the context of deliberate strategic change in a high-risk environment with particular focus on how employees perceive the leadership's commitment to safety, and how the perception of this *commitment* affects employee attitudes toward change. I will also explore how leadership choices made regarding change planning methods and implementation types, moderated by organizational and environmental dynamics, affect attitudes towards change, and, ultimately, how these changes affect perceptions of safety over time.

I have chosen to focus this study upon strategic change within high reliability organizations, not only because this study focuses on one such organization within a particular high-risk industry, but also because many of the specific traits of this type of organization can then be *generalized* to other organizations, both within the civil aviation industry, but also to other industries and organizations with similar characteristics based on the HRO model that might benefit from the findings of this study.

4.1.1 Criteria for design

Based on the research questions, this study requires (a) an identification of the strategic change process initiated in Avinor, as well as, evidence of the planning process and implementation methods chosen, (b) identification of specific leadership actions taken and employee responses during both the change planning and implementation processes, (c) exploration of how organizational culture, as revealed through safety climate, interacted with leadership actions, and how these interactions affected attitude toward the deliberate change process, and, finally (d) an evaluation of how individual perceptions of the leadership's commitment to safety, combined with safety climate, affected attitude toward change implementation, and ultimately, individual perceptions of safety.

Deliberate strategic change, and *frame-breaking* change, in particular, usually involves an extensive planning process which is based on a revolutionary strategic vision or model, and is often contained in a series of formal strategic planning documents (Stensaker, 2002). In some cases, the planning process can take the form of a strategic change project led by an external change agent, as was the case in this study. This process usually takes place over some specified period of time and results in a written plan, or project specification, that identifies: the guiding vision of the organization, the strategic goals of the change process, description of the implementation process itself, short and long-term objectives, important timelines, and other key factors affecting the change implementation process. These documents are often supplemented by formal presentations and/or other types of verbal communication intended to clarify intentions. It is through these documents and other types of communication that I will identify the initial planned strategy for the deliberate change process in this study. However, I must also supplement the written evidence by revealing the thought processes behind the intentions in order to gain an understanding of the underlying motives for change and expected outcomes.

To do this, the research design needs to incorporate both secondary data, in the form of strategic documents, formal presentations and plans, official correspondence, letters, etc., and primary data, in the form of interviews, open discussion, direct participation in planning meetings, and other opportunities to perform both direct and indirect observation. In addition, as the focus of this study is on the effects of strategic change on safety as an outcome variable in a safety-focused organization, there should also be documentation specifying current internal and external safety performance policy, requirements and procedures, training and

certification processes, as well as, the regulatory standards that are to be met and specific procedures to be followed. And finally, I will need a precise breakdown of all the key stakeholders and external actors involved either directly or indirectly in the change process to gain an understanding of the role and influence they might play in the change process.

As this study focuses upon a deliberate change process and its effect on an outcome taking place over a longer time period, I will also need to include a temporal focus into the data collection strategy. This can be accomplished using either time-series data, defined as data collected at certain time intervals, or using a longitudinal approach by collecting data continuously over a longer timeframe (Langley, 1999; Stensaker, 2002). As this study focuses upon the effects of deliberate change on safety over time, which includes the formation of potential latent conditions (Reason, 1997) created during change processes, a longitudinal study is considered most appropriate. However, as I am also interested in measuring the effects on a process over time, specifically safety, I will also need to gather time-series data to support my findings. Furthermore, by collecting data continuously over a longer time period I expect to observe how strategic change interacts with organizational and environmental dynamics. And it is expected that these interactions can affect the key independent latent variables directly linked to perception of safety, specifically, individual perceptions of the leadership's commitment to safety and safety climate.

One fundamental requirement for the study of an actual organization undergoing a change process of this type is access. Direct observation of a deliberate strategic change process in a natural setting is essential for capturing the complexity and the contextual nuances that are affected by the change process itself, as well as, the affects on the performance outcome of interest (Stensaker, 2002). In addition, as this study involves the *specialized* field of civil aviation, it is also important that I either gain through research, or possess through experience, an appropriate appreciation and understanding of the complex phenomenon to be studied, which includes an understanding of the particular culture and special language used within the industry setting being studied. Access to real-time organizational processes in their natural setting represents the greatest challenge for this type of research (Stensaker, 2002).

In this study, I was granted full and unlimited access to the entire organization throughout the period of the study, and I was also invited in as a *participant-observer* on numerous occasions at several different levels within the organization. Participant-observation is a technique that provides unusual opportunities for collecting data, and gave me a unique insight into the

phenomenon being studied (Yin, 2003). In some ways, this means that this study took on some of the characteristics of an ethnography, with all of the advantages and disadvantages provided by this type of study. However, Becker (1958) warns that participation places the researcher in danger of leaving the role of external observer, and this can lead to certain biases, or even worse, force the researcher to assume positions or advocacy roles contrary to good scientific practice (Yin, 2003). Acknowledgement and control of bias formation during this study was a real concern, and an explanation of how this was dealt with will be described in detail later in this chapter (See page 60).

In summation, based on the research questions to be answered and the discussion above, the research design needs to incorporate a combination of both primary and secondary data. The design should also allow for active participation and unhindered access to the organization being studied over an extended period of time, as well as, access to significant internal and external stakeholders involved in the process. This will ensure that relevant and time-critical information can be revealed, and must also allow for the collection of data, over time, in order to provide in-depth information from an actual implementation process in progress.

4.1.2 Choice of design

Following the arguments above, and considering the complexity and dynamic nature of the civil aviation environment, I believe that the most suitable approach for gaining a better understanding of the research problem is to perform a mixed-methods field research study using a single longitudinal case study approach that incorporates both holistic and embedded units of analysis (Yin, 2003). A single case design was chosen for several reasons. The first was practicality. A second case within the Norwegian transport sector was originally considered, however, this was quickly rejected once I discovered the complexity and uniqueness of the Avinor case. In addition, Yin (2003) argues five separate rationales for conducting single case studies. It could be argued that the Avinor case supports all of these rationales in some way. First, the Avinor case is a *critical case* for testing several well-formulated theories based on propositions to be described in a conceptual model in Chapter 7 (See page 154). Second, the Avinor case represents a *unique case* in that Norway is one of the early movers within an international corporatization initiative, and is, therefore, of interest to those that follow. Third, the Avinor case is a *representative case* of a safety-focused organization within a high-risk industry undergoing a deliberate change process. Fourth, the Avinor case is a *revelatory case* in that access to the process allows me to observe, analyze

and report a process and result that has been previously inaccessible to scientific investigation. And fifth, and most importantly, the Avinor case must be studied using a *longitudinal* approach over an extended time period to observe how change processes affect outcomes over time (Yin, 2003: p. 42).

The case study approach is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt, 1989), or can involve either single or multiple cases, and numerous levels of analysis (Yin, 2003). Case studies typically combine data collection methods such as archives, interviews, questionnaires, and observations, producing both qualitative and quantitative data, where the combination of data types can be highly synergistic (Eisenhardt, 1989). A combination of data collection methods, as discussed earlier, seems most appropriate in this study, however, the primary focus will be on qualitative methods where I want to uncover and understand a phenomenon about which little is known (Ghauri and Grønhaug, 2002). However, as there is also a significant amount of quantitative data from different sources directly related to the research questions, I intend to use both types of data to triangulate results in order to gain a stronger foundation to support the findings (Langley, 1999). Jick (1979) argues that *organizational researchers can improve their judgments by collecting different kinds of data bearing on the same phenomenon* (p. 602), and Sieber (1973) goes even further by proposing that field methods can contribute to survey analysis with respect to validation of results, an area that I will address in detail later in this chapter (See page 84). It is also hoped that through a better understanding of the causal relationships between various organizational dynamics imbedded within a deliberate change process, I will be able to contribute new knowledge in how to better match deliberate change methods with specific cultural settings within high reliability organizations, and hopefully contribute with new theory in this area.

4.1.3 Handling potential bias

One of the key issues addressed early in the study was the handling of potential biases due to the nature of human behavior, and my personal familiarity with the industry, including: prior experiences in aviation operations; prior experience as a top leader responsible for strategic organizational change; and particularly, prior experience and longstanding personal relationships with several individuals within the company chosen for this study. Hogarth (1991) explains that bias in information acquisition can be conceptualized by enquiring when and why information becomes salient to an individual, and can be accessed from two sources:

(1) the individual's memory; and (2) the task environment (P. 209). As I have an extensive aviation background, with over 15-years of operational aviation experience, it was clear that many of the observations made during this study triggered comparative memories from previous experiences. However, I have also been a top leader responsible for several strategic organizational change processes similar to the Take-Off 05 project, and this study also triggered memories from a specific leadership paradigm, which were, in many ways, even fresher in memory than operational experiences. These experiences proved extremely valuable in helping me to understand the main issues related to change, and the individual experiences related by the participants in the study from both a leadership perspective, but also from the operational perspective. However, these experiences were also acknowledged as potential sources of bias from both perspectives, and this was a danger addressed early, and often, throughout the study. One area of particular concern was to consider ones own "*experiences to be 'normal', and thus to make erroneous attributions in judging the deviant behavior of others*" (Hogarth, 1991). These potential biases were addressed already in the first meeting with my main academic advisor, and became an integral part of the research design from the early stages. This topic was also discussed regularly during the study with all three of my academic advisors. And the handling of potential biases was also a recurring topic of discussion between me and other academic forum, as well as, external stakeholders. One positive aspect of my experience was familiarity with the complexity of the aviation environment, the aviation language and technologies where other researchers would either struggle, or more likely fail to fully grasp the intricacies of complex operation situations.

One of the most difficult issues related to potential bias, and the research design, was how to handle on-going professional relationships with friends and colleagues embedded within the case. The researcher's personal experience with Luftfartsverket, and then later with Avinor, began already in the late 1970's. These engagements were primarily as a military liaison responsible for military operations in Norwegian national airspace, but also as the director of a company providing consulting services to Avinor. Through these engagements, I established and maintained numerous personal relationships with employees at all levels within the Avinor organization, and also with key stakeholders within the civil aviation industry directly related to the case. In addition, my spouse is an air traffic controller at Norway's second busiest airport, and a part of the Avinor leadership structure. All of these issues were addressed directly with Avinor's Chief Executive Officer during a private meeting at the beginning of the study. In particular, a research design was presented that took these potential

biases into consideration, and the handling of these potential biases were discussed at length. The result of this discussion was full acceptance of the research design by the CEO, and full support and unrestricted access to the company records and personnel during the study.

4.2 Research setting

The research setting for this study is the Norwegian Air Navigation Services Provider (ANSP) Avinor during a complex strategic change process known as corporatization. This is considered an interesting case in that the corporatization initiative is a contemporary phenomenon (Yin, 2003) being implemented on a universal scale within the international civil aviation industry, but where individual nations, alone, are responsible for both the corporatization model chosen, as well as, change design, implementation, and timing (ICAO, 2002). This is also a case that contains social dramas, and the public inquiries they produce, giving me a unique opportunity to look inside a previously shielded social system (Pettigrew, 1990), and to gain new insights into organizational behavior.

Avinor was chosen as a single-case scenario in that it is considered an extreme case, and that the case is revelatory (Ghuari and Grønhaug, 2002). In this study, I will initially focus upon a single case (Avinor), where four imbedded sub-cases have been chosen for comparative purposes. The reasoning behind the individual selections for the imbedded case design and selections will be described in detail later in this chapter (See page 66). The case study approach is believed most appropriate in that I have little control over the events, and the focus is on a current phenomenon in a real-life context (Yin, 1994).

One of the areas of focus for this study will be to gain a better understanding of the operational environment in which Avinor operates, the role of various stakeholders within and outside the organization, and their influence upon the strategic change process, and to map the causal relationships between strategic change, organizational dynamics, and safety as an outcome variable. It is through these causal relationships that I hope to find links between leadership actions taken and affects on attitude toward change, and how these affect perception of safety as an outcome. Due to the complexity and dynamic nature of the civil aviation environment, and the numerous stakeholders directly involved in the strategic change process, a combination of research methodologies will be used to gather data.

4.2.1 Avinor

Avinor is a high reliability organization within the high-risk civil aviation industry, and is responsible for the safe and efficient control of civil and military aircraft within the Norwegian national airspace. In addition, Avinor is responsible for the management and security of 45 national and regional airports, and associated national civil aviation infrastructure located throughout Norway (Avinor Corporate Handbook, 2004). Avinor is a complex company providing many diverse services to a broad customer base ranging from individual passengers to national and international airlines, and is also responsible for provision and maintenance of the national air navigation services infrastructure. Avinor delivers a wide spectrum of aviation-related services including: approach, departure, and transit radar services and control, ground services, snow clearance, aircraft de-icing, and weather reporting to domestic and international airlines. Avinor also provides airline customer-related services ranging from airport hotels, parking and food services, baggage handling, and physical security (Avinor Corporate Handbook, 2004). In this study, I follow Avinor through an extensive, deliberate strategic change process known as corporatization described earlier, which includes: a new business model (from state-run management organization to 100% State-owned private company), a total reorganization of its leadership structure, significant downsizing in personnel to increase efficiency and reduce costs, adoption of a new safety management system, and introduction of new technologies. All of these changes take place over a relatively short time period contained in a results improvement program called Take-off 05. The stated goal of the Avinor leadership was that all of these activities were to be accomplished "*without any reduction in air traffic safety, without the closing of any airports, and without reduction in customer services*" (Avinor Press Statement, 4 Dec 2003).

Avinor, as an air traffic management organization, fits nicely into the high reliability organization paradigm as it is responsible for the safe and efficient coordination of civil and military air traffic within Norwegian airspace, as well as, operations from Norwegian aerodromes, with safety as its stated highest priority. Responsibility for air navigation services is a very simplified description of what is, in effect, a major national infrastructural resource which acts as an integration point within the overall national transport system that links to high speed rail and key road networks (Graham, 2003). In addition, Avinor itself provides only a fraction of the overall services available within the civil aviation industry, so they represent an essential part of a larger integrated system. However, as the coordinating link

between the infrastructure and the users, Avinor's role as service provider takes on an increasingly important role. The other key players vitally linked to Avinor include: airlines, handling agents, government bodies, concessionaires, and other types of specialized organizations (Graham, 2001). All of these players have varying degrees of interest in the safety and security requirements provided by Avinor, and have a direct interest in the corporatization process mentioned earlier.

As this study is focused upon safety as an outcome variable, I have chosen to focus this study primarily to those portions of Avinor providing direct air navigation services and infrastructure that supports air traffic management, specifically the interface between the air traffic controllers, and ATC assistants, with ground personnel and aircraft.

4.2.2 The corporatization decision

Initial discussions for transforming the Norwegian government-administered civil aviation organization (Luftfartsverket) into a state-owned, private company were first debated by the government in early-2000 (S. nr. 13 – 2001-2002). However, due to a disagreement between several parties as to the actual corporate form and timing of the transition, the decision to initiate the change was shelved until an unspecified future date. The debate was later revisited in the Transportation Budget Committee (Fall 2001) during discussions addressing the deteriorating economic results within Luftfartsverket during the 2001-2002 budget debate (S. nr. 13 – 2001-2002). It was also noted that the deteriorating economic conditions were not just limited to Luftfartsverket, but that the economic situation within the entire civil aviation industry was considered *serious* with particular reference to 911 as a contributing factor for reducing revenues, and future uncertainty for the industry. Based on these discussions, the committee made reference to a previous proposal by the Labor, Socialist Left, and Center parties, that:

> "*The parliament requests the (ruling) government conduct a review of Luftartsverket's economic results, and evaluate the need for addition appropriations or other measures in 2002 based on Luftfartsverket's rather uncertain income basis. The evaluation should also include the relationship between the administration and business form of Luftfartsverket*." (S. nr. 13 – 2001-2002, p. 37)

During the discussions regarding the organizational form that was best-suited for a company whose primary responsibilities included: building, owning and managing airports and civil aviation infrastructure, in addition to, the business principles for providing airport and air

navigation services to airlines and other customers, the majority of parties believed that the government-administered form was the least effective possible, and also potentially problematic in a deteriorating civil aviation environment (S. nr. 13 – 2001-2002). Instead, the majority preferred, and recommended, that Luftfartsverket be converting into a private, state-owned company, that would provide many advantages for the new company that were not available in the current form. In particular, the private company would have access to financial resources, and would allow a longer time perspective for planning and predictability (S. nr. 13 – 2001-2002, p. 36). The decision to initiate this transformation was issued in a subsequent budget session (St.prp. nr. 1 Tillegg nr. 2 (2002-2003)). Avinor became a state-owned, private company effective on 1 January 2003, and this event was chosen as the starting point for this study. The study followed the company over a 3-year timeframe leading up to the eventual collapse of the deliberate strategic change project known as Take-Off 05 in December 2005.

4.2.3 The planned strategy: Take-off 05

The need for change was realized already in 2002, but the change initiative did not commence before the new company was formed in 2003. Take-Off 05 was the name given to the results improvement program initiated shortly after the official establishment of Avinor, with a pre-project phase commencing already in February, 2003. The official Take-Off 05 project *kick-off* took place on 19 March 2003 (Take-Off 05 Design Phase Report, 2003). The need for such a program was based on economic results within the company being reduced by almost 50% over the previous three year period due to reduced traffic income, and a real growth in operating costs of 4-6% per year. In addition, there were 1.2 BNOK in overdue maintenance requirements, and low investment levels for maintaining value, and further development of core activities (Report Take-Off 05, 2003).

The project was divided into three distinct phases: analysis phase, design phase, and implementation phase (Report Take-Off 05, 2003). The stated objectives for these phases were: to define potential savings, design solutions, and to implement decisions. The program's objectives were based on a *zero-point* for improved results based on economic results posted on 31 Dec 2002. The project was touted as a participative effort between the leadership and the employees:

> "*a large number of employees have been involved in the process by laying a foundation, submitting ideas and discussion*" (Report Take-Off 05, 2003)

The first official phase of the Take-Off 05 project was the analysis phase. During this phase, working groups formulated potential savings measures within eleven sub-categories within the company (Report Take-Off 05, 2003). Participation in the project was described as such:

> "*Avinor has a comprehensive cooperation model with both the employees and the employees' official representatives. These methods were also used in connection to the results improvement program. The program has also worked out its own communications plan both for the program in its entirety, but also for individual sub-projects. The employees and employee representatives were invited to submit ideas and recommendations during the entire process, and the central employee representatives will have regular meetings with the program leadership and project groups underway. There has been a great deal of engagement evident and a large number of improvement suggestions from employees from the entire country* (p. 4).

At this point in the change process, all seemed well with no real indications of difficulties ahead. And this is where the story begins.

4.2.4 Internal cases

Due to the complexity and diversity of the various business units and areas of interest within the Avinor case, and in order to gain a cross-sectional view of the change process with specific effects on flight safety, three imbedded cases within the air navigations services division were originally selected as the basis for this study. The individual cases initially chosen for the study were three large regional airport complexes providing full air navigation services including tower/approach and national airspace transit services, and represented east, southwest and northern Norway. The airports selected were the Oslo (Gardermoen/Røyken) complex, the Stavanger airport (Sola), and the Bodø airport in northern Norway. The reasoning for choosing these locations was similarity in size and functions provided, and the fact that these three locations also included an Air Traffic Control Center (ATCCs) responsible for control of national airspace transit activities. The fourth national ATCC (Trondheim) was not included in the initial focus of the study. Norway's second busiest airport (Flesland, Bergen) was intentionally excluded from this study due to potential bias implications discussed earlier.

4.2.4.1 Case A

Oslo Airport Complex (Gardermoen/Røyken). The Oslo airport (Gardermoen) is an independent daughter company of Avinor with around 600 employees (Avinor Corporate

Handbook, 2004). The Oslo Airport, located about 60 miles outside of Norway's capital city Oslo, is Norway's main link to the international market, and Norway's busiest and most profitable airport. Gardermoen is slightly different from the other cases chosen in that radar approach services, and upper level transit services provided by the Oslo Air Traffic Control Center are located at a remote location in Røyken, Norway. Røyken was considered the most modern ATCC facility in Norway during the period of this study, and had been relocated to this site from the Fornebu airport, Oslo in 1996.

4.2.4.2 Case B

Stavanger Airport (Sola). The Stavanger Airport, located outside Stavanger, Norway is a large category airport which supplies regional radar coordination and air traffic services to western Norway, conducts both domestic and international traffic, and supports significant helicopter activity serving the North Sea Oil Industry. The Sola airport is also the site for Norway's southern most ATCC.

4.2.4.3 Case C

Bodø Airport (Bodø, Norway)**.** Bodø is a large category airport, and the largest airport in northern Norway, and was also chosen to be the location for the consolidated ATCC site which subsumed the ATCC services formerly provided from Trondheim, Norway. In addition, Bodø is the home for the nation's most active military air base, and also the new site of the headquarters for Luftfartstilsynet, the governmental oversight organization responsible for monitoring safety performance of Avinor.

4.2.4.4 Case D

Trondheim ATCC (Trondheim, Norway). The Trondheim ATCC was not an original part of the study. This ATCC was one of four ATCCs in Norway before the Take-Off 05 project was put into effect. The decision to close this ATCC, and the follow-on effects of both the decision to close this facility and the manner that the move to Bodø took place, had significant consequences both for the organizational climate in the Bodø ATCC but also proved vital for understanding much of the animosity and conflict that develops during the study.

4.2.5 Imbedded case adjustments underway

The study initially focused only upon Tower, Approach and Air Traffic Control Center (ATCC) facilities located at each of the original selected sites (Bodø, Oslo and Stavanger), and included the air traffic controllers, air traffic control assistants, administrative staff, the supporting leadership structure within the Air Navigations Services Division, as well as, Avinor's top leadership. However, early in the study it became evident that even this selection was too broad, and the study was further reduced in scope to include only the four original Air Traffic Control Centers (Trondheim, Bodø, Stavanger, and Oslo), the leadership structure supporting these units, and the planning/decision and implementation processes within the Take-Off 05 project to reduce the number of ATCCs in Norway from four to two centers.

This was done for several reasons. First, it was obvious after the first round of informal visits, and the results of the semi-structured interviews, that there were significant differences between the tower/approach facilities and the ATCCs, both in regards to operational duties, organizational sub-cultures, and operational demands placed on these co-located facilities. But second, and more importantly, as the study developed it was clear that the implementation processes related to the decisions taken for reducing of the number of ATCCs were the most interesting processes to follow considering the research questions, and that the change processes affected the ATCCs in significantly different ways than the corresponding tower/approach facilities. It was also clear that it was these units that were most likely to experience dramatic affects on safety processes directly related to change processes.

During the main participative portion of the study, only three ATCCs were in operation (Bodø, Oslo, and Stavanger). Yet despite the similarities in size and functions of these three sites, they still varied significantly in their exposure to the change processes as they were each involved in a different phase within the same change process. The Bodø and Trondheim ATCCs had been merged into one unit (Bodø ATCC) during the early phases of the study, and midway through the study, the decision was made to close down the Oslo ATCC (Røyken), and merge this unit with the Stavanger ATCC (Sola). Criteria for the revised choice of design will be addressed in more detail later in this chapter (see page 78).

4.3 Data collection

This section deals with how data were collected, and how collection sources and methods were revised during the course of the study to accommodate unexpected interruptions in the

original research design. As already discussed, the research design chosen required both primary and secondary data over an extended period of time to support the study. There was also a mix of real-time and retrospective data gathered during the process, and particularly, after the Take-Off 05 project was officially terminated in the early-spring of 2006. The data was collected in four ways:

1) Archival data
2) Observations
3) Surveys
4) Interviews

The original research design for gathering safety climate survey data based on the results of semi-structured interviews was revised midway during the study when a sudden *storm* of negative media coverage within the civil aviation industry caused the Norwegian government to react by tasking the Norwegian Transportation Safety Board (HSLB) with conducting a short study of whether the effects of organizational change over the previous 5-year period had affected safety within the civil aviation industry. Fortunately, I was granted access to the results of this study by the Ministry of Transport even before the study commenced, and was invited to discuss and compare the goals of the my study and the industry study with the HSLB study team. The results of the industry questionnaire conducted in the study by the Norwegian Transport Economic Institute (TØI) proved to be of high academic quality and directly relevant and aligned with the focus of this study, and these results were used in place of the originally planned survey.

4.3.1 Pre-study activities

Data collection commenced unofficially in January, 2004 when I contacted and presented a rough outline of the primary focus of the study proposal to the Avinor Safety Director. During the period from this introductory discussion until the official acceptance of the study, in December, 2004, I gathered open source data from international civil aviation agencies, such as EUROCONTROL and CANSO (Civil Air Navigation Services Organization), to gain an understanding of the corporatization process, and also researched relevant academic literature and prior studies addressing both strategic change and safety in high risk environments. In addition, individual presentations of the study proposal were given to key external stakeholders considered important for the study, including the Norwegian civil aviation regulatory agency (Luftfartstilsynet), the Norwegian Transportation Safety Board (HSLB),

and the Ministry of Transport (Samferdselsdepartementet) to solicit input and support for the study. These organizations were also helpful in suggesting improvements for the research design, and identifying key informants within the civil aviation industry in Norway to support the study.

I then contacted the Chief Executive Officer of Avinor in August 2004, and was granted the opportunity to present the study proposal to the Safety Director, and the Director of the Air Navigations Services Division in September, 2004. I was subsequently invited into the Avinor headquarters to present the study proposal to the air navigation services division's working environment representatives group (DAMU), who would ultimately accept or reject the study proposal. The study was presented as an independent research initiative funded by the Norwegian School of Economics and Business Administration (NHH) in partial requirement for my PhD studies. It was made clear to DAMU that this study was not being conducted at the request of the Avinor leadership, and that Avinor would not be funding the study, nor would Avinor have any influence or editorial rights over the findings. The response from the group was extremely positive, and although one middle manager mentioned that the study was considered *"dangerous"* by some within the leadership group, the study was officially accepted on 15 December 2004.

4.3.2 Primary Data

4.3.2.1 Orientation visits

The Avinor study officially commenced with an extensive round of orientation meetings and presentations from the Avinor top leadership. Here I was presented a broad overview of Avinor as a company, its role within the civil aviation industry, and the Take-Off 05 project. The orientation included presentations covering: the history behind the transition from Luftfartsverket to Avinor, the current situation and the reasoning behind the need for deliberate organizational change, the new organizational structure, the corporate vision and strategy, Avinor's Safety Management System, and the Take-Off 05 project. All of these presentations were presented by the individual leaders personally responsible for the topic covered, and included: the CEO, the Director of the Air Navigations Services Division, both the Safety Director and Safety Manager, and each of the four leaders responsible for the main operative sub-divisions within the air navigation services division. The presentations were all very professional and informative. Discussions during the presentations were open and frank, and I found that all of the top leadership were supportive of the study. It should be reiterated

that I was granted full, open and unrestricted access to all Avinor personnel and documentation during the study, and this proved to be true, even during the most volatile events leading up to the Take-Off project collapse. In addition, the CEO announced the study on the corporate intranet site, which described the focus of the study, provided a photo and biography addressing my background, and expressed the full support of the leadership for the study.

The next phase of the study included 3 separate site orientation visits (Bodø, Stavanger, and Oslo/Røyken). These visits were designed to introduce me to the leadership and personnel at the individual sites, and also so that I could become familiar with the various working environments in which I would be studying. These visits were very important for gaining a better understanding for the operational demands on safety during the change process, as well as giving me a first look at the general impressions at the individual level of the Take-Off 05 process. My focus was to learn how individual impressions of the change process were affecting safety processes in order to improve the research design. During these visits, I spent a great deal of time observing operations and becoming familiar with the level of technology used at each site, and gained an overall understanding of the operating environment, working conditions, and the general workload at each site. These site visits proved invaluable and enabled me to gain outstanding insight into some of the different viewpoints held about the change process from different levels of management, as well as, helping me to gain an understanding of how the Take-Off 05 project was affecting safety at the operational level. These insights proved instrumental in designing the semi-structured interviews.

4.3.2.2 Interviews

The most important source of information for understanding how employees experienced both the change process, and perceptions of safety during the Take-Off 05 process came from the individual interviews. However, one particular issue, revealed early during the orientation phase of the study, was the general scepticism by operative personnel of *external consultants* representing what they considered the management's interests. They used the term *studies for hire* which indicated that those collecting the data were doing so to collect data to support a specific, predetermined finding, and not necessarily open for other views. In addition, many of the employees complained that they had been saturated in recent months by a steady-stream of consultants and government agencies conducting interviews and surveys where the questions being asked did not make sense nor reflect the context within which they were

working. To address these issues, a great deal of effort was expended to create both an understandable and useful interview protocol focused on the actual working environment, and also clarifying my role as an independent researcher in the context of the study. A copy of a sample interview protocol used in this study is attached in Appendix A (See page 209).

The interviews were designed to gain a general understanding of how the employees' viewed safety and safety culture in Avinor in the context of strategic change based on the academic literature in these areas of interest. The interviews explored how employees had experienced the organizational change process, their role in the process, and how the various change processes had affected both their perception of safety, and perceptions of the leadership's commitment to safety during the change process. The interviews focused primarily on the five areas of safety climate as described by Zohar (1980): management attitude toward safety, importance of safety training, communication and contact between workers and management, general environmental control and good housekeeping, and perceived risk levels. The interview protocol was then reviewed for content and language by two experienced air traffic controllers located at a unit outside of the cases of interest.

The interviews were semi-structured in nature, and were based upon the research questions and the key constructs in the tentative safety measurement model presented in Chapter 3 (See page 51). All interviews were conducted in Norwegian. Questions were open-ended in order to allow interviewees to expand on important issues, as well as, to potentially reveal new areas of interest. Each interview process began with a short description of the purpose of the study with particular emphasis on the research objectives, and an explanation of how the interview data would be used. I then gave each interviewee a presentation of my aviation background and experience, the academic institution that I represented, and described my role as a neutral, academic researcher. Clarifying my professional and academic background before the interview proved to be an important aspect of the interview process as it instilled a sense of neutrality in the research being conducted during a period of intense scepticism by the employees that all external actors were paid consultants. This was then officially reflected in a signed Study Interview Contract with a copy provided to the interviewee (Appendix B, see page 211). Providing an interview contract seemed to satisfy the interviewees that this study was potentially different than others, and in several cases, there was a noticeable change in body language and tone after the letter was signed and presented.

Interviewees were, for the extent possible, randomly selected to include a mix of leaders (chief air traffic controllers, heads of training, shift supervisors, and union representatives), air traffic controllers, air traffic controller assistants, and administrative personnel in order to gain a balanced view of the planned change from several perspectives, as well as, to observe results and impressions of safety performance from different levels. The only exception to the random selection criteria was that each chief air traffic controller was asked to participate. Each interview took between 60-90 minutes, and all were digitally recorded with the interviewee's consent. A total of 60 interviews were planned (20 at each original site) over a 3-month period (one week at each site). However, during the final week of interviews, the CEO of Avinor suddenly resigned, and only 17 of the planned 20 interviews at Røyken were conducted. This was not considered critical as two of the missing interviews were Chief Air Traffic Controllers (neither of which responsible for an ATCC), and one Oslo approach controller due to lack of manning. As will be discussed later, none of these missing interviews were relevant to the final research design.

4.3.2.3 Participant-observation

I was also invited to observe and participate in regularly scheduled leadership meetings within the air navigation services division, and included, among others, a strategy group meeting focused specifically on identifying the existing organizational culture, and how to produce a long-term plan for implementing changes to the organizational culture in place. These opportunities were particularly informative as most gatherings included both top and middle managers, but also had employee and union representatives as working members. The dynamics in these groups were open and often mildly adversarial, and revealed a great deal about the internal tensions within the company. In addition, I was invited in regularly to present study updates to various levels of the Avinor leadership, including the top management team.

4.3.2.4 Key informants

The use of key informants proved to be an extremely useful and important source of data, both for gaining an understanding of the historical background behind individual decisions and events, but also to verify data, and for gaining different perspectives for understanding how events transpired. However, as argued by Van de Ven and Huber (1990) using participant informants introduces a set of problems of identifying the best informants and ensuring that they correctly understand the investigator's queries, and that they provide

veridical answers. This was dealt with, partially, by using several different key informants from each internal and external stakeholder grouping, as well as, representatives from middle and top management to ensure a more balanced view of stakeholder interpretations of events. In addition, most of the key informants provided additional contact information for subject matter experts for different issues that came up in discussions.

4.3.3 Secondary data

The Avinor case proved to be extremely rich in secondary data. Most of this data was either discovered directly through various internal sources, including the Avinor database, or requested officially through the leadership. However, there was also a great deal of secondary data volunteered directly from other sources, including: individual employees, union representatives, middle and top leaders and managers, as well as, external stakeholders and regulatory agencies. Sometimes this turned out to be potentially problematic as the data came from diverse stakeholders, all with special interests and biases toward the outcome of the study. This meant that each piece of data had to be evaluated individually based on its source, and screened for the potential bias inferred by the data provided. Data that proved potentially interesting for the case was followed up, both with the source, but also with other stakeholders and key informants that might provide balancing views of the importance and relevance of the data. One benefit gained from these unsolicited sources of data was that they often revealed areas of contention within the organization for further investigation, and added richness to the archival data.

For this study, I have categorized the secondary data collected into three primary types: archival data, anecdotal data, and third-party generated surveys. Archival data is historical in nature, and was used primarily to chart the historical background behind the deliberate change process, to document the planning processes and eventual plans that were generated during the analysis and planning phases of the Take-Off 05 project, and to fine-tune the research design. Data of this type included: the Avinor Corporate Handbook, the company strategy document, and the individual Take-Off 05 Phase reports. Other forms of archival data included documents that set operational standards, safety, or external evaluations of Avinor during the change process. These documents included: EUROCONTROL Standards and Procedures documents, Avinor's Safety Management System, and external reports from Det Norske Veritas, the Norwegian Transportation Safety Board (HSLB), and the Booz Hamilton Report. Anecdotal data came in the form of official letters, PowerPoint presentations, meeting

minutes, emails, official correspondence, and internal periodicals, particularly the Avinor official internal publication Bakke Kontakt (Ground Contact), and the Air Traffic Controllers official publication Flygelederen (The Air Traffic Controller). In addition, there were over 200 articles from national and international news media, as well as, several high profile television news broadcasts.

4.3.3.1 Third-party surveys

Two separate third-party generated surveys were conducted during the timeframe of the study. The first set of survey data came from an internal leadership and environment questionnaire contracted by Luftfartsverket, just prior to its transition to Avinor in the fall of 2002, and was repeated in the fall of 2004. This questionnaire was designed and administered by the external commercial consulting firm Humetrica. These data were particularly helpful in that they focused upon local and top leadership issues, and were useful in identifying employee perceptions of the leadership at different levels within the organization, as well as, changes within the local work environment, at two distinct timeframes important to the study. These data were a valuable source of measuring the employees' overall perception of the leadership's commitment to safety in the context of change. In addition, the first round of the survey included responses from the Trondheim ATCC, which, as explained earlier, was later merged with the Bodø ATCC, and allows across-case comparisons of the two groups before, and after the consolidation process was implemented.

The second set of survey data came from the Norwegian Ministry of Transport-initiated study entitled "*Safety in Norwegian Civil Aviation during Change Processes*" (HSLB, 2005), and was chosen to replace the originally planned safety climate survey for reasons explained earlier. Access to these data was provided by the Norwegian Ministry of Transportation. The data was in the form of an expanded safety climate survey obtained in cooperation with the Norwegian National Transport Safety Board (HSLB) and the Norwegian Transport Economic Institute (TØI) in response to a tasking by the Norwegian Minister of Transport (Ministry of Transport letter dated 7 Oct 2004). The purpose of the study was to investigate the effects of organizational change on safety levels within the Norwegian civil aviation industry over the previous 5-year period. Quantitative data were collected using structured questionnaires sent via post to the individual respondents, but the questionnaires could also be filled out electronically via the Transport Economic Institutes (TØI) webpage using an individually controlled password (TØI, 2005). The objective of the safety questionnaire was to test the

perceptions of safety among eight professional groupings within in the Norwegian civil aviation industry (Air Traffic Controllers/ATC Assistants, Pilots, Luftfartstilsynet, Aviation Leaders, Cabin Crew, Planners and Engineers, Ground Personnel, and Mechanics/technicians), and the relationships between organizational culture, organizational change, and the leadership's role in the context of change, specifically, the leadership's focus on safety issues in a changing environment (TØI, 2005). Although I had access to the entire survey data set, only the responses from the Air Traffic Controllers and Air Traffic Controller Assistants were used in this study.

Of the total population of 639 air traffic controllers/assistants that received questionnaires, 422 responded for a response rate of 66 percent. Dependent and independent variables were measured using multi-item measures based on a 5-point Likert scale, and included both positively and negatively worded formulations. The questionnaire was created using a composite of questions forming modules from corresponding international civil aviation databases, as well as, specific interest areas requested by the Norwegian Transportation Safety Board. Questions pertaining to safety climate were taken primarily from the Global Aviation Information Networks (GAIN) "Operator's flight Safety Handbook" (GAIN, 2001), and Questionnaire on the Reporting of Errors and Incidents: ATCOs Attitudes and Perceptions (Boje-Andersen, 2003).

4.3.4 Data collection sources and timing

Table 4-1 illustrates the sources, levels and timing of the data collection process during the official study period.

Table 4-1 - Data Collection Timetable

	Interviews	**Survey**	**Observations**	**Archival Data**	**Timing**
Corporate Level	3		8	100+	Contact establish Jan 2004 Intensive data collection Oct 2004 – Dec

					2006
Case A (Oslo) Chief Air Traffic Controllers, Air Traffic Controllers, ATC Assts and Administrative personnel	17	3	5		First visit Mar 2005 Interviews Dec 2005 Leadership Survey administered Fall 2002/Fall 2004 Safety Survey Spring 2005
Case B (Stavanger) Chief Air Traffic Controllers, Air Traffic Controllers, ATC Assts and Administrative personnel	20	3	4		First visit Mar 2005 Interviews Nov 2005 Survey administered Fall 2002/Fall 2004 Survey Spring 2005
Case C (Bodø) Chief Air Traffic Controllers, Air Traffic Controllers, ATC Assts and Administrative personnel	20	3	2		First visit Mar 2005 Interviews Nov 2005 Survey administered Fall 2002/Fall 2004 Survey Spring

					2005
Total	**60**	**3**	**19**	**100+**	

The interviews annotated in Table 4-1 reflect planned interviews that were actually conducted where the interviewees knew they were being interviewed for content, and had corresponding interview protocols, and were recorded digitally. The table does not reflect the numerous informal conversations, key informant contacts, or discussions conducted during site visits. These discussions were recorded in a field journal. Each site visit and observer participation opportunity generated follow-up contacts for both verify information presented within these settings, or to further investigate areas of interest. The observations category reflects actual planned official site visits, or one-on-one opportunities with Avinor personnel in official settings, such as divisional leadership meetings. Many of these meetings were held at the top leadership level within the air navigation services division but always included employee representatives. Most of the data collected during the interviews and observation opportunities were real-time in nature. This allowed me to experience actual cultural dynamics in group settings. There were also many unannounced visits where I happened to be in the vicinity of a unit for some other reason, and popped in to simply maintain contact and to discuss issues of importance for the respective site.

Archival data was collected primarily during the official kick-off meeting at the Avinor headquarters on 3 February 2005, followed by 3-days of introductory presentations by the Avinor corporate leadership. However, several subsequent visits were conducted to review Avinor board minutes and to gain access to the Avinor internal database. The leadership was extremely helpful and forthcoming with all documents requested, and were also proactive in providing extra documents that they considered important for the study. It should be mentioned that most of the archival data collected during this study came in electronic format, and this proved very helpful, not only during he analysis phase, but also in formulating modifications to the research design, and design of the interview protocol later in the study.

4.3.5 Criteria for choice of cases

When using a case study approach, it is important to choose cases that are both interesting, relevant, and are clearly defined operationally (Yin, 2003). It is also important that the researcher is open for modification of the case design if the original focus proves to be

misguided or poorly focused. In this study, the initial choice of cases, described earlier, proved to be too broad, and this became increasing clear after the initial round of interviews revealed that the individual cases were, in fact, bundled units that where not only different in operational tasks, they also possessed distinct individual unit sub-cultures. They also had different leadership lines of authority, and differed in how they experienced the Take-Off 05 process. This was mainly due to the fact that tower/approach units have distinctly different tasks than ATCCs, but also because the change process was distinctly different for these units. In addition, as events unfolded during the study, it became increasingly clear that the most interesting embedded cases for the research question were the four original Air Traffic Control Centers, and the planning and implementation processes and decisions involving these four units that led to internal conflict, and the eventual collapse of the Take-Off 05 project. This will be discussed in more detail in the data analysis section.

Narrowing the focus of the study to the four embedded cases described above was a deliberate decision that meant that only 10% of the entire Avinor employee population base was represented in the embedded case portion of the study (288 out of 2853). However, this group represented 45% of the total Air Traffic Controller and ATC Assistant population (288 out of 639) which collectively represented 22% of the entire Avinor population base. The entire ATC and ATC assistant population base was used in the safety measurement model presented in Chapter 7. This choice meant that the remaining 78% of the Avinor population was excluded from the study. But as explained earlier, most of this remaining population were not directly involved in the safety processes of interest for this study.

4.4 Data analysis

Data analysis is the process of identifying, classifying and reducing data into manageable and understandable units. However, as I am studying events that took place over an extended time period, I also need an explanation of temporal order and sequence in which a discrete set of events occurred based on a story or historical narrative (Abbott, 1988). In the Avinor study, I am dealing primarily with process data where I am concerned with understanding how things evolve, over time, and why they evolve that way (Langley, 1999). Process studies are fundamental to gaining an appreciation of dynamic organizational life, and for developing and testing theories of organizational adaptation, change, innovation, and redesign (Van de Ven and Huber, 1990). Van de Ven and Huber (1990) also address the issue of astronomical accumulations of data gathered during studies conducted over time. But Huberman and Miles

(1983) warn that problems of data overload, and the requirement for structured understanding, are not reducible just to questions of data reduction and display. And this was also a problem for this study, where thousands of pages of archival and anecdotal documentation were collected. So a decision was made to focus the data analysis by using data tied specifically to the process of interest (i.e. strategic change), and significant chronological events of interest that took place during the period of study. This was done by first reducing the data to a manageable level by narrowing the focus provided by the revised embedded cases (Bodø, Stavanger, and Oslo ATCCs), and then to relate these cases to a chronological sequence of events, and analysing the effects on the selected cases. Figure 4-1 depicts the timeline of the chronological events of interest for this study, and represents a visual map for the organization and analysis of data.

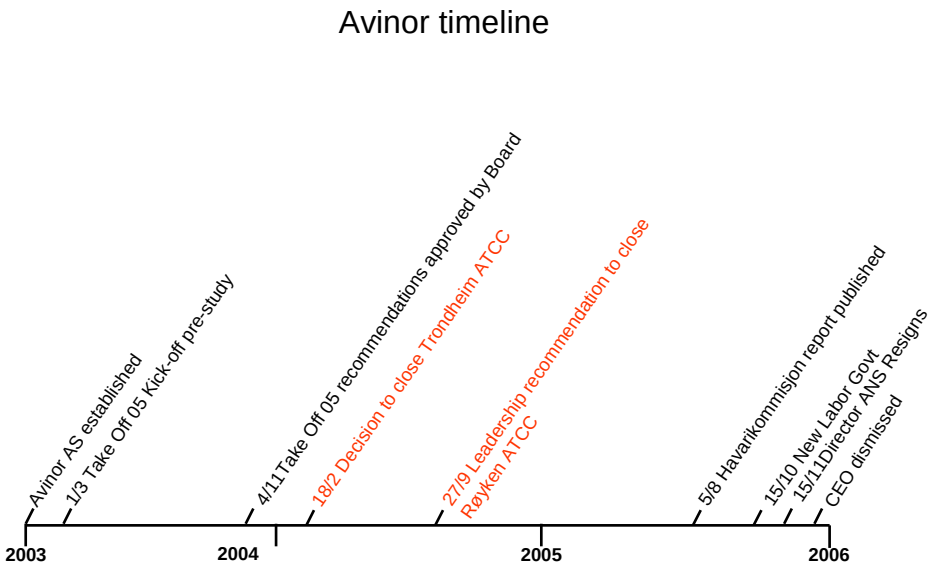

Figure 4-1: Avinor Chronological Timeline

4.4.1 Preliminary data analysis

Data were collected continuously over a three year period, and these data were also continuously evaluated for relevance to the research questions, as well as, against significant events within the case as they unfolded. One method of classifying the data was in relationship to the beginning and ending points for the data collection. Pettigrew (1985)

argues that the framework may focus on major dramas and breakpoints in a firm's history, and is supported by Tushman and Romanelli (1985). In this study, the natural *breakpoints* were the establishment of Avinor as a state-owned private company on the first of January 2003, which is also the approximate starting point of the Take-Off 05 project, and the ultimate departure of the CEO three years later in December 2005. This also represented the effective collapse of the Take-Off 05 project.

As explained earlier, preliminary data analysis revealed that the original embedded cases chosen for study were overly broad. This led to a further narrowing of focus to the four original Air Traffic Control Centers (ATCCs), and the planning and change implementation experiences of these units during the Take-Off 05 process. This need for a narrower focus became increasingly clear as the interviews in Bodø revealed a marked difference between the two organizational sub-cultures that had been forcibly co-located within the merged Bodø ATCC. Another reason for focusing on the ATCCs, specifically, was that they, as a distinct sub-grouping within Avinor, were involved in the most controversial and public decisions taken by the leadership within the Take-Off 05 process, and these highly public events created national concern, and fulfilled the need for *drama* described by Pettigrew (1985). In addition, these decisions were considered the most extreme examples of an organizational mismatch between change implementation choices and organizational sub-cultures (Meyerson and Martin, 1987) that were directly linked to safety outcomes. As I will show in the findings of this study, the decisions to close the Trondheim and Oslo ATCCs, and the circumstances under which these decisions were taken, created a significant conflict between the leaders of Avinor, and the Air Traffic Controller union representing these units, and dramatically affected employee attitudes toward the change process. This also marked the turning point in the change process where a *weak* general consensus for a reduction in the number of national ATCCs was lost, and marked the beginning of an internal conflict that would become highly public, and end with the eventual collapse of the Take-Off 05 project.

So, based on these arguments, I have chosen to focus the mixed-methods portion of the study on the process analysis of the four original ATCCs as merged into the three embedded cases (Bodø ATCC, Oslo ATCC, and Stavanger ATCC) using a temporal bracketing strategy as described by Langley (1999). In particular, I will use this *sensemaking* strategy to look at distinct phases within the larger Take-Off 05 change process based on chronological events depicted in Figure 4-1 (see page 80), and "*examine how the context affects processes, and*

what the consequences of the processes are on the future context, and other relevant variables of interest" (Langley, 1999: p. 703). This analysis will consider the Take-Off 05 mandates associated with the analysis, the planning and implementation processes involved in the sub-group responsible for air transit services (ATCCs), as well as, the decisions taken by the leadership for closing 2 of the 4 ATCCs in Norway. And finally, I will look at how the employees reacted to these decisions and implementation processes, and ultimately, how reactions to these processes affected attitudes toward change and perceptions of safety.

4.4.2 Data processing

Most of the documents collected during the data collection phase where electronic in format and were stored in the software program Nvivo 7. Nvivo 7 is a non-numerical computer software program that allows the researcher to store, hierarchically structure, and analyze large electronic data sets. Nvivo 7 is the next generation software of the original NUD*IST software series that has the added advantage of being able to store and process several different electronic word processing formats simultaneously, including Microsoft Word. In addition, other documents, such as PowerPoint slides, could also be saved and accessed. This allowed me to analyze many documents simultaneously using intersect search tools provided by the software package.

The most important qualitative data utilized in this study were the transcribed interview data analyzed using Nvivo 7. One of the first judgements that had to be made was how to reduce open-ended responses into a parsimonious set of attributes for theory testing based on the research model used (Glick et al., 1990). The interviews were first transcribed, verbatim, using one common Norwegian language (Bokmål) for ease of coding, and then stored in the Nvivo 7 software for further analysis. The transcriptions were then read in entirety to gain a general overview for the types of responses given, and to detect differences in tone between the different sites. Individual transcriptions were then coded using broad coding segments starting with one example from each case to maintain a balance between the different sites. The segments were coded freely by topic, and later further categorized under four tree nodes corresponding to the four latent constructs of interest in the Tentative Research Model (See Figure 3-2 p. 51). The focus was specifically upon leadership in context of change, safety climate, attitude towards change, and perception of safety.

Each transcript was also coded descriptively to enable both within-case and across-case comparisons. After the first round of rough topic coding, I sent one third of the transcriptions

to a colleague experienced in qualitative data coding for verification and quality assurance of the coding selections and results. One observation was that the coding was perhaps too detailed, with over a 120 different codings registered. But it was also noted that many of the codings were, in fact, similar concepts, or sub-concepts, with different names that were later grouped together. Key informants within Avinor were intentionally excluded from this phase of data analysis as certain responses by individual respondents could easily be tracked back to the source, and this confidentiality had to be protected. All analysis was conducted in the Norwegian language with results later translated into English.

4.4.3 Within-case analysis

Once the coding strategy was validated, I began within-case intersect searches to identify recurring themes. However, one of the first issues in analyzing large data sets is to organize the data into workable structures. The within-case analysis began by using the visual mapping technique (Langley, 1999) described above, combining the chronological timeline (Eisenhardt, 1989), and the events of interest, with particular focus on the individual constructs represented in the safety measurement model (see page 154). This was a logical starting point, as these represented the basis for the interviews in the first place, and were to address the individual latent constructs to be used in the safety measurement model afterwards. One early surprise from the coding was the complexity and richness of the responses within the four main areas of interest, which was also reflected in the large number of individual codings. It also became clear that one of the sites (Bodø) had experienced the change process in a more dramatic manner than either of the other sites due to the merging of two distinct sub-cultures at one site. This produced distinctly different responses from the separate cultures within the same imbedded case. It was also observed that the responses from the original Bodø crew were noticeably more negative than was expected based on the earlier experiences from the site orientation visit. Based on these revelations, I decided to expand the focus of the analysis to include the four original ATCCs as distinct groups, and this will be reflected in the findings.

4.4.4 Across-case analysis

Once I had completed the within-case analysis, the next phase was to analyse the differences across cases. It was not surprising that the across-case coding indicated that individual sub-cultures responded in similar manners within each site based on the concepts chosen but differed across cases. It was hypothesized that each embedded case would respond differently

as each was experiencing a different phase of the same change process. The within and across case analyses will be discussed in detail in Chapter 6.

4.5 Methodological strengths and weaknesses

In the words of Nachmias and Nachmias (1996) "*a scientific methodology is a system of explicit rules and procedures upon which research is based and against which claims for knowledge are evaluated*" (p. 13). But there is no one *best approach* for conducting a scientific study, and this requires the researcher to make deliberate choices. All methodologies have their own strengths and weaknesses, so the researcher should choose the methodology that best supports answering the study's research questions. In this study, I was particularly interested in how contextual conditions contributed to a specific phenomenon of interest (i.e. safety) within a complex case that took place over an extended period of time, and to test relevant theories (Yin, 2003). This led naturally to a case study design. However, theory development, particularly in the design phase, is also important, and even essential, in confirmatory studies (Eisenhardt, 1989). But Eisenhardt also warns that theory development takes time and could be difficult. This was particularly true in this study as defining the term safety proved to be a difficult task which also affected measurement alternatives. So to facilitate this process, a single-case, longitudinal case study was chosen for reasons presented earlier. A longitudinal study also allows the researcher to combine a full range of theories relative to the study to include *individual* theories focused on areas, such as, cognitive behavior, along with organizational theories that describe organizational structures and function (Yin, 2003).

The strengths of this type of study are that it allows the researcher to closely follow a complex process over a longer period of time to observe results based on a diversity of theoretical concepts in a unique dynamic setting. Another strength of case study research is that it is likely to generate new theory, or expand upon already existing theory, as is one of the objectives of this study (Eisenhardt, 1989).

4.5.1 Validity

In its purest form, validity asks the simple question "*of whether one measures what one intends to measure*" (Borsboom et al., 2004: p. 1061). This implies both an ontological position and epistemological claim. Do the attributes of interest exist, and is there a causal relationship between these attributes and the outcome to be measured? The quality of any

research design needs to be judged against a logical set of tests that answers these questions (Yin, 2003). The four tests relevant to case studies are: construct validity, internal validity, external validity, and reliability.

Construct validity. Construct validity is the most problematic for case studies as it is difficult for the investigator to "*develop a sufficiently operational set of measures and that subjective judgments are used to collect data*" (Yin, 2003: p. 35). To address this issue it is important to design a research strategy that incorporates multiple sources of evidence, and "*to relate measurement instruments to a general theoretical framework in order to determine whether the instrument is tied to the concepts and theoretical assumptions they are employing*" (Frankfort-Nachmais and Nachmais, 1996). However, Borsboom et al. (2004) argue that validity cannot be *contracted out* to methodology alone, and must, therefore, be grounded in substantive theory. This requires that measurement tools fit the theoretical expectations about the variable to be measured and "*allow the investigator to postulate various kinds and degrees of relationships between the particular variable and other specified variables*" (p. 168). In the Avinor case, there was an abundance of evidence both from internal and external sources, and I was able to establish a reasonable chain of evidence during the timeframe studied. To fulfil the second demand above, most of the instruments used were based on tools derived from the literature and theoretical propositions presented. In addition, all tools were then validated by key informants within the organization (but not from either of the embedded cases studied). And finally, key informants representing the top leadership and employee union were used to review the drafts of the case study report.

Internal validity. Internal validity is particularly relevant for explanatory studies where causal relationships between latent variables are being investigated. Cook and Campbell (1996) devote a great deal of effort in describing the threat in this area, and different ways to ensure that "*the researcher can answer the question of whether change in the independent variable did, in fact, cause the dependent variable to change*" (p. 106). To address this issue, I used several recommended techniques, such as randomization and pattern matching during data analysis. Randomization, for example, was achieved during the interview process by selecting interview objects based on their availability during a particular timeframe within the interview sessions based on previously scheduled break periods. All interviewees that were available accepted the opportunity to participate, and no rescheduling was made to accommodate others who might have wanted to participate. Pattern matching was used during

the analysis phase both during within-case and across case analyses of coded data. A third technique used to strengthen the confidence in internal validity was the use of triangulation of data from diverse sources, and this was emphasised by Campbell and Fiske (1959) who argued that "*more than one method should be used in the validation process to ensure that the variance reflected that of the trait and not of the method*."

External validity. External validity deals with the issue of generalizing the findings beyond the immediate case study. A key factor here is replication of logic across settings. This is an area often argued as a weakness for single case studies. I have argued that the Avinor case is a representative case of an organization within a high-risk environment undergoing a change process that is part of a larger change initiative of similar organizations described as high reliability organizations. As the international civil aviation industry is a highly regulated industry with uniform standards and operational requirements that extend across national boundaries, it is expected that the organizational structures and cultures developed within these organizations are similar. And this similarity leads to the generalization that these organizations will experience deliberate change in similar ways. However, I will also argue that other types of high reliability organizations that also function under similar HRO structures and regulatory regimes might also benefit from the knowledge gained from this study.

Reliability. Reliability concerns the issue of being able to replicate the results of the study based on the same procedures and data by another researcher. This has been addressed by using case study protocols and compiling a case study database.

4.6 Summary

This chapter has addressed the methodological issues of this study. I began by presenting the research design and the choice of research setting, and why these were appropriate to answer the research questions. A longitudinal design was selected for many reasons including:

- Possibility to observe, firsthand, a dynamic deliberate change process in a high reliability organization, over an extended time period
- Possibility to identify the initial change strategy, and to investigate the background for initiating such a dramatic change, and to identify the major stakeholders involved in the change decision process

- Possibility to follow the change implementation process, real-time, and to observe the internal and external reactions to decisions made and actions taken
- Direct access to key leaders responsible for the change process from initial planning to ultimate implementation underway
- Direct access to operative personnel directly responsible for safe outcomes, and to observe their reactions to the change process

The Norwegian Air Navigation Services Provider, Avinor, was chosen as the research setting for this study. This was done for several reasons, the first of which was timing. Deliberate large-scale organizational change initiatives in HROs have, until recently, been rare events. The opportunity to study one of the first movers in a comprehensive international change initiative, with strong national interest, was a key factor for choosing this case. A second reason for choosing this case was related to my unique background within the topic of interest, specifically, strategic organizational change and the effects on safety within the civil aviation setting. And the third reason for conducting this study was access into an exciting and interesting environment where few researchers have had the opportunity to study *in vivo* previously.

Avinor proved to be a highly complex organization comprising multiple key business areas, many of which support, but do not have direct interface with aviation operations. As the main purpose was to study how deliberate organizational change affects safety, as an outcome - over time - in an organization where safety is the stated highest priority, I chose to focus on three embedded operational cases with direct interface with the operative aviation community. As explained earlier, the initially defined embedded cases (Oslo, Bodø and Stavanger) proved to be too broad as Tower/Approach control units and Air Traffic Control Centers perform distinctly different tasks, and due to the dynamics and key decisions made by the leadership during the change implementation process, these units experienced change in completely different ways. So the primary focus of the study at the micro level was narrowed to include only the four original ATCCs (Trondheim, Oslo, Bodø and Stavanger), and the key decisions taken to reduce the number of ATCCs in Norway from four to two centers. However, as we will see in the findings section, my intention is to apply the findings from these four cases to measure safety at a macro level within the air navigation services division using all of the operative air traffic controllers and air traffic control assistants as a respondent base.

Data collection was initially gathered based on a deductively developed model where attitude toward change was affected by the organizational culture (in place), and the leadership's role in the context of change, and that these three latent variables, together, affected the dependent latent variable – perception of safety - over time. The refined conceptual model and hypotheses will be presented in the findings section of this study (see page 154). Data was initially gathered using Avinor-provided presentations, internal and external documents, site visits, observations, participation in meetings, interviews, and key informant discussions. In addition, two separate quantitative data sets directly related to the study objectives were provided by Avinor and the Norwegian Transportation Safety Board. This led naturally to a mixed-methods approach where the combination of quantitative and qualitative data was used to strengthen the findings of the study, but also to address some of the validity issues. Data analysis was conducted using a mixed-method approach combining process data with survey data using several techniques including: visual mapping of key events, temporal bracketing, and a narration tied to key concepts supported by survey data.

At the end of the chapter, I discussed the strengths and weaknesses of the methodology chosen, as well as, how I addressed those weaknesses in regards to four different validity criteria: construct validity, internal validity, external validity, and reliability.

Part IV: RESULTS

In this chapter, I will address the overall findings from three separate sets of analysis, each building upon the previous findings. The first analysis is a chronological presentation of the Take-off 05 process from inception to collapse. The findings from this section are used to analyse the final 12-month period of the change process to fine-tune the constructs of interest for use in a conceptual safety measurement model in Chapter 7. Chapter 7 is a presentation of a structural equation model measuring safety as an outcome of change.

5 Aborted Take-Off: Leadership choices leading to resistance and collapse of the Take-Off 05 project

This chapter analyzes a three-year chronological account of the deliberate organizational change project known as Take-Off 05, and how leadership choices and actions during the planning and implementation phases of the project led to a loss of consensus for change, resistance to change, and the eventual collapse of the deliberate change process.

The focus of this chapter will be on identifying leadership choices and actions in the context of deliberate organizational change in a high reliability organization based on a mismatch between the organizational culture type, in place, and the change implementation type, application and timing chosen by the leadership. And, more specifically, to show how these choices affected individual reactions and attitudes toward the change process leading to resistance to change, and how four embedded cases reacted to the change process.

I have argued previously that the organizational culture-type that best fits Avinor is described by Meyerson and Martin (1987) as a *differentiation* culture, which is a culture consisting of several distinct sub-cultures, or anti-cultures, with various degrees of connectivity within a weak overarching main culture. The sub-culture of interest in this chapter is the sub-culture representing the air traffic controllers and ATC assistants located in the 4 embedded cases described in Chapter 4 (See page 66). I have also argued that the *differentiation-type* culture is best served by a mixed-type of change process where both *participative* and *unilateral* change types are used in a complex change process that include both *structural-technical* and *behavioral-social* elements (Waldersee and Griffiths, 2004). I will show that on the surface, the leadership approach to the Take-Off 05 project was, in fact, a mixed-type of change process. But I will also show that the participative and unilateral (top-down) change types were applied in a manner that created conflict, and were counterproductive considering the differentiated culture leading to resistance to change, and ultimately, the collapse of the change process.

The analysis begins at the macro level by briefly presenting the environmental conditions within the civil aviation industry creating a need for change. I will then address the decision to change on a company level, as well as, a presentation of the analysis and planning phases of the change process leading up to the recommended Take-Off 05 implementation plan approved by the Avinor board of directors in December 2003. Included in this presentation will be a more detailed analysis, at the micro level, of the individual sub-project (DP7)

responsible for decisions and recommendations for changes in the en-route services structure in Norway represented by the four embedded cases. These particular decisions and recommendations were central to both the loss of consensus for change between the leadership and the organization's strongest sub-culture (air traffic controllers), and leads to an internal conflict that escalates dramatically, over time, that directly affects the entire organization. This also creates a substantial escalation of direct and indirect external stakeholder involvement that further complicates the implementation process.

The public unveiling of the Take-Off 05 final planning document marks a key turning point in the deliberate change process representing the loss of both the content and scope of consensus (Markóczy, 2001) for the strategic change initiative between the leadership and the company's most powerful sub-culture. In addition, the subsequent approval of the Take-Off 05 final planning document by the board of directors in December 2003, and the manner in which the plan is pushed through the board, represents a reversal in what was originally described by the leadership as a *participative* change process, becoming distinctively unilateral in nature. The initial internal reaction sparks public interest in the conflict that gradually intensifies, and becomes a highly public event that rages in the news media over a two-year period culminating in a sudden change of the top leadership, and an end to the Take-Off 05 project.

The process, decisions and recommendations from DP7 are particularly interesting for this study as they give us an insight into the mental processes at work from both the leadership and employee perspectives, but also reveal separate agendas for change that only become clear with the approval of the final planning document. The results and recommendations from the DP7 planning process dramatically influence both the tone and the direction of the deliberate change process, and this change of direction is the focal point of this chapter.

Though not a specific focus area of this study, the chronological events in this chapter uncover a political perspective (Pettigrew, 1981; Hardy, 1995) where conflicting goals and agendas, largely based on historical conflicts and pre-conceived notions of the value of participation, contribute to the mutual distrust and disagreement between the air traffic controller union, the employees, and the Avinor leadership. And these political influences cross several boundaries that add complexity and drama to an already complex change process. The loss of employee trust leads to resistance to the deliberate change process by Avinor's strongest sub-culture but also has an increasing negative effect on the entire

organization, and quickly spreads outside the organization. These unexpected interactions complicate an already difficult situation and create a dynamic that takes on a life of its own.

For the remainder of the chapter, I will narrow the focus of the chronological presentation to the four embedded cases associated with the en-route services structure in Norway. I will concentrate on the two key strategic decisions regarding location and timing of relocations of the air traffic control center (ATCC) structure in Norway that were made based on the recommendations from the work of DP7, and how these decisions affected employee behavior. To do this, I will use a temporal bracketing strategy (Langley, 1999), using a mixed-method approach, linking key strategic decisions and significant follow-on events to individual responses based on the Avinor Chronological Timeline depicted in Figure 4-1 (See page 80). Through this process, I intend to show how key leadership decisions and actions within the context of the Take-Off 05 process were perceived by the employees, and how these perceptions affected both cognitive processes and behavior.

5.1 A need for change

The urgent need for a new business model for the government-managed civil aviation authority (Luftfartsverket) was realized by its Chief Executive Officer already early in 2002 based on deteriorating economic conditions affecting the entire civil aviation industry that included: significantly reduced revenues, increasing operating costs, and minimal traffic growth projections for the foreseeable future. The decision by the Norwegian government in 2002 to transform the government-managed air traffic management organization (Luftfartsverket) into the government-owned, private company (Avinor) was influenced by these conditions, and gave the CEO the opportunity, and the mandate, to use this new business entity to plan and implement a new, competitive business model. With the vision – *Leading in Safety and Punctuality in European Civil Aviation*, Avinor AS (a state owned, private company) was officially *launched* on the first of January 2003. With safety and punctuality as its foundation, the leaders announced that Avinor's goal was to be the *force* that would innovate and stimulate the civil aviation industry in Norway (Bakkekontakt, Jan 2003).

Along with the new vision, came new challenges, and the leadership announced that with the new business form, Avinor could plan for the long term, and create a modern and flexible organization (Bakkekontakt, Jan 2003: p. 3). This vision was already taking form before the transition as Luftfartsverket had engaged an external change agent already in Dec 2002 to

lead a *results improvement program*, and to have the responsibility for getting Avinor's new strategic plan *on track* (Bakkekontakt, Jan 2003: p. 4). This initiative was reflected in one of the first orders of business taken by the newly formed Avinor Board of Directors in a decision to initiate a *results improvement program*:

> *"The Avinor Board of Directors has decided that a results improvement program will be initiated because:*
>
> • *Avinor's economic results have nearly halved in three years. This is due to reduced traffic income and real growth in operative costs of 4-6% per year.*
> • *Postponement of maintenance for almost 1.4 billion NOK*
> • *Too low investment levels for maintaining value and development."*
> (Summary Report Take-Off 05 - Design Phase, 27 October 2003)

Although this decision clearly called for a *results improvement program*, the explanation that supported this decision revealed a potentially different focus:

> "*The economic situation within the civil aviation industry is serious. Since the civil aviation industry and Avinor's customers are having serious economic problems, and the income levels for Avinor are correspondingly too low for the current cost levels,* ***the focus for Avinor is reduction of costs****, and not increased income growth through increased pricing for the airlines. With the new competitive situation in the market, Avinor's fees compose a larger and larger relative percentage of the company's costs*." (p. 3.)

The focus on the reduction of costs, mostly in the form of downsizing of personnel, proved to be a recurring theme throughout the study and will be addressed in more detail later in the chapter. Based on this initiative, a single, results improvement working group, divided up into three *mapping groups,* was formed on 5 February 2003 to conduct the first phase of a three phase project described, as such:

> *"The overall methodology is based on the IBM Business Consulting Services tool for large reorganization projects. The methodology separates the reorganization process into three phases: analysis phase, design phase, and implementation phase. The main activities in the individual phases include: defining potential savings, designing solutions, and implementation measures. The Program's "Zero Point" for results improvement is established based on the economic results from 31 December 2002."*

The program's "zero point", based on results from 2002, combined with future growth projections in air travel post-911, proves to be an important leadership choice that has far-reaching consequences during both the planning and implementation phases.

5.1.1 Results improvement working group (analysis phase)

The six week analysis phase was conducted by the results improvement working group from 19 March through 25 June 2003. The group mapped and analyzed:

- 45 airports
- 4 en-route air traffic control centers (ATCCs)
- 5 regions
- Headquarters

The group conducted approximately 270 interviews broken down by category (Summary Report Take-Off 05, 2003: p. 3):

- 140 Air Navigation services personnel
- 75 Ground services personnel
- 55 regional and Headquarters personnel

Through this process, the group mapped 2,853 man-years of activity divided into 3 main areas of interest:

- Air Navigation Services
- Ground Services
- Support and common services

The results improvement working group completed and delivered a report based on the findings of the three working groups from the analysis phase of the project to an internal steering group consisting of 13 top leaders from the headquarters staff and major regional units within Avinor on 24 June 2003. After evaluating the report the steering group decided:

> "*Based on the background of this report, eleven process areas were detailed and quality assured for potential consequences. To carry out this work, eleven project groups were formed*." (Summary Report Take-Off 05, 2003: p. 3)

The project mandates were approved by the steering group on 1 September 2003. The eleven sub-projects (DPs) included:

1. Management model
2. Common tasks
3. Management and control of IT
4. Service definition and pricing
5. Conformance to standards
6. Training
7. **En-route services**
8. Landing/Departure/Approach services
9. Flight Navigation Services business concept
10. Effective airport
11. Rolling material

Although all of these sub-projects represent complex undertakings in themselves, for this study, I focus primarily on sub-project seven (DP7) – En-route services, with occasional reference to sub-project eight (Landing/Departure/Approach Services) which is closely related both administratively and operationally to DP7. Together these two sub-projects represent approximately 20% of the Avinor workforce, and arguably represent the strongest single sub-culture within the company - the air traffic controllers and ATC assistants. And, most appropriately for the research questions, this sub-culture is represented by those most closely involved in operations at the front line having a direct impact on flight safety and safety outcomes that are the company's expressed highest priority.

5.1.2 A participative process?

The operating philosophy for conducting the results improvement process was expressed by the Avinor leadership as such:

> *"Avinor has a comprehensive cooperation model with the employees and union representatives. These arenas are also used in association with the results improvement program. The program has, in addition, worked out its own communications plans both for the program as a whole, but also for the individual sub-projects. The employees and union representatives are invited to come with contributions and recommendations during the entire process, and the central union representatives have had meetings with the program leadership and project groups underway. This has produced a significant engagement and there have been many solution recommendations by the employees from the entire country".* (Summary Report Take-Off 05, 2003: p. 3)

And this was also the impression that many of the employees shared during the early analysis and design phases of the project:

> "*We were very satisfied with our contribution. We worked hard during these brainstorming sessions to find as many potential cost savings as possible that would eventually be put into a comprehensive implementation plan that would go through an extensive quality control and risk analysis process*." (Sub-group member)

> *"In actuality, everything began very well with the whole Take-Off concept and that we would be more effective by reducing from four to two control centers ... and that we should have a more rational business model, I was absolutely agreed*. (Air Traffic Controller)

Even the air traffic controller's union was positive toward the change initiative and, though they chose not to participate directly in the main planning process, were actively engaged in

monitoring the progress of the working groups, and preparing for input at the end of the design phase of the project.

5.1.3 Sub-project seven (DP7) - En-route services

Of all of the sub-group activities, DP7 was the sub-project that was potentially the most difficult and controversial due to numerous prior failed attempts to change the en-route structure in Norway. The sub-group was guided by the following mandate:

> *"The mandate for this project phase is to design a solution for en-route services. The project will further develop the possibilities and consequences of optimizing (operating) sectors within the airspace and combining (reducing number) control centers – the en-route service function is to be a specialized function within Avinor."*(Take-Off 05 Final Report – DP7 En-route Services, 2003)

The stated goals for DP7 were to identify, and recommend changes to improve (reduce) en-route sectorization, and to determine the number/location of air traffic control centers in Norway, based on a pre-determined annual cost savings of between 55-85 MNOK as identified in the analysis phase of the Take-Off 05 project (Take-Off 05 Final Report – DP7 En-route Services, 2003: p. 3). Savings would be achieved first by reducing the number of operative sectors at each unit based on operational simulations, and the corresponding number of air traffic controllers saved through this reduction. And second, to reduce the number of ATCCs in Norway, and, accordingly, the operating costs achieved through this reduction.

The working group, itself, was composed of a mixture of air traffic controllers, a technician, a representative from the headquarters budget staff, and a consultant from IBM business consulting services. None of the air traffic controllers involved in the project came from the existing en-route services structure nor did they have any direct/recent en-route services experience. This lack of direct experience was a deliberate action by the leadership who argued that participation by any active air traffic controllers from this structure would potentially bias the decision process, and negatively affect the quality of the location decision (Top leader interview). What was not addressed was the capability of these air traffic controllers, with limited en-route experience, to capture all of the details and nuances associated with en-route sectorization, and this would later become one of the focal points for the air traffic controller union's (NFF) criticism of the plan.

From a short-term cost savings perspective, the most pressing task for the sub-group was to decide the best solution for the number and location of ATCCs in Norway, and this proved to

be a solution that would have long-lasting consequences that would negatively affect the entire Take-Off 05 process. But this was not an easy task as this question had been addressed within Luftfartsverket on many occasions before, beginning already back in 1990, and was revisited on no less than four occasions (1992, 1994/1995, 1997, and 1999). The reports from these efforts were commented upon but never achieved full agreement, and each attempt to change was eventually stopped (DP7 Final Report, 2003: p. 4). One leader commented that this experience was the reason that participation in this group, in particular, was limited, and that the union would only be given a limited timeframe to evaluate and comment on the recommendations that could potentially stop the progress yet again.

The evaluation process was broken into three main phases where each phase would be used as a basis for the following phase. The three phases were:

1. Defining the need for number of sectors
2. Fix the number of control centers, and
3. Recommending the localization of the control center(s).

The vision used in this evaluation demanded:

> *"A customer-focused en-route service, with high demands for safety that are, simultaneously competitive in a liberalized market, and sets high demands for effectiveness. This will be achieved through high demands for professionalism in the individual actors providing en-route services, and a goal-oriented management of the service." (DP7 Final Report, 2003: P. 11).*

With this vision as a guiding principle, the sub-group carried out the analysis and produced the following solution:

> *"From a purely economic perspective, the cheapest solution for en-route services in Norway is to reduce to one control center. However, this will also take the longest time and have the largest transition costs for implementation of such a solution – it is also not possible to establish this solution during the timeframe set out by the project mandate. In addition, the project group finds it problematic from a vulnerability perspective to locate all the sectors at one place,* ***so the group recommends a solution containing two control centers.****"*

It was clear that the mandate guiding the process was instrumental for determining both the number of centers but also prescriptive as to the solution that had to be taken. This was particularly evident in both the focus on short-term cost savings but also the timeframe within which these savings must be achieved. Based on the decision for two control centers, the project moved on to the evaluation of where to locate them:

"Localization debates are always complicated in Norway. In this case, it is also clear that a purely economic consideration does not give a clear enough answer that one can base a decision. In addition, the project group has evaluated the execution and implementation questions, and has weighted these into the localization decision. All three localization alternatives for Control Center North involves moving (either temporary or permanent) today's Trondheim control center to Bodø on the NARDS (Norwegian Automated Radar Display System) *platform to avoid establishing Trondheim, such as it is today on the NATCON (Norwegian Air Traffic Control) platform. Control Center North can be established more quickly, and cost savings can also be realized earlier, if Control Center North is in Bodø." (DP7 Report, 2003)*

"Concerning Control Center South, we see the localization at Værnes (Trondheim) or Sola (Stavanger) as giving similar operative and transition costs, while localization in Røyken will give higher operations cost but lower transition costs. There is uncertainty tied to the relief arrangements set as a basis for the projects manning plan, and accordingly, the economic savings that can be achieved in a mountain facility. There are also uncertainties tied to moving Oslo approach and the Farris TMA (Terminal Area), such economic differences are small, and vary depending on which parameters are given the most weight." (DP7 Report, 2003)

Based on these evaluations, the project group recommended the following solutions:

- Air Traffic Control Center North to be located in Bodø
- A strategic evaluation for the future must be used as a basis for an eventual decision for localization of Control Center South. The project outlines these evaluation criteria without concluding a clear recommendation.

The final recommendations from DP7 were not universally agreed when they were made public, particularly by the air traffic controller union who believed that:

- the process had proceeded too quickly
- that the decisions were based on inadequate analysis (that were used mostly to support decisions already taken)
- that the analysis did not include many important operative relationships having direct economic consequences, and
- there was no balance in the evaluation of alternative choices (NFF Comments to DP7, 2003).

In addition, the union also felt that the claims for short-term cost savings, based on the aging NARDS (Norwegian Automated Radar Display System) platform was overly optimistic (NFF Comments to DP7, 2003). Based on these conclusions, the air traffic controller union requested that the results of DP7 not be presented to the Avinor Board for evaluation before the air navigation services division could conduct a thorough evaluation of the findings based on a long-term, detailed evaluation of the future integrated structure. The union also argued that the process should also include the employees affected by the changes so that the results could be anchored within the organization. That would ensure that the changes were accepted

such that the implementation would have positive support from the employees (NFF comments to DP7, 2003). And this was, of course, expected considering the *participative* nature of the Take-Off 05 Project. However, this request was not supported by the steering committee and the recommendations were sent to the board without further comment as part of the final Take-Off 05 planning document.

But NFF was not the only group dissatisfied by the results, even some of the individual participants in the DP7 process were surprised by the recommendations:

> *"I must say that I thought the evaluation process was quite good up until the decisions were made. I was not allowed to take part in that process. And I must say that I was rather surprised when I read the decisions of the group that I was a part of. I was of the impression that Trondheim was the best choice, although I may have been in the minority. Trondheim was a technically better facility and ready to transition to the new NATCON (Norwegian Air Traffic Control) system. I have to admit that it was a strange process in the end with a great deal of external steering and most of the focus was on cost savings in the shortest period of time. Maybe that is why I was not involved in the end" (DP7 sub-group member).*

A second member in the DP7 working group was less satisfied with the process itself:

> *"I was not satisfied with the process. It started off fine, but I was under the impression that we were constantly under-evaluating the complexity of the whole. My impression was that we were 100% focused on the operative aspects and completely overlooked all other factors. Everything was cut to the bare minimum. We were implementing a new concept that was not grounded in reality, in my opinion. In addition, we did not have the competence to completely evaluate the sectorization alternatives. We believed that it was possible but this was never fully followed through. In the end, I was not involved in the decisions that were presented even though I really had no real preference. I was a little surprised by the final recommendation but not really as it was always clear that the leadership wanted to show that they could push through a decision" (DP7 sub-group member).*

A third member of the group commented that:

> *"We were trying to push through a large change, and taking back power (from the union) was a part of this. The power of each group must be clear and it is clear that we under-evaluated the relative power of the air traffic controller's union but I can also say that we over-evaluated the political support which eventually led to the collapse of the project. Speed was the issue and this was particularly true for the Trondheim decision, and the short time period for the move to Bodø" (DP7 sub-group member).*

And finally, one middle manager with direct ATCC experience that volunteered to work on DP7, but was refused, commented:

> *"The whole thing was a custom-made solution, bought and paid for by the leadership. And I believe that is why I was not allowed to participate. There were many weaknesses*

in the process and gaps where problems were passed off to other groups. And this proved to be a problem under implementation. The union was agreed - 'in principle'- with reducing from four centers to two centers but implementation, means and timing were never agreed, or even discussed."

It was clear from these comments that the process was not as participative as the leadership had described, but most of this was unknown to the rest of the organization.

5.2 The Final Take-Off 05 plan

When the final results of the design phase of the project were made public in the form of the final Take-Off 05 implementation plan on 6 November 2003, most employees were completely shocked by the depth and breadth of the changes contained in the final version of the plan. One participating member from one of the sub-projects put it this way:

"I was totally shocked by the final Take-Off 05 plan as it was presented by the leadership as it did not truthfully reflect the expectations of the employee members that participated in the planning phase. The leadership simply took all of the potential savings ideas and combined them into one plan that was not integrated, as expected, and was not sufficiently analyzed for quality or potential risk to safety."

And then added:

"In addition, we (employee members of working groups) were looked upon by our colleagues as being personally responsible for the contents of the plan, and this made life very difficult. I regret that I had anything to do with the Take-Off 05 process, and I will never volunteer for anything again within this organization."

Another project member who participated in both the analysis work, and also one of the eleven sub-groups said:

"The analysis work really presented a rough idea of what was theoretically possible. My impression was that it wasn't that critical, just an overview for the follow-on work. The DP work was more of the same where we came up with a 110% solution that the line leadership would evaluate and optimize. That did not happen. Many of our estimates were just percent solutions based on best-guesses, and many second-level tasks were not considered at all."

In the final analysis of the design phase of the Take-Off 05 project, the leadership presented the results as such:

"The total results improvement effect of the recommended measures is approximately 490 MNOK annually compared to the basis year 2002, which represents approximately 20% of the comparable mapped cost basis or approximately 2.4 Billion NOK from 2002" (Summary Report Take-Off 05, 2003: p. 7).

The effects of these changes were to be achieved already in 2006. But the report goes further to explain:

> *"As the largest portion of the cost basis in Avinor is made of salary and personnel costs, over 75% of the cost savings come from the reduction of number of employees."*

This reduction represented a total of 725 man-years over a six-year period where 655 of these redundancies would be taken out already in the first two years of the implementation process. The total planned reduction made up approximately 25% of the comparable man-years of 2,853 employee base charted in the analysis phase, and included 292 air traffic controllers and ATC assistants (Summary Report Take-Off 05, 2003: p. 8). The leadership were clear in their message that the extent of the cuts was largely driven by demands from the government. In addition, the leadership were emphatic in their view that the proposed cuts would not reduce safety, but quite the opposite, many of the measures would, in fact, improve safety (Bakkekontakt, Nov 2003: p. 7). The unions were given less than four weeks to respond to the Take-Off 05 planning document before presentation to the board for approval on 4 December 2003.

5.2.1 Initial impressions of the Take-Off 05 planning process

After analyzing all of the sub-project reports, my first impression, as a non-participant to the analysis and planning process, was that the breadth and scope of the Take-Off 05 project were extremely ambitious considering the number, types, magnitude, and depth of the strategic changes proposed, particularly the cutting of over 25% of the workforce. And this was particularly worrisome from a safety perspective in a high reliability organization if you consider the fact that this complex reorganization, downsizing and introduction of new technologies would be undertaken simultaneously under a compressed timeframe. And this was also the impression of the Norwegian independent risk management consulting company Det Norske Veritas (DNV), that commented:

> *"The Take-Off-05 project was performed within an extremely limited timeframe. There is reason to ask the question of whether all of the measures are adequately worked out and evaluated for potential consequences given the time pressure. The magnitude and breadth of the planned changes in Take-Off-05 can cause unforeseen and unpredicted consequences both for safety and in relationship to Health, Safety and Environment. (DNV report 1232, 2003: p. 9)*

In addition:

> *"Both within Take-Off-05, and in Avinor, in general, it is DNVs impression that there is too much focus on individual parts, and a lesser degree of an overall safety perspective within the civil aviation system" (DNV report 1232, 2003: p. 8).*

Equally concerning was the impression that these sub-projects were operating concurrently under very demanding cost-saving goals and compressed timelines with little evidence of direct interface between the individual sub-groups, and a real potential for double-counting, or achieving savings by transferring tasks and potential cost savings to other sub-groups without actually addressing these tasks between the sub-groups. And this was also echoed in the DNV report that stated:

> *"DNV sits with the impression that the individual sub-projects in the Take-Off 05 process, to some degree, recommend taking out economic savings from other portions of the organization without the requisite level of investigation to verify if there is capacity to complete these tasks" (p. 8).*

Another impression was that the planning process moved so quickly that many potentially important operational considerations were overlooked. This was mentioned earlier in the air traffic controller union's comments to DP7 above, but was also strongly reflected in the DNV report:

> *"It is DNVs impression that those in the sub-projects have used a similar methodology. However, at the same time DNV is uncertain of how thorough the process has been in regards to capturing all of the central functions and tasks while also identifying the manning and competence needs that this requires. DNV is of the impression that the process of describing the new organization runs the risk of leaving out functions and tasks, or* ***under-evaluating manning and competence needs****. If DNVs impressions are correct, safety could be weakened over time, especially if during the implementation of the new organization the company quickly begins to lay off employees.* ***The danger that critical competence that is important for maintaining safety, over time, disappears will be significant****. In addition, the competence over which functions and tasks contribute to safety could disappear.* ***Over time, such a situation could contribute to a gradually reduced ability to take care of safety****. In addition, this could lead to HSE (Health, Safety and Environment) problems for the employees and the staff. Under-evaluating manning and competence needs will lead to an overload and inability to complete tasks."*

These warnings would prove to be both prophetic and accurate, and I will expand upon these issues later in the chapter.

Another risk factor concerned the many cost savings based on potential operational synergies achieved through the introduction of new technologies and the implementation of a new

operations concept that had not yet been put into place, nor had the potential of these cost-savings synergies been confirmed.

Surprisingly, despite the many concerns express by DNV in their report, the Avinor leadership often cited DNV's role in the Take-Off 05 planning phase as if they were more integrated into the process than they actually were. And the Avinor leadership often emphasized DNV's role in ensuring that safety would be maintained:

> *"Det Norske Veritas has been used to make an independent evaluation of the safety and health and work environment in relationship to the detailed measures. Veritas has worked in parallel with the program in this phase and has given continual feedback to the projects. Several workshops have been conducted with representatives from various professional groups and union representatives under the direction of Veritas. This includes both for safety and health and environment. Veritas will deliver an independent report concerning the design phase." (p. 4)*

However, the DNV participants did not necessarily see themselves in this integrated role and digging into the detailed measures but instead as independent observers giving guidance and feedback based their overall impressions of the change process, and to identify where the future threats to safety were most likely to occur, but had no direct input into the actions taken by Avinor:

> *"The change proposals contained in Take-Off-05 during the project period were, to a small degree, of such a character that quantitative analyses were not completely appropriate. This has resulted in that DNV has had to use a qualitative approach that includes the process evaluation. Given the various measures' complexity, it has not been possible to make a total evaluation regarding the increase or decrease of safety or the Health, Safety and Environment-levels in Avinor as a result of the changes. In addition, there does not exist in Avinor today an overview of the existing total safety level or established parameters for quantifying risk, something that should have been an assumption for such an evaluation." (p. 5).*

In discussions with various leaders within Avinor, they considered the DNV report too vague and difficult to implement changes based on general impressions based on the qualitative approaches mentioned above. However, the DNV report is a central document in this study as it is used extensively, both as the basis for many of the criticisms of the Take-Off 05 process used by NFF, and later by the Norwegian Transportation Safety Board in their report on safety within civil aviation in Norway (HSLB Report, 2005).

5.3 A ”fatal” change in direction

Up to this point, I have followed the deliberate change process within Avinor through the analysis and design phases of the Take-Off 05 project. Indications from the leadership, and most of the employees involved in the complex planning process, reflected a general consensus for the need for change, and this included the decision to reduce from four to two ATCCs in Norway. And this was also agreed, in principle, by the air traffic controller union (NFF):

> *“NFF was of the opinion that it was absolutely necessary to implement extensive changes within this poorly structured, over-weight, and increasingly more bureaucratic activity. NFF, therefore, supported parts of the Take-Off 05 project.” (Flygelederen, Sept 2003: p. 3).*

And most of the employees, and the union, believed that the methodology initially used to analyze and plan the change process was appropriate considering the level of participation allowed by employee representatives in the various sub-groups. But a more detailed examination of the Take-Off 05 process, as a whole, and the DP7 process, in particular, reveals that there were many signals that the planning process may not have been as *participative* in nature as employees, and the union, were led to believe.

The true quality of the participative process first became clear when the proposed final Take-Off 05 planning document became public on 6 November 2003. The union was given four weeks to respond to the proposal before it would be presented to the board. As mentioned earlier, the short timeframe allowed for a response to the proposal was reported by one top-level leader as a deliberate action based on the prior history of difficulties in coming to agreement with the union on difficult change issues, and this had been particularly true with the ATCC issue. It was believed that the short timeframe would limit the number of arguments that the union could generate to oppose the proposal and, particularly, as time was a critical factor. But the union did respond, and in a letter dated 20 November 2003, NFF presented a detailed report that summed up the findings as such:

> *“NFF is, for the time being, quite worried about the high tempo that has characterized the execution of the project. This has, based on the union’s evaluation, reduced the quality of the underlying ground work. This is particularly true of DP7, En-route services. The recommendations from this project are, in NFF’s opinion, filled with essential missing information and a lack of clarity, and is not an adequate or acceptable basis for taking the important decision it is supposed to support.*”

And then on 26 November 2003, NFF presented their findings to the steering group with a request to delay sending the Take-Off 05 proposal to the board:

> *"NFF contests the figures laid out (in the Take-Off 05 planning document) and do not agree that the case should be placed before the board before a 'reality check' is complete."(NFF Letter dated 26 Nov 2003).*

However, this request was not accepted by the steering group, and the Take-Off 05 planning document was presented to the board for acceptance on 4 December 2003.

At the December 4th board meeting, the three employee representatives on the board of directors put forward a motion that the decision to accept the planning document should be postponed pending further study based on the arguments in the NFF letter *dated 26 Nov 2003*. But after a short discussion, a vote was taken to reject this request and to accept the document as presented. The motion was passed by a vote of 5-3. The results of this vote are important as it sets the stage for many future board actions where the employee-representative initiatives are brushed aside through parliamentary procedure, and a recurring vote of 5-3.

The board action did not, however, take a decision on the location of ATCC North, and tabled this decision until further documentation was available. This last glimmer of hope for flexibility on the ATCC issue would prove to be short-lived.

5.3.1 Board decision assures cost reductions

In the Dec 2003 issue of the internal professional magazine for Avinor (Bakkekontakt), the headlines read "*Board decision assures cost reductions.*" This issue presented the employees with their first look at the stark reality of the decisions that would shape the future of Avinor:

> "*The board in Avinor has accepted the recommendations in Take-Off 05 at their meeting on 4 December 2003. The company will save a minimum of 400 million Norwegian Kroner per year from 2006. The consequence is that over 700 employees must leave. One of the measures implies that the number of control centers will be reduced from today's four to two. The localization of these two control centers has not been decided."* (Front Cover, Bakkekontakt Dec 2003).

Inside the magazine were comments by the CEO and the Chairman of the Board explaining the urgency for the change, and why such a dramatic change was essential for survival of the company:

> *"I feel that it is necessary for Avinor to take a large "wave" now so that we avoid a new round of downsizing in a short time. Both for the board, and for me, it has been*

> *important to keep up the tempo, and to have full openness in the downsizing process."* (Bakkekontakt, Dec 2003: p. 3).

The Chairman also expressed satisfaction with the work that had been conducted and the recommendations that were accepted, also considering safety. He had faith in the Veritas (DNV) report, and emphasized that the regulatory agency Luftfartstilsynet would place its stamp of safety in the final round. He ended the interview with the statement:

> *"High safety levels, cooperation with the organizations and the employee representatives, and a steady implementation of the measures are slogans for our further work"* (p. 3).

With the public release of the Take-Off 05 implementation plan, the seriousness of the proposed changes became clear. Shortly thereafter the implementation process was set into motion.

5.4 The reality of change

With the approved planning document in place, and the reality of the magnitude and scope of the planned change process sinking in, the serious work of instituting the new leadership structure and downsizing began. As part of the restructuring, most of the experienced middle managers from the old Luftfartsverket structure were removed and replaced by a *new* leadership, many with little or no direct leadership experience. In addition, few of these new leaders were directly involved in the Take-Off 05 change planning process. The expectations for the transition phase were expressed by the top leadership as:

> *"Anchoring at the leadership level - as an effect of the changed organization, Avinor will employ many new leaders at the 2nd and 3rd levels. Many of these new leaders will occupy leading positions in Avinor with significant responsibility and new tasks. It must be assumed that they will not, in the same way as leaders that have followed the entire process, have the same understanding of the process that the company will go through. (p. 21). There must, therefore, be given a certain weight on good organization of the transition phase, as well as, leadership training and learning for the affected leaders. At the same time, it is clear that the candidates in the selection process understand that the positions carry a mandate for fulfilling the measures decided by the steering group for Take-off 05. This also places demands for a clear formulation of the individual projects mandate (Summary Report Take-Off 05 - Design Phase, 2003: p. 22).*

Included in the new top leadership structure was the announcement that the external change agent responsible for the Take-Off 05 planning project, an MBA-educated leader from the public health sector with no experience in civil aviation, would become the director of the newly formed Air Navigations Service (ANS) division responsible for all operative air

navigation services, including air traffic control, in Norway. This announcement received little attention from the unions at the time but would later become a major factor in the conflict that developed between the union(s) and the leadership.

5.4.1 The first shot of a protracted war

On 18 February 2004, the Avinor board of directors readdressed the issue of where to locate ATCC North. Based primarily on the recommendations from DP7, and supplemented by arguments presented to the board from the Avinor CEO, the board decided that ATCC North would be located in Bodø. In addition, the board also decided that the control center in Trondheim would be shut down, and that the operative services from this center would be moved to Bodø (Avinor Board Protocol case 25/2004).

This decision was immediately challenged by the three employee representatives on the board, and these members requested a delay in approving this decision using the arguments contained in the letter from the air traffic controller union (NFF letter of 26 November 2003). This request was discussed within the board, and then a vote was taken to reject the proposal by the employee members, and to accept the decision to locate Control Center North in Bodø, and shut down the Trondheim ATCC. A vote was taken and the motion passed by a vote of 5-3. It was also decided that there was still not enough information to take a decision for where to locate ATCC South, and this decision was shelved until a future date. With the brushing aside of the employee representatives during the board decision for location of ATCC North, it was clear that the participative nature of the Take-Off 05 was over. The reality of the challenges ahead for all sides of the developing conflict became clear.

5.4.2 Keeping up the tempo

With the decision in hand, the process of closing the Trondheim ATCC was quickly set into motion using an abbreviated process of preparing and moving personnel, and operations, to Bodø. According to one leader, the preparations for moving the Trondheim operations to Bodø had, in fact, already been planned and simulated within the various workstations by personnel in Bodø in December 2003, and this activity was kept *secret* for several months prior to the official decision taken by the board. One union official stated that this information created *bad blood* between the two units even before the moving process commenced, and this would later have a negative affect on the integration process in Bodø.

Of the 30 air traffic controllers located in Trondheim, 17 were sent letters in April 2004 giving them two-weeks to either accept relocation to Bodø, as part of the closing of Trondheim ATCC, or being terminated from the company.

> *"I was sent a letter giving me the option of moving or quitting voluntarily with a very short notice period. As I was still under a contract obligation, I guess I could have quit but as I was young and without too many commitments I chose to move. It was not so easy for others, and none of the experienced air traffic controllers moved, and I do not believe that any supervisors moved north. They all received other jobs elsewhere in the system based on their seniority*." (Air traffic controller, Trondheim ATCC)

The move was not as painless for other junior air traffic controllers with families based in Trondheim. The majority of these controllers chose to commute to Bodø rather than expose their families to the move north. Reasons given for not moving the family to Bodø included: established family networks (local roots), a lack of reasonable housing, excessive cost of relocating, and unavailability of acceptable job opportunities for partners. But the decision to commute was not without cost, and created a significant financial burden for those who chose this option. The first was maintaining two high-cost residences, and the second was the excessive cost to cover round-trip airline tickets for this long-range commute. But these costs were not limited to the individuals involved as there would also be substantial operational costs for Bodø. Air traffic controller's commuting to Trondheim were not available to fill in holes in tight watch schedules on short notice, and this became increasingly disruptive considering the minimal manning levels created by Take-Off 05. And this would later become even more critical when the civil aviation regulatory agency, Luftfartstilsynet, cracked down on the use of overtime due to safety concerns. Up until this point, the regulatory agency had often granted dispensation for overtime limits, so this change significantly affected work schedules for a unit that had already used up most of its overtime quota for the year. But this was only one resource issue created by external stakeholders that was not anticipated by the leadership, and this topic will be discuss in further detail later in this chapter.

The Air Traffic Controller Assistants (ATC Assistants), on the other hand, suffered a completely different fate from the air traffic controllers. First, with the acceptance of the Take-Off 05 planning document, the Avinor leadership announced that due to the synergies created by the new technological platform (NATCON), and the new operational concept, most of the tasks of the ATC Assistants would either be eliminated by the new system or transferred to air traffic controllers, so a large portion of this group would no longer be needed within the organization. This meant that most ATC Assistants would be without jobs

in the near future. However, the timeframe for achieving these synergies was unknown, so every ATC Assistant that I spoke with lived under the constant threat of losing their job on short notice. This created several problems. The first was reduced morale based on an unknown future and no direct communication from the leadership. And this also carried over to the air traffic controllers who worked closely with the ATC Assistants in the performance of their tasks. And the second were unplanned losses of ATC assistants that left Avinor unexpectedly when other opportunities arose. For the Trondheim crew, only five of fifteen ATC assistances were offered the opportunity to move north, the remainder left the company.

5.4.3 A glimpse into the troubled waters ahead

The decision and announcement to close the Trondheim ATCC in February 2004, had an immediate devastating effect on employee morale in Trondheim, and even produced short-term affects on productivity in the form of increased sick leave that would eventually lead to the first signs of the potential difficulties ahead. The following headline in the national newspaper Verdens Gang (VG) website was the first of what would become routine national media coverage of the internal conflict developing within Avinor due to the Take-Off 05 project:

> ***"Sick Air Traffic Controllers create Easter-chaos*** *- Sick leave among upset air traffic controllers at Trondheim airport has led to delays and long waiting periods for several thousand Easter tourists.***"** (VG, 13 April 2004: artid=222881)

According to the Avinor leadership, the traffic restrictions over central Norway causing the delays were directly due to the elevated levels of sick leave by the air traffic controllers in Trondheim:

> *"We believe this is connected with the control center at Værnes (Trondheim) being closed down and that employees are losing their jobs. We have reasons to believe this is the connection. We are talking about many jobs that will disappear, and many feel that this is a large personal burden." (*VG, 13 April 2004: artid=222881*)*

The Easter chaos situation in Trondheim was short-lived but was only a small sample of the media storm to come, and the beginning of national media exposure of the Take-Off 05 project that would increase pressure on the Avinor leadership, and would plague the implementation process over the next two years. ATCC Trondheim officially closed on 12 September 2004.

5.4.4 Loss of confidence and trust in the leadership

By the middle of summer 2004, the effects the Take-Off 05 process began to take its toll on the entire organization. Downsizing and reorganization processes, particularly in administrative positions, had increased the workload on the remaining personnel. The leaderships' top-down approach for handling initiatives by the unions and the employee members of the board, created a combative atmosphere that led to loss of trust and confidence in the leadership, and this led to resistance that spread throughout the company. This convinced the unions that the change process was out of control, and on 15 June 2004 the 7 trade unions, with the air traffic controller union in the lead, sent a joint letter of no confidence in the CEO and the top leadership to the Avinor board of directors. Surprisingly, this event gained little national coverage at the time but will resurface later.

5.4.5 A clash of cultures

The move to Bodø in August 2004, was a difficult transition for the seventeen air traffic controllers selected from Trondheim to man the new sector south at Bodø ATCC. These controllers were relatively junior on the union seniority scale so they had little choice but to accept the move, or leave the company. As mentioned earlier, most did not want to move, and only did so as they had no immediate alternatives considering the short timeframe they were given to decide. Every air traffic controller that I spoke with expressed deep dissatisfaction with the way they were treated by the leadership during the moving process, and also with the reception they experienced by their new co-workers in Bodø. There was little advance personal contact between the units before the move, and one leader believed that this was a conscious decision by the top leadership. The chief air traffic controller responsible for the Bodø ATCC was also not satisfied with the preparation process:

> *"When I learned that the Trondheim sectors would be moved to Bodø, I wanted to get involved earlier in the process and to get to know our new colleagues. I wanted to sit down and discuss what had been said concerning the decision and what needed to be done so that they would be well-prepared to come here …but I was not allowed to be a part of that process." (Chief Air Traffic Controller, Bodø)*

It was also clear from the discussions that I had with many of the former Trondheim air traffic controllers that they had experienced a sort of culture shock with regards to working procedures and reporting routines in Bodø. In addition, as no senior air traffic controllers accompanied them to Bodø, they felt that they had no real management representation in the

new location. Supervisors responsible for supporting sector south were covered by supervisors from the northern sectors (former Bodø ATCC sectors). These supervisors were neither certified, nor technically knowledgeable, in the southern control areas for which they were personally responsible. This created an even more difficult situation when combined with the already weak cultural integration that one supervisor described as:

> "*They are not agreed in either the way we do things or anything else, and none of us here in Bodø are checked out in that sector, not even me as a supervisor, I do not have a certificate for the south sector, none of us do, it is only these people from Trondheim that have them. Many times we find ourselves in conflict were we must operate with 'flow control' and such things and I can not even discuss this with them because I do not actually have the competence to do so (in that sector). This is a very unacceptable situation and if I take a decision, that I believe must be taken, they are dissatisfied with me.*" (Air Traffic Controller Supervisor, Bodø)

Despite the fact that the potential difficulties of integrating two different cultures during the movement of Trondheim to Bodø was addressed during a CRM (Crew Resource Management) session in November of 2004 (CRM Report, 2004), no apparent follow-up to these recommendations were conducted either before the move or once the Trondheim group arrived in Bodø. This led to a clear split in the local culture that was visibly obvious to an outside observer, and this split had a significant effect on the combined local culture that deteriorated over time.

5.4.6 The decision to close Oslo ATCC (Røyken)

On the morning of 27 September 2004, the Director of the Air Navigation Services Division personally delivered the news that the Oslo ATCC (Røyken) would be closed down, and relocated to ATCC South in Stavanger. This news came as a total shock to the air traffic controllers gathered within the Røyken complex who had never even considered that the largest and most modern air traffic control center in Norway could possibly be closed down. Their collective reaction was swift and dramatic - all of the air traffic controllers on watch were so *upset* by the announcement that all of the air traffic controllers on duty declared themselves unfit to safely control aircraft, diverted all airborne aircraft for immediate landing, and left their positions.

The ensuing national chaos was immediate and dramatic, and would effectively shut down all air travel in southern Norway for nearly two days, stranding many thousands of passengers, and severely burdening national airlines that were already suffering economically due to the

depressed conditions within the aviation industry. The air traffic controllers, who were often cited in the media for taking work actions with dramatic national consequences, claimed that this was not an action but a genuine human reaction to the dramatic news they had received:

> *"This is not an action, nothing has been planned. No one has gone out sick or has gone home from their job it is just that some individual's have determined that it is not defendable, from a safety perspective, to work further." (Comments by union representative – VG 27.09.2004: artid=247096)*

The reaction of the air traffic controllers to the decision that the Oslo ATCC would be shut down, and the national consequences of their response, caught the Avinor leadership completely off guard, and elevated the internal conflict to a new level that would only escalate over the following months.

5.4.7 Media storm

The national civil aviation chaos caused by the air traffic controllers' reaction to the news of the decision to close the Oslo ATCC, and the temporary shutting down of all airspace in southern Norway for safety reasons, generated an instant media storm that would rage over the next fifteen months. The media coverage was relentless, and would escalate until the departure of the CEO in December 2005, and the replacement of the Chairman of the Board in early-2006. During that timeframe, VG Nett, one of Norway's most widely read internet news sites, published no less than 89 news articles directly related to the effects of the Take-Off 05 project. More interestingly, the news media, in all forms, became the primary communications means between the employees, leaders and external stakeholders including: airlines, regulatory agencies, government officials, and even private citizens directly or indirectly affected by the Take-Off 05 project. And this was especially true for the two internal professional magazines Bakkekontakt (Avinor) and Flygelederen (Air Traffic Controllers) where point and counterpoint articles were featured each month. The internal rhetoric became so predictable that employees referred to Bakkekontakt as "Pravda" in reference to the government-controlled newspaper from the days of the former Soviet Union. It was also clear that this form of communication was more harmful than helpful in addressing the internal conflict.

5.5 Safety as an outcome of change – HSLB report

The Oslo ATCC closing decision, and the dramatic events that followed, put a national *spotlight* on the Take-Off 05 project, and raised questions as to whether this obviously painful

change process was affecting *safety* within the civil aviation industry as a whole. And this was particularly appropriate as Avinor was not the only major civil aviation organization undergoing dramatic deliberate organizational change during this period. For example, the national Norwegian civil aviation regulatory agency (Luftfartstilsynet), responsible for monitoring safety levels and regulatory conformance by all of the actors within the civil aviation industry, including Avinor, was undergoing a highly public, and controversial, politically motivated forced relocation from Oslo to Bodø. In addition, the two largest national air carriers in Norway (SAS and Braathens) were merging into one airline (SASBraathens) while simultaneously conducting a painful major downsizing and reorganization project.

In addition, as the focus on how organizational change was affecting safety within the civil aviation industry intensified, several opposition parties within the Norwegian government began demanding that an investigation be conducted looking into the general health and safety of the civil aviation industry. In a letter dated 7 October 2004, the Norwegian Transport Ministry responds by directing the Norwegian National Transportation Board (HSLB) to conduct a special investigation into the general condition of flight safety within the civil aviation industry in Norway:

> *"With the goal of hindering future aviation accidents, the department asks HSLB to conduct a more general investigation and analysis of how flight safety has been taken care of in connection with the ongoing changes and reorganization processes by the national authorities, and companies within the Norwegian Civil Aviation industry*."

Based on this request, HSLB conducted a comprehensive study of the Norwegian civil aviation industry focusing upon three areas:

- Civil aviation authorities
- Infrastructure and air traffic services
- Airlines

The report entitled "*Flight Safety in Norwegian Civil Aviation under Reorganization Processes*" evaluated a four and a half year reflection of change within the civil aviation industry, and was released on 5 August 2005. The main conclusion from the study was that the civil aviation industry in Norway was safe, but also added that:

> *"The general high safety level, and resulting low number of accidents and serious incidents, makes it difficult, if not impossible, on a national level to use accident statistics to 'measure' or assert if flight safety has become better or worse as a result of*

the past years reorganizations/changes. However, the main conclusion is that a number of large and small changes were not adequately evaluated for consequences considering safety – neither individually nor comprehensively."

The report did, however, raise many serious questions directed specifically at the Avinor leadership, including:

- The Avinor leadership should evaluate competence requirements within the fields of civil aviation and/or safety management for leadership positions with flight safety responsibility

- That Avinor should pause decided or planned safety-related "Take-Off 05"-measures that have not already been implemented until safety-related consequence evaluations have been thoroughly conducted and documented, with reflection on DNVs impressions and comments, as well as, confirmed with relevant safety and regulatory agencies.

- That Avinor should evaluate conducting a documented analysis of experiences from Take-Off 05-measures that have already been implemented, with consideration of the DNV impressions and comments, and that relevant national authority demands have been taken into consideration.

- Avinor should consider increasing capacity, in general, and professional safety competence specifically for following up the increasing number of recommendations and measures that the safety management systems generates.

- The "employer" Avinor and the employee organizations together should consider intensive work to achieve better cooperation and employee involvement in internal decision making processes such that it creates trust between the partners. This is considered essential for developing a positive safety culture. (HSLB Report, 2005: p. 7).

In an accompanying VG Nett article, "Worried about Flight Safety", the head of the HSLB expresses concerns that Avinor's safety focus, based on minimum requirements, is unsatisfactory, and that the relationship between the leadership and employees is tense:

"We have identified a lack of trust that large groups within Avinor have toward the leadership, which is not advisable for a safety culture … but provided the changes we have recommended are implemented, safety can be good." (VG Nett 05 August 2005: artid=285939)

And this is commented upon by the Avinor leadership:

"The most important thing that we read in the report is that safety in Norway is good, and do not agree that the report attacks our work. Not at all, the report's main conclusion has confirmed that flight safety in Norway is good and that it has become

even better over the past years. And that is the most important thing for us … and for those who are out flying." (VG Nett 05 August 2005: artid=285939)

The publishing of the HSLB recommendations, and the response from the Avinor leadership, only added fuel to the fire between the Avinor leadership and the union. The union claimed that Avinor's leadership did not accept, or even recognize, the criticism directed against them, and believe that they only focused on the positive parts of the conclusions. One Avinor leader put it this way:

> *"I have read the response that Avinor will send to the Havarikommisjon, and I think that when I read these words I wonder if they have read the same report as I have read. They turn everything into a positive. So if these are positive things and not negative, then you get the impression that everything is alright anyway ... but it is not." (Chief Air Traffic Controller)*

The HSLB report marks a new phase in the struggle between the Avinor leadership and the union. As the media coverage intensifies and disruptions within the Norwegian civil aviation industry become daily events, a new threat for the leadership is looming on the horizon … national elections. With national elections taking place in September 2005, it becomes clear that a shift in national government could significantly change the political landscape, and adversely affect the positive political support the leadership had enjoyed up to this point. This realization by the union puts all short-term internal negotiations on hold awaiting the political outcome, and the focus of the conflict shifts to the question of manning.

5.5.1 How many air traffic controllers?

By early-fall of 2005, high profile airline delays, and threats of delays, became daily media events. The reasoning behind these delays was invariably inadequate manning levels of air traffic controllers or ATC Assistants at all three ATCCs in Norway. And this became a major point of contention between the leadership and the union. The leadership argued that there were still too many air traffic controllers in the system, and, of course, the union argued that there were too few. The leadership's arguments were based on the operative manning requirements reflected in the Take-Off 05 project which called for a reduction of 72 Air Traffic Controllers and 164 ATC Assistants from 2002 levels, just in the areas of en-route services and Landing/Departure/Approach services. (Summary Report Take-Off 05 - Design Phase, 27 October 2003: p. 16).

In reality, however, no air traffic controllers were ever forcibly cut, but several had accepted voluntary severance packages under pressure of being cut, and quite a few others left, unexpectedly, to take jobs in other countries. In addition, air traffic controllers who were not cut, but moved to other positions, voluntarily, were effectively removed from operative service for a period of anywhere between 8-12 months while undergoing retraining at their new site according to one middle manager. Though these moves were limited due to understaffing throughout the system these unplanned moves were a direct result of the Take-Off 05 process.

One major problem for the leadership's line of argumentation was that the Take-Off 05 savings were based on manning requirements using the 2002 "zero-point" calculations, and significantly reduced traffic volume projections. According to several middle managers, these calculations were flawed for several reasons. First, traffic volume had increased dramatically over the 2003 predictions, and this fact, by itself, significantly increased operative workloads. Second, air traffic controller requirements had been calculated primarily on operative tasks based on expected synergies from the new technology and processes (that never fully materialized), and did not adequately account for administrative tasks. In addition, severe cuts in administrative staff, throughout Avinor, had taken place creating an increased administrative burden throughout the system. And this was particularly reflected in the administrative workloads for chief air traffic controllers who were no longer operative, and spent a larger portion of time dealing with the growing administrative burden. Every chief air traffic controller that I spoke with was drowning in paperwork, and felt that this was negatively affecting their ability to lead.

The growing administrative workload was further aggravated by the introduction of new administrative demands, both externally and internally-driven, that significantly reduced operative availability, such as: annual recertification and training requirements for air traffic controllers, incident and accident investigation board participation as part of the new safety management system, and other unplanned tasks. Another unplanned drain on operative availability was the initiative by the civil aviation regulatory agency (Luftfartstilsynet) restricting the use of all overtime over 200 hours, and significant tightening of the rules for using overtime in other areas. This had an immediate and dramatic effect on Bodø where large-scale military exercises in the spring of 2005, virtually used up all extra overtime hours for the year by mid-August 2005. And finally, effective on the first of January 2005, the

Norwegian Regulatory agency (Luftfartstilsynet) determined that the operative age limit for air traffic controllers would be 60 (vice 65) years of age (BSL C 3-1, 2004). This created a significant unplanned loss of personnel, and these losses were not considered in the Take-Off 05 planning process.

One manning issue that did not have significant short-term effects on operations but did create a long-term problem that was directly tied to cost-cutting was the decision by the top leadership to shut down the pipeline for training of new air traffic controllers in the US, and instead to join an initiative between the Scandinavian countries to form a joint Scandinavian Air Traffic Controller training facility in Sweden. This decision, although not intended to last for more than 12 months according to one top leader, created a multi-year gap in new air traffic controller trainees that would create problems for the organization well into the future, but more importantly, also increased the dissatisfaction between the air traffic controllers and the leadership.

5.6 A change in government

On 15 October 2005, an official change in the Norwegian national government brought in a new transport minister and, more importantly, a change in the level of political support for the Avinor leadership. The autumn months were filled with a series of highly critical media articles warning of impending civil aviation delays due to minimal air traffic control manning, and also questions raised as to the wisdom of the business model used by Avinor which combined "*pizza and parking*" with air traffic control. In addition, an increased focus on incidents and near-accidents within civil aviation, often dating back years, received near-daily attention. With the new government in place, and increasing focus on safety in civil aviation, various political parties demanded that the reorganization process in Avinor be stopped, and that the entire organization should be evaluated. In response to these calls, the new transport minister decided to initiate a full evaluation of the Avinor business model on the first of November 2005.

5.6.1 NRK Brennpunkt (Ignition Point) - the beginning of the end

On 8 November 2005, the National Norwegian Broadcasting Company (NRK) televised a highly critical documentary entitled – "*An Incident*." The documentary uncovers an important, safety-related, airspace management project that the Avinor leadership has quietly placed *on ice,* due to lack of resources associated with the Take-Off 05 project, without

informing the regulatory agencies in Norway. The documentary is dramatically set within a real-life, near miss situation taking place in June 2000, and capitalizes on the recent drama surrounding the Take-Off 05 project to increase the critical focus on the Avinor leadership. The program includes direct critique from the leaders of Norway's two leading civil aviation regulatory agencies - Luftfartsverket and the Norwegian Transportation Safety Board (HSLB). The program succeeded in placing a spotlight directly upon the Avinor top leadership with particular focus on the director of the Air Navigation Services Division, the CEO and the Chairman of the Board.

5.6.2 Avinor Director quits in protest

On 16 November 2005, eight days after the media storm created by the Brennpunkt program, the director of the air navigation services organization unexpectedly quits in protest reportedly over the transport minister's decision that the organizational form of the company will be reevaluated:

> "*I took this job in 2003 because I believed in the change process that had been approved. And I still do. I consider the decision that has now been taken to reevaluate Avinor's organizational form as legitimizing the resistance to the changes. Therefore, I have decided to resign.*" (VG Nett 16 October 2005: artid=109538).

This resignation was followed quickly by an article where the regulatory authority, Luftfartstilsynet, comments:

> "*Now we have had enough. From now on we will approve all employment of Avinor's top leadership with responsibility for flight safety and will demand a professional aviation background*."

5.6.3 CEO finished as Avinor chief

After a continual barrage of negative media articles in December, the Avinor board of directors, together with the CEO, mutually decided on 16 December 2005, that the best decision for all concerned would be for the CEO to resign with immediate effect:

> *"The CEO has, together with the board, due to the recent media pressure that has taken place, found it best to replace the top leader in the company." (VG Nett 16 December 2005: artid=111089)*

With the departure of the CEO on 16 December 2005, the Take-Off 05 project is effectively aborted.

5.7 Summary

In this chapter, I have presented the chronological events of the Take-Off 05 project covering a three-year period from the initial environment creating a need for change in 2002, through the eventual collapse of the project in December 2005. I have tried to highlight how leadership decisions and actions, in the context of the organizational culture in place, influenced employee attitudes and perceptions toward the change process. And, more importantly, how individual reactions to decisions made, and actions taken, destroyed a general consensus for change, led to a loss of trust and resistance to change, and eventually contributed to the collapse of the Take-Off 05 project.

I showed that in the beginning, there was relative agreement on both the need for change and some of the more controversial elements of the change plan. And one could also argue that this was even supported by the existing culture within the organization. But when the leadership chose to change its direction regarding change implementation type to purely top-down process, this triggered an immediate clash between the leadership culture and the air traffic controller subculture. But cultures are slow to change, and the initial resistance by the air traffic controller subculture was more reactive than deliberate. However, as the conflict developed and resistance began to take effect, a more deliberate resistance emerged and was eventually joined by other unions.

Another important discovery from the chronological presentation identified how leadership choices and actions, in the context of a mixed-type organizational change process adversely affected employee attitudes toward change and perceptions of safety. In addition, I have also tried to highlight how deliberate organizational change and evolutionary change can interact in unexpected ways leading to failure. This was particularly evident when external actions taken by regulatory agencies reduced the use of already limited operational resources, such as periodic training and certification, overtime usage restrictions, and operational age limitations. In addition, the Take-Off 05 plan was based on operational assumptions which proved to be inaccurate over time. One issue that was not addressed specifically in this chapter, but was an obvious factor for change implementation success, was the speed, or pacing, of the change process, and the leadership's unwillingness to slow the change process when signals of internal and external stress were evident.

Another important factor revealed in the presentation addresses how the external environment can directly influence the change process, especially when strong external stakeholders

become directly involved in complex change initiatives. Two areas that were particularly influential in the Avinor case were the influence of the news media on change success, and the contributions of key stakeholders.

The intention of this chapter was to map the Take-Off 05 planning and implementation process against chronological events that affected the individuals in the embedded cases. In the next chapter, I will triangulate qualitative and quantitative data taken from two different points of time to show how the dramatic events from this chapter affected the key constructs described in the Safety Management Model presented earlier to both better understand the consequences of the leaders' decisions and actions, and to fine-tune the constructs to be used in Chapter 7.

6 Mapping the effects of deliberate organizational change

In the previous chapter, I presented a three-year chronological account of the deliberate organizational change project known as Take-Off 05 with particular emphasis on key events, and how leadership choices and actions, in the context of a *mixed-type* organizational change process, adversely affected employee attitudes toward change and perceptions of safety. I then showed how changes in attitudes towards the change process led to resistance to change, and ultimately, contributed directly to the collapse of the Take-Off 05 project.

In this chapter, I will narrow the focus of the study further to cover the final turbulent 12 months of the Take-Off 05 project, and I will analyze how the change process affected the four latent variables of interest for the research questions within the four embedded cases at the individual level, specifically: leadership in context of change, safety climate, attitude toward change, and employee perceptions of safety. I will do this by triangulating both qualitative and quantitative data in within- and across-case comparisons of the four embedded cases during the last 12 months of the internal conflict. Through this analysis, I intend to fine-tune the latent variables for use in the safety management model in Chapter 7.

6.1 Organizational and safety climate

It has been shown that organizational and individual factors interact to produce climate-related perceptions that can differ geographically within large organizations (Schneider and Reichers, 1983), and can also vary over time. As described in the literature review, organizational climate is a surface manifestation of organizational culture, and, as such, can be measured using psychometric techniques (Schneider and Gunnarson, 1991; Cox and Flin, 1998; Hale and Hovden, 1998). Mearns et al. (2003) argue that climate is a surface manifestation of culture, and is measurable, but that culture is too abstract to measure directly. But psychometric measures, by themselves, are not enough as they do not fully reveal the underlying cultural aspects affecting local conditions.

Safety climate is a specialized form of organizational climate particularly associated with high-risk industries, and includes high reliability organizations, and this is the area I will focus on in this chapter. In the specialized field of safety, a recent trend has been to use a combination of psychometric techniques with qualitative approaches to investigate safety culture, and these are often referred to as safety audits (Flin et al., 2000; Ciavarelli, 2003). Schneider (1975) assumes that attitudes and perceptions have psychological utility, and serve

as frames of reference for guiding behavior. And this is supported by others that have shown that employees develop coherent sets of perceptions and expectations, and act accordingly (Dieterly and Schneider, 1974; Litwin and Stringer, 1968). And, although there are mixed reviews in the early literature regarding the effects of changes in attitudes and perceptions on behavior (Griffiths, 1985; Syroit, 1985), and some studies only credit weak influence (Eagly, 1992), more recent studies have shown that perceptions and attitudes are essentially behavior predictors (Glendon and McKenna, 1995). And this has been shown to be particularly relevant in safety-related behavior (Donald and Canter, 1993).

In the Avinor case, I will use the definition of safety climate provided by Diaz and Cabrera (1997), which is an extension on the work of Zohar (1980), "*as a set of molar perceptions, shared by individuals with their work environment, which are valid as reference for guiding behavior in the execution of tasks during day-to-day eventualities*" (p. 644). Safety climate is also reflected in the workforce's perceptions of the organizational atmosphere (Flin et al., 2000) which Guldenmund (2007) describes as a *snapshot* of culture that is both more superficial and transient than culture itself. It is this concept of a *snapshot of safety* at a specific point in time that will be the focus of Chapter 7.

Safety culture, on the other hand, is more complex and long-term, and is less quantifiable using psychometric techniques, and is best analyzed using a mix of qualitative and quantitative methods. Flin (2007) argues that this is required because questionnaires alone cannot uncover the underlying safety culture. And this is also of great interest to the civil aviation industry as evidenced by the current initiative by the EUROCONTROL Experimental Center to further this area of research (Gordon et al., 2007). This is considered an important initiative in that a strong safety culture, by its nature, can prove to be a competitive advantage if you consider safety as an emergent property of a complex system that produces safe outcomes (Hollnagel, 2008) that are also key performance indicators, and it has been shown that strong safety cultures produce long-term positive effects on performance.

6.2 Method

6.2.1 Samples

Interviews - The qualitative data set consists of 30 random semi-structured interviews conducted at the three surviving ATCCs (Bodø, Stavanger and Oslo) in the Oct/Dec 2005 timeframe. The Bodø ATCC, in 2005, is a combination of the former Bodø and Trondheim air

traffic controllers and ATC assistants at the time of the interviews, and the sample is proportionately representative of these two groups. Each interview started with the signing of a formal study contract where I introduced myself and the academic institution that I represent, a presentation of my academic and aviation background, the purpose of the study, my role as a neutral researcher, how the interview process would be conducted, and how confidentiality would be maintain, and data handled. I then asked each interviewee to co-sign a study contract, and each participant received a copy of the signed document.

Ten interviews were conducted at each site, and each contained a mix of junior and senior air traffic controllers and ATC assistants, the chief ATC, and two middle managers (including one ATC watch supervisor). Randomness was achieved by only interviewing persons appearing on the watch schedule during the planned 5-day visit, and only those personnel that fit into the interviewing schedule during regularly scheduled break periods were allowed to participate. The only exception was the participation of the Chief Air Traffic Controller which is the local leader for the unit. All air traffic controllers; ATC assistants, middle managers, and Chief ATCs accepted the opportunity to be interviewed.

6.2.1.1 Questionnaires

The second set of data for comparison purposes in this chapter consists of two samples from an Avinor-initiated organizational climate survey prepared and conducted by the private organizational analysis firm - Humetrica Organization Analysis (HOA), and was administered at two different points in time. The first sample was conducted in November 2002, before the Take-Off 05 process commenced, and the second sample took place in December 2004, during the turbulent period following the decision to close down second ATCC in Oslo (Røyken). The average response rates and percentages for the two questionnaires were:

2002

- Trondheim ATCC (n=30/48 for 63%)
- Bodø ATCC (n=33/68 for 49%)
- Stavanger ATCC (n=30/52 for 58%)
- Oslo ATCC (n=62/120 for 52%)

2004

- Bodø ATCC (n=46/85 for 54%)
- Stavanger ATCC (n=35/50 for 70%)
- Oslo ATCC (n=64/103 for 62%)

The questionnaires mapped 10 different organizational factors with 74 items common for both years:

- Leadership
- Development
- Teamwork
- Rivalry
- Work satisfaction
- Cooperation
- Customer focus
- Quality focus
- Safety and health
- Policy

Respondents were required to rate their level of agreement with regards to each item based on a 7-point Likert scale ranging from (1= do not agree) to (7=completely agree). Questions were formulated in a combination of both positively and negatively worded questions. An additional 14 special interest items were included in 2004, and these items will only be used for across-case analyses in the three remaining ATCCs in 2004.

For this study, I have grouped selected items from the organizational climate questionnaire into three separate dimensions corresponding to three of the latent variables of interest for the research questions, specifically:

- Leadership – job performance, motivation, communication, commitment, and trust
- Organizational/safety climate – personal conflict, communication, competition, physical working environment, emotional environment, motivation, morale, job satisfaction
- Safety – reporting, error management, safety performance

As this questionnaire was not specifically designed as a safety climate survey, the safety-related questions only covered a small part of this dimension, and were of minimal use, so this section will rely primarily on the interview data. As there were no questions specifically focused on the change process itself in either questionnaire, this area will only be addressed using qualitative data in this chapter.

6.3 Mixed-method approach

In order to more fully understand the differences in organizational climates and the underlying cultures that develop in the embedded cases during the period of interest, and how these differences might affect safety behavior, I will use a mixed-methods approach to triangulate the results of the individual semi-structured interviews conducted at each of the embedded units during the Fall 2005, with quantitative data from the two internal

organizational climate questionnaires. The primary focus of this chapter will be on the semi-structured interview responses that reveal the underlying safety culture, and these responses will be used as a basis for fine-tuning the latent variables to be used in the safety measurement model.

The organizational climate questionnaires will be used primarily to confirm within-case and across-case differences, and also to map the effects on organizational climate at the embedded units at two different points in time. There is an ongoing debate regarding the best mix of dimensions to measure safety climate (Flin et al., 2000; Guldenmund, 2000; Zohar, 1980: 2003) but most studies agree that the leadership's role is of significant importance, and is also reflected in the change literature (Isabella, 1990; Dasborough, et al., 2003; Lines, 2004). Accordingly, I have split leadership in the context of change out as its own construct, as depicted above, and this will be further refined in the safety measurement model in Chapter 7 based on this analysis.

6.4 Analysis

In the following section, I will present within-case and across-case analyses of the four embedded cases using primarily qualitative data from the semi-structured interviews supported by quantitative results from the organization climate questionnaires where appropriate. It is important to remember that the semi-structured interviews and the second administration of the organization climate questionnaire took place midway through the Take-Off 05 implementation process, and this was also the most turbulent period leading up to the collapse of the Take-Off 05 project. At this point in time, the Bodø and Trondheim ATCCs had been merged into one unit, the Oslo ATCC had been informed that they would be closed down and merged with Stavanger in 2008, and the Stavanger ATCC knew that they would assume the role as ATCC South. Accordingly, each unit was experiencing a completely different phase of the same organizational change process and it was obvious during site visits that each was being affected in different ways which will be confirmed by the data.

The questionnaire data will be used in two ways. First, I will conduct within-case analyses to show how the change process affected individual embedded units at two distinct points in time. For this purpose, I have combined the responses from Trondheim and Bodø in 2002, and these units merge into one unit in Bodø in 2003. The decision to merge the responses was made after the responses from Trondheim and Bodø in 2002 were analyzed using an independent-sample case analysis in SPSS, and found that the responses from these two units

were remarkably similar with only 3 items indicating significant differences (Appendix C). For the remainder of the chapter, I will conduct across-case analyses comparing how the remaining three embedded units differed in their responses due to experiencing different phases of the same change process. I will do this by comparing coded data from the individual interview responses and triangulate, where possible, with the responses from the operational climate questionnaires.

6.4.1 Within-case and across-case analyses

The results of the within-case analyses will be performed by comparing responses in the four embedded cases from 2002 and 2004 for the three imbedded cases: Trondheim/Bodø, Oslo and Stavanger as depicted in Figure 6-1.

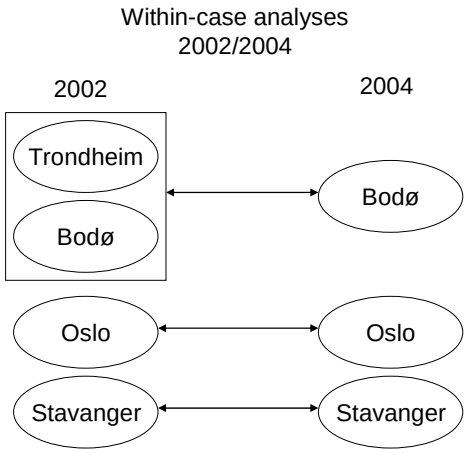

Figure 6-1: Within-case analyses

Across-case analyses will be performed by comparing responses between the three remaining embedded units in 2005 as depicted in Figure 6-2.

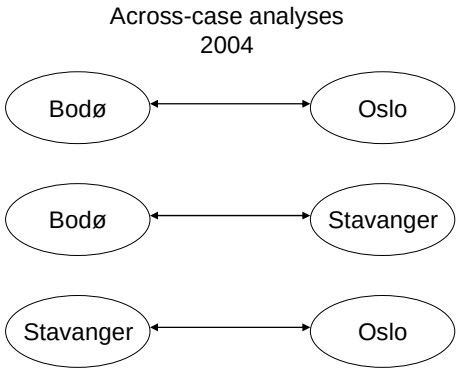

Figure 6-2: Across-case analyses

6.5 Leadership in the context of change

In the safety literature, the leadership's role in the context of safety has been shown to have a strong influence on safety attitudes and behaviors (Zohar, 1980: 2003; Flin et al., 2000; Flin, 2007; Gordon et al., 2007), and this is also reflected in the change literature (Isabella, 1990). For this reason, leadership in the context of change has been separated from safety climate as its own construct as mentioned earlier, and it is expected that leadership has a direct influence on both employee attitude towards change and perceptions of safety. Leadership also has an indirect influence on safety via attitudes toward the change process. The same relationships are true for safety climate with the same direct and indirect influences.

During the coding of the semi-structured interviews, 24 of the 108 free nodes coded in NVIVO 7 were directly related to leadership issues, and many others were indirectly related. Leadership, itself, was the most common coded response followed closely by safety and safety culture, and these free nodes often intersected in the interview responses. This demonstrates the close relationship between these two variables in a high reliability organization where safety is a key performance indicator. There were also many direct reflections on individual leaders but for this analysis I will only focus on top leadership traits, as a group, and not individuals. In addition, it is clear that there was a significant difference in attitudes toward the local leadership and the top leadership in all of the embedded units, and I

will consider all levels of leadership above the local level as top leadership for analysis purposes.

In the relationship between the leadership and change, the most common comments are related to the leadership's top-down approach that limited employee input into the process:

> *"I do not know who they used to evaluate this strategy, or how they came to this process here, but I am convinced that they did not use the employees with the professional competence that should have been involved. Even the experts will say that this just won't work and I can't either. And those who make these decisions should also have competence in the job that will be done, they should."* (Bodø 02)

> *"That which bothers me most is that leaders do not listen to their own employees, especially in the areas were they are weakest, and particularly manning issues."* (Stavanger 02)

Top-down summary. The preceding quotes were representative of most responses where 100% of the respondents characterized the leadership's approach as top-down during some phase of the change implementation process. The leadership actions, including the perception of a rigid top-down implementation strategy will be addressed further in the follow analyses.

6.5.1 Within- and across-case analyses

6.5.1.1 Local leadership results

Table 6-1 shows the results from five local leadership questions, and one top leadership question, from the organization climate questionnaire:

- V01 - My leader motivates me to do a good job
- V07 - My leader contributes to an open discussion of questions and problems
- V19 - My leader is good at distributing important information that concerns our job
- V25 - My leader is good at creating unity and commitment in relationship to our common goal
- V41 - I have trust in my leader
- V73 - I believe that the top leadership in Avinor is doing a good job for the company

Based on the local leadership items (V01, V07, V19, V25, and V41), we can see that the local leadership from both the Trondheim and Bodø ATCCs were rated very highly by the employees in all items in 2002. In contrast, the local leadership from the Oslo and Stavanger ATCCs were rated significantly lower in these same categories.

Table 6-1: Leadership group statistics 2002 – Trondheim/Bodø ATCC

	Trondheim 2002	Bodø 2002	Oslo 2002	Stavanger 2002	Bodø 2004	Oslo 2004	Stavanger 2004
(V01) Leader motivates	5.00	5.00	3.67	3.97	3.30	6.02	5.57
(V07) Leader Discussion	5.38	4.81	3.87	2.97	3.62	6.38	5.54
(V19) Leader distributes Information	5.21	4.64	3.98	3.53	3.71	6.28	5.69
(V25)Leader unity/ commitment	5.03	4.34	3.56	3.37	3.20	6.37	6.06
(V41) Trust in Leader	6.20	5.84	4.26	4.37	4.17	6.64	6.46
(V73) Leader performance	3.38	3.48	3.54	2.37	1.48	1.13	1.89

The results from the merged Bodø ATCC in 2004 show a completely different picture. First, the merged results in Bodø show a significant reduction in employee attitude toward the local leadership even though the leadership team in Bodø remained essentially unchanged from 2002. One explanation could be the circumstances described in Chapter 5 where 17 air traffic controllers were essentially forced to move to Bodø, on short notice, with the perception of insufficient administrative and monetary support. In addition, the leadership team had no prior contact with the group from Trondheim before the move, and there was no real attempt to integrate the new personnel into what was essentially a completely different organizational culture/climate. This created two opposing cultural groupings which had negative effects, over time, on both groups and these gradual changes were also observed during my visits to the Bodø ATCC. One air traffic controller from Trondheim described the local climate and leadership as such:

> *"The leaderships contribution to the local working environment is not impressive … they say things that demonstrate that we live in two separate worlds in many respects. Many times I have actually wondered if we work in the same company. It might be that they have a special focus on greater things but it is not good when it turns into a war."* (Bodø 06)

And this split in cultures is also reflected statistically in Table 6-2, where an increase in standard deviation and standard error means in all areas presented where n=56 represents the combined Trondheim/Bodø results in 2002, and n=45 represents the merged Bodø results in 2004.

Table 6-2: Leadership Group Statistics both years – Trondheim/Bodø ATCC

	Trondheim/ Bodø	N	Mean	Std Deviation	Sig. of diff. in means
(V01) Leader motivates	2002	56	4.96	1.549	
	2004	45	3.29	1.950	.000
(V07) Leader Discussion	2002	56	5.07	1.621	
	2004	45	3.59	2.117	.000
(V19) Leader distributes Information	2002	56	4.97	1.810	
	2004	45	3.73	1.933	.001
(V25)Leader unity/commitment	2002	56	4.67	1.538	
	2004	45	3.18	1.980	.000
(V41) Trust in Leader	2002	56	5.98	1.480	
	2004	45	4.13	2.473	.000

6.5.2 Oslo and Stavanger ATCCs - 2004

The results from the Oslo and Stavanger ATCCs showed a very different picture from the Bodø ATCC, with both local leaderships' ratings being dramatically improved in all local leadership categories in 2004. One explanation could be that as a result of the Take-Off 05 process, completely new local leadership teams had been installed in both locations, and it was clear that these new leaders were acting proactively for the employees on the problems that were developing locally. In fact, both the chief air traffic controller and the assistant chief ATC at the Oslo ATCC resigned in protest in December 2005 when the top leadership would not respond to their inputs.

A second explanation for a change in the relationship between the employees and the local leaders is the specific situation in which each unit found themselves within the greater Take-Off 05 change process. At the Oslo ATCC, for example, I noticed a gradual change in attitude toward the top leadership after the unit began to recover emotionally from the shock of the closure announcement. As media attention intensified on a national scale, the local attitude developed into a more war-like footing, bordering on hostility, and was completely focused on the middle and top leadership. This focus on a common *enemy* created a closer bond between the employees at the Oslo ATCC, and this included the local leaders. Unlike the Bodø ATCC, along with the dramatic positive increase in attitude toward the local leadership

in the Oslo ATCC, we see that the standard deviation is reduced indicating closer agreement within the unit.

Table 6-3: Leadership Group Statistics both years – Oslo ATCC

	Oslo	N	Mean	Std Deviation	Sig. of diff. in means
(V01) Leader motivates	2002	60	3.71	1.704	
	2004	62	6.02	1.208	.000
(V07) Leader Discussion	2002	60	3.85	1.821	
	2004	62	6.37	1.028	.000
V19) Leader distributes Information	2002	60	3.97	1.746	
	2004	62	6.27	.833	.000
(V25)Leader unity/ commitment	2002	60	3.57	1.691	
	2004	62	6.33	1.080	.000
(V41) Trust in Leader	2002	60	4.25	1.971	
	2004	62	6.65	.704	.000

The situation in Stavanger was different in that they were not going to be closed down, and this was very positive, but there was still a great deal of apprehension building from the prospects of having to undergo the same painful merging process that was creating problems in Bodø. In addition, the new leadership in Stavanger was also very proactive and openly challenged the top leadership, particularly on manning issues. The changes in Stavanger are reflected in table 6-4, and show the same tendencies of the Oslo ATCC with strong results for the local leadership in place.

Table 6-4: Leadership Group Statistics both years – Stavanger ATCC

	Stavanger	N	Mean	Std Deviation	Sig. of diff. in means
(V01) Leader motivates	2002	28	3.89	1.771	.000
	2004	35	5.57	1.313	.000
(V07) Leader Discussion	2002	28	3.89	1.853	.000
	2004	35	5.54	1.358	.000
(V19) Leader distributes Information	2002	29	3.45	1.526	.000
	2004	35	5.69	1.430	.000
(V25)Leader unity/commitment	2002	29	3.34	1.587	.000
	2004	34	6.06	.983	.000
(V41) Trust in Leader	2002	29	4.31	2.089	.000
	2004	35	6.46	.780	.000

And the interview responses reflect this increased support for both leadership teams:

> *"I am critical to the top leadership not the local leadership. We have had a very, very competent leadership at the local level here at Røyken who have tried to point out problems, point out manning problems, point out which steps must be taken to improve the situation but they continually hit a wall and are unable to push anything through … that is why they quit … so there was nothing that I was dissatisfied with concerning our local leadership, we were very, very satisfied both at the professional level and personal level … they were brilliant.*" (Oslo 06)

> *"Our local chief air traffic controller was the best boss I have ever had … both because he was the boss and he knew his role … he listened to us and we know that he took things forward but no one would listen and that is not his fault, and we know that he felt that he never was heard."* (Oslo 10)

> *"Both of our local leaders are rather fresh and I was a little skeptical at first but they have done a good job even though the boss struggles with the amount of work he has in this phase ... but on a professional level and giving proper responses on things that are taken up, he is really good, absolutely "* (Stavanger 05)

Local leadership summary. The responses above characterized the general impressions of most respondents toward the local leadership. The exceptions to this were the responses from Bodø where the impressions of the local leadership were mixed due to the culture clash issues addressed earlier.

6.5.3 Top leadership results

As depicted in table 6-5, employee attitude towards the top leadership performance in 2002 was slightly negative but not critical. However, in 2004, this deteriorates significantly and indicates a near-total lack of confidence in the top leadership during the height of the conflict period.

- V73 - I believe that the top leadership in Avinor is doing a good job

Table 6-5: Top Leadership Group Statistics both years – All cases

	Trondheim 2002	Bodø 2002	Oslo 2002	Stavanger 2002	Bodø 2004	Oslo 2004	Stavanger 2004
(V73) Top Leader performance	3.38	3.48	3.54	2.37	1.48	1.13	1.89

Employee attitude towards the top leadership was not particularly strong in 2002 at either of the embedded units, but during the height of the turbulent change process this deteriorates significantly and becomes a critical factor. And this is strongly reflected in the interview data. Leadership-related responses from the coded interview data are focused in several specific areas, including: leadership, leadership actions, leadership communication, leadership

qualifications, and leadership commitment. And there were other lesser referenced traits such as: arrogance, false information and lies, hidden agendas, mistakes, and lack of concern for employees.

The responses also included comments that were both general for the entire leadership group and individual to specific individual leaders. Two recurring themes in the interview responses are directed at the leadership's commitment to safety and focus on cost cutting, and these contribute to a fundamental disconnect between the messages coming from the top leadership related to the companies stated number one priority – safety – and the change process. Each of these areas will be addressed in the following sections.

6.5.3.1 Leadership commitment to safety

Leadership commitment to safety is a critical factor in any high-risk industry and is a consistent dimension of interest across the safety climate literature (Zohar, 1980; Díaz and Cabrera, 1997; Flin et al., 2000; Guldenmund, 2007). The interview responses were consistently negative toward the leadership's commitment to safety:

> *"If the leadership's commitment to safety isn't a complete disaster, then I think it is on the right track to be so. I have been in many division leadership meetings where some of the comments made by the top leadership are frightening, in my opinion. They claim that they are focused on safety but the reality is quite different … the level of understanding between the divisional leadership and the operative air traffic controllers is zero."* (Stavanger 03)

> *"The leaders say they are committed to safety, but it is not believable if you look at the way the employees are treated … it affects safety. We are tired and angry."* (Oslo 05)

> *"I think the leadership's commitment to safety is poor. I think it is completely unacceptable that they go out in the media and say that they set safety as the highest priority when they do not even react to things such as our manning situation … they have a completely different understanding of reality than we have."* (Bodø 08)

> *"Their commitment to safety is not reflected in their vision to be the leading organization in Europe for safety if you consider, first and foremost, our manning situation because that does not match up. I remember once a comment made in an interview by one leader - it is not the number of heads that counts, it is the quality within those heads that is of vital importance. But that is an illusion because it is obvious that you have to have enough people to do the job, and you cannot just say that it is the quality that counts, and in this regard I think the leadership has misunderstood the point, at least in relationship to flight safety."* (Stavanger 03)

"I would not say that the leadership is committed to safety. A lot looks good on paper and sounds very nice. They say all of the right things in interviews with the required dose of self-critique. But there has been no change." (Bodø 03)

Leadership commitment summary. Individual responses regarding the leadership's commitment to safety were some of the most critical and emotional responses recorded during the individual interview process. Two areas received the most focus. The first was the question of technical competence of the leadership to lead such an organization. As mentioned earlier, several of the top leaders came from outside the civil aviation industry, and this seemed to be important to many respondents. This will be examined further in the next section. And the second was the apparent disconnect between leadership words and actions. The literature reflects that leadership commitment to safety has a strong positive influence on safety perceptions which in turn affect behavior. But these comments reflect individual perceptions of the leadership's commitment, and not necessarily actual leadership commitment. This area will be investigated further in Chapter 7.

6.5.3.2 Leadership qualifications

One issue that was very important for the employees was the perception of the top leadership's lack of adequate technical knowledge and competence to lead such a dramatic change in Avinor. Some of the top leaders had no prior civil aviation experience and limited experience in high-risk industries. This was also reflected in the interview responses:

"The top leadership has a total lack of understanding of air traffic control and aviation safety, and that it what it is all about ... only money ... not particularly good with people, not in the least." (Oslo 10)

"They are clearly talented MBAs, and the economic results are much better than they have ever been, economically speaking … and from that perspective they have done a brilliant job and they have the owners supporting them … but honestly speaking, one must also have a basic understanding of how air traffic functions, it takes more than economics to run this type of company." (Stavanger 03)

"They are surely well qualified to run a budget ... but to run air navigation, there they are not qualified at all, not at all, but they should have understood that themselves and surrounded themselves with people that are well-qualified, and that has not been done in my opinion." (Stavanger 03)

Leadership qualifications summary. The individual responses directed at the leadership's qualifications targeted several areas. First, many believed that several leaders lacked the civil aviation experience required to manage a high-risk organization such as Avinor. Other comments identified leadership skills. And the most frequent comments indicated that the

leadership was overly focused on economic outcomes at the expense of operations, and often safety.

6.5.3.3 Focus on cost reductions

The Take-Off 05 project was described as an improvement program, but as presented in Chapter 5, the primary focus was on a cost savings of over 400 million NOK per year in a short timeframe. This placed a great deal of pressure on the leadership to stick to the timing of the implementation plan, and this created a great deal of pressure at the unit level:

> *"I feel that the focus on cost reduction is so strong and that their focus is so high that they close their eyes to other things, so if you match these goals of cost reductions with the needs of the people in the organization, they do not correspond. The top leaders are only focused on the economy parts of our job and that is equally as bad as if air traffic controllers were only focused on the aircraft and air traffic control. But if we lack the piece that the other has we must find a way to get that piece and I feel that this has not happened. There is way too much focus on cost."* (Bodø 05)

> *"And the total arrogance over professional personnel, you can say that I thought this was very scary … this is a safety culture resulting from experience transfer that has taken place over many years … and that we have a system that takes care of safety and one believes that these are relatively talented people that have been a part of a safety culture for many years … and when someone without a professional background, and cancels out what we have built up by starting with a clean sheet of paper, it seems unbelievably without understanding and almost arrogant."* (Oslo 06)

> *"The thing that bothers me most is the way that things have been pushed through without the necessary competence … I have the impression that no one has given this message to the top leadership out of fear to speak up. There is a form of (forced) loyalty culture the leadership talks about. My clear understanding is that to be loyal is to speak up when you know something, but I sit with the impression that when leaders communicate down, then it is important to send the message that was taken despite the fact these come with strong warnings. That part is difficult when you know that things are going to go wrong, and you have said so, but they plow forward anyway, it is depressing. So the leadership in Avinor demands trust, but trust is not something you can dictate, it is something that people come to through actions and that is difficult if you demand too much."* (Stavanger 02)

> *"The owners think the leadership is doing a good job, but that is difficult to understand. The leadership is rather foreign to us such that the further down you go into the system, the less chance of getting action and is usually stopped in the middle. Things are often brought up to the employee representatives meeting but in reality there is no follow through and most is just talk, but nothing happens."* (Stavanger 02)

> *"They (leadership) continue to stand by the numbers that were worked out over two years ago that we only need so many air traffic controllers, and they continue to live in that world. But this has a very relevant relationship to safety in that they fail to accept*

the reality that the current situation has changed dramatically with current traffic levels at an all-time high, and they have failed to recognize and accept this." (Stavanger 03)

Cost focus summary. Most respondents felt that the leadership were overly focused on cost reductions, and that economic results alone were driving the change process. References to cost reductions were present in 100% of the interviews.

6.5.3.4 Leadership actions

Together with the belief that the top leadership were not qualified for the positions they occupied in a company such as Avinor, the employees also were highly critical on how decisions were made and personnel issues were handled during the volatile change process:

"There is a general lack of humility amongst the top leaders. It is clearly not fun to be criticized the whole time … but I make mistakes, and my colleagues make mistakes, and I am quite sure that the top leadership makes mistakes as well, so I believe that they should show a little more humility than they do because they do not acknowledge anything before it is really burning." (Bodø 05)

"What I think is strange is the way they (leadership) interpret things in a manner that supports their needs when they are pressed, without the understanding of the contents of the issues of they are discussing." (Oslo 13)

"When the division leadership and top leadership can interpret the Transportation Safety Board report as confirming that safety is good, that is scary in my opinion. This shows that they manage to pick out the positive side of things but fail to recognize the things that are worst. These types of comments are frightening." (Stavanger 03)

Leadership actions summary. Most respondents were critical of the way the leadership handled managerial tasks. The responses above reflect that many employees felt that the leadership often interpreted situations in ways that supported their own goals. This was particularly evident in responses regarding the results of the Norwegian Transportation Safety Board study.

6.5.3.5 Leadership Communication

Communication is an extremely important dimension in both the safety culture literature (Zohar, 1980; Berends, 1996; Guldenmund, 2007), but is also reflected in the change literature (Aldrich, 1999; Dasborough, et al., 2003). Interview responses in this area were quite negative:

"Communication upward must be taken more seriously but when you have a leader that doesn't have a clue about our part of the business, then they must listen to us and speak

with the people who know what is going on. Being in a reorganization process demands an open dialog." (Oslo 09)

"That which bothers me most is that leaders do not listen to their own employees, especially in the areas were they are weakest, and particularly manning issues." (Stavanger 02)

"Concerning internal communication, it is just a fact that we sit here and talk between ourselves, and there is nothing more. There is no communication at all, nothing, and we really do not know what is going on, and I believe that our local leader does not know either." (Bodø 03)

Leadership communication summary. Most respondents were highly critical of the leadership's way of communicating with the employees. Much of the communication was characterized as *one-way* where the employees felt that they had no input upward. But communication was also an important issue as it is also linked with employee perceptions of the leadership's commitment to safety commented upon earlier. The employees felt that they were the experts in the field, and what they had to say was important.

6.5.4 Leadership summary

It is clear from the data above that there were two important levels of leadership: the local leadership and the top leadership. The attitude toward the local leadership in all cases was positive compared to the top leadership team. Several areas of importance for safety climate, specifically, perceptions of the top leadership's commitment to safety and communication, were viewed as very weak. In some cases, the situation that each unit was experiencing influenced the dependence on the local leaders. The strongest finding in this section was the importance of leadership commitment to safety in this change process.

6.6 Organizational/Safety climate

Measuring safety climate in high reliability organizations has received considerable attention over the past years as there has been a deliberate "*movement away from safety measures purely based on retrospective data or 'lagging indicators' such as fatalities, lost time accident rates and incidents, towards so called 'leading indicators' such as safety audits or measurements of safety climate*" (Flin et al., 2000: p. 178). And Flin et al. argue further that this reduces the need to wait for a system failure before identified weaknesses can be uncovered and proactive remedial actions taken. In this section, I will present organizational climate responses that also reflect the safety climate in a high-risk environment based on the selected items and responses in Table 6-6:

V02 - Personal conflicts create problems in my division/unit
V15 - The conditions in my division/unit make it so that I dread going to work
V16 - Cooperation problems create difficulties in the division/unit
V21 - It happens that employees are harassed in my division/unit
V26 - In my division/unit the working environment is the reason for sick-leave
V37 - Power struggles create problems in my division/unit
V46 - I am poorly motivated in relationship to my job
V52 - My job is a burden on my private life
V63 - In my division/unit there is low work morale
V64 - In my division/unit there is little acceptance for opinions that are different
V72 - I am proud to work in Avinor

Table 6-6: Organizational Climate Group Statistics – both years

	Trondheim 2002	Bodø 2002	Oslo 2002	Stavanger 2002	Bodø 2004	Oslo 2004	Stavanger 2004
(V02) Personal conflicts	2.03	2.64	3.35	4.80	4.69	2.60	2.69
(V15) Work conditions	1.77	1.50	1.52	2.03	3.65	2.45	1.56
(V16) Cooperation problems	1.72	2.16	3.11	4.17	4.91	1.94	2.00
(V21) Employees Harassed	1.45	1.94	2.81	4.63	3.48	1.41	2.74
(V26) Working Environment	2.57	2.38	3.35	5.33	5.29	4.28	3.13
(V37) Power struggles	1.62	2.06	3.49	3.53	4.00	2.08	1.97
(V46) Poor motivation	2.87	2.30	3.00	3.33	4.26	5.16	2.46
(V52) Job burden Private life	2.70	3.52	2.76	3.80	5.11	4.66	3.49
(V63) Low work Morale	2.03	2.33	3.21	4.53	4.00	3.37	2.74
(V64) Different Opinions	2.52	3.59	3.81	4.14	3.98	2.35	2.80
(V72) Pride in Avinor	4.67	5.38	4.46	4.00	2.57	1.56	2.94

6.6.1 Within- and across-case analyses

It is clear from the results above that the same patterns for the analyses in the leadership section are also reflected here. Again, Trondheim and Bodø are relatively similar in most areas in 2002, but the combined unit responses are degraded significantly in 2004. The Oslo and Stavanger ATCCs also vary significantly from 2002 to 2004 with similar patterns reflected in the leadership section with one exception, the Oslo ATCC work morale (V63) does not appear to change in 2004 despite the decision to close down the unit, and the

increased turbulence and media focus. This could be a result of the strong local leadership, but more likely it was the realization that the change process was not going smoothly, and this increased the focus on resisting the top leadership's efforts through *work to rule* types of actions. The Bloomsbury business library describes *work to rule* as: "*any form of industrial action in which employees work strictly according to the terms of their contract of employment. A work to rule usually involves refusal to do any extra tasks and an overtime ban, causing production to slow down."*

Although these types of actions were never officially initiated, events that fit this description did occur, for example, when the leadership announced that the Oslo ATCC would be shut down, the operative air traffic controllers on watch were so upset by the news that they collectively felt unable to perform their demanding tasks in a safe manner and left their positions after getting all airborne traffic safely on the ground. And this was supported by Norwegian regulations regarding "fit for flight" situations (BSL C 3-1, 2003). This event stopped all air traffic in southern Norway for two days, and created a small-scale national crisis that sent shockwaves throughout the Norwegian civil aviation industry. Other work to rule-type actions included: personnel refusing to work overtime; resigning from voluntary training positions, increased use of sick leave, shutting down sectors when uncomfortable with traffic volume, etc. There were even externally generated work to rule-type actions, for example, the Norwegian civil aviation regulatory agency restricted the use of overtime in Avinor and refused to grant local waivers for exceptions to rules and regulations that had previously been normal practice.

6.6.1.1 Leadership's role in safety climate

When asked about the top leadership's role in creating a positive safety climate respondents were relatively disappointed. The leadership's role for creating a positive environment are reflected in many of the items above (V02, V15, V26, V52, V63, and V72) where the external demands and actions affected local working conditions:

> *"I believe that the leadership is completely absent in creating a positive working environment. They should have been here and listened to our problems. But I am very concerned by what I hear from the leadership via the radio and television. Our local leaders say they have sent the proper signals but no response."* (Bodø 03 - Leader)

> *"The culture was much better in Luftfartsverket than it is now, not the least of which was that we had satisfied co-workers that were focused on the jobs they were to carry*

out, but now under this change process, our focus is not on job related issues but on other areas that are not related to our jobs." Bodø (05)

"Safety culture went straight to hell … right down the toilet. The culture in the beginning when we came was that those who came from Trondheim, we should be harassed willingly ... it wasn't organized harassment but there were quite a few that thought they had placed their carriers on the line, for example, with some of the safety analyses … the safety analyses that were delivered were made to order by the top." (Bodø 02)

"It is crystal clear and quite noticeable that people are more and more frustrated. The whole situation is due to inadequate resources, people do not have time to work with the things they should, and so we have many who have quit there additional duties and have gone back to being 100% air traffic controllers. And in my opinion this has a direct effect on safety, although it is difficult to measure. But it is clear that people will not take these extra tasks for following up operative cases, and it is these things that improve safety that are affected." Stavanger (07)

Leadership's role in safety climate summary. The leadership's role in safety and safety climate in high-risk industries is well-documented in the literature. Most respondents felt that the leadership's actions were negatively affecting safety and safety climate through words and actions that were inconsistent. One area mentioned by most respondents focused on the lack of resources available to carry out both operative and administrative tasks. And these often were connected with the previously mentioned areas of communication and cost focus. Resources will be addressed in the next section.

6.6.1.2 Operational and administrative resources

The most serious complaints from the local working environment were resource based, where every respondent commented. A recurring theme of each unit was a general lack of resources both in operative personnel but also administrative staff that had been significantly reduced as a result of the Take-Off 05 downsizing. This had a negative effect on productivity, and increased the burden on the individuals in place, increasing stress and reducing morale:

"I sit here as a chief air traffic controller, rather central in all of this, and I do not have a administrative support apparatus around me that can take care of the administrative workload in an appropriate manner that should be in place." (Chief Air Traffic Controller)

"I need personnel resources that I can manage, and preferably a little extra. I understand that under reorganization we need extra personnel but now the 'porridge has cooked over' and we must cut so and so many air traffic controllers … but we need ten ATCs, and that's a lot, but that is our daily situation … we have no reserves on the watch list, if someone is sick, the only alternative is overtime which is pushing us into a

corner where we have used up most of our overtime allowance … this is not a good situation, it stresses our personnel and it could affect safety." (Bodø 02)

"We have a manning problem particularly on the ATC assistant side, and it is well known that they are under great pressure ... on the air traffic controller side we have adequate manning but only because we have no administrative tasks … but in reality we have many administrative tasks, we just don't do them … we cannot continue to work like this." (Oslo 06)

"We have a chief air traffic controller who is purely administrative … he has an administrative job … and he uses his whole day working on manning issues and related things … and we have an operative assistant chief air traffic controller … and he has to use all of his time in operative position and doesn't have time to even peek into his office and handles things underway … an that is due to the manning situation." (Stavanger 04)

Operational and administrative resources summary. It was clear in Chapter 6, that the Take-Off 05 implementation process was strongly focused on downsizing. Surprisingly, no air traffic controllers were ever forcibly cut during the Take-Off 05 process. However, some quit voluntarily when offered early retirement packages and others just resigned. But much worse, and unexpected, many air traffic controllers applied and accepted positions outside the company and in other countries, and were unplanned losses that had a significant effect on productivity, especially in Bodø. More insidious to the resource problem was the downsizing of administrative staff which did take place across the entire organization. This shifted the administrative burden to others, such as the chief air traffic controllers. This had several effects. For example, chief ATCs were overloaded with administrative tasks which often kept them from other leadership tasks. This was reflected in all local leadership interviews. Other local leaders accommodated the growing operative workload by dropping administrative tasks to fill operative gaps. In addition, external demands such as periodic operational training and recertification, and unplanned projects decreased operational availability of a portion of the air traffic controller base. When combined with a decrease in the authorized use of overtime, operational availability suffered.

6.6.1.3 Safety reporting systems

There was one area within safety culture that received unanimous praise by the respondents, and that was the newly operative incident and accident reporting system called MESYS that was not really a Take-Off 05 initiative but an externally generated requirement. However, even this was not completely positive in that every respondent also commented that although the system was good, in principle, the administrative support required to efficiently handle the increased information and workload created by this system did not exist. And this led to

frustration, and many commented that they no longer reported many incidents as there would be no response in any case:

> *"MESYS has been positive, in principle, it has made reporting easier, but again, the lack of administrative capacity give little or no feedback, but the unit does not have any capacity either."* (Stavanger 07)

> *"SMS has come quite a way and I have the SMS handbook, but here again, manning is not good enough to have an overview of what is happening. I don't know why but there is a sort of vacuum … and it is difficult to say what will happen." (*Stavanger 07)

> *"There are people who work hard with MESYS, so there is nothing to take away from them, but I feel that our people, for the most part, do a good job considering the limited resources but the question is how long we they continue if the motivation falls, and that is what is happening I feel. The big picture here is maybe difficult to measure but when you have unsatisfied colleagues, there can be a danger that MESYS reports are not followed up."* (Stavanger 07)

> *"The MESYS system, and the safety staff, and the safety personnel, and the safety culture, they all look very good on paper but there are not adequate resources to do any of these things. If the system had worked as it should on paper, then we would get critical responses to reports within 2 days ... but I have written at least 20 MESYS over the past 2 years and have only received one answer. There are administrative bottlenecks that effect both directions, so the system does not work today."* (Bodø 04)

Safety reporting system summary. The MESYS incident reporting system was one of the few areas within the interview responses where all employees were initially positive. However, most respondents also reported that lack of feedback due to lack of administrative resources to perform follow-on investigations, and little to no direct feedback from reports, hurt the system. And many reported that they avoided reporting if they thought they could do so without consequence. This is particularly interesting in that traditional safety measurement systems that are focused on incident and accident reporting are dependent upon individuals both noticing when undesired events take place, but also reporting the events.

6.6.2 Organizational and safety climate summary

It was clear from the personal interviews that each local climate was affected in some way by the change initiatives in Take-Off 05, although each unit experienced the change differently, and this is reflected clearly in the responses. However, it was also evident that the change process was placing stress on the entire system, and this affected both attitudes toward change and also the perception of safety. But it was also clear that the underlying organizational culture was relatively positive in adjusting to many of the changes but that these effects were

wearing down the system, and that safety margins were being affected. This will be addressed later in this chapter.

6.7 Attitude toward change

In the literature review, I presented many of current academic arguments for why organizations need to change. And this is particularly true in competitive industries where failure to change can affect long-term viability and survival (Aldrich, 1999). In this case, a deliberate decision to change was made by the owners and carried out by the leaders. But I have also pointed out the potential difficulties of implementing deliberate large-scale organizational change in high-risk industries, especially those characterized as high reliability organizations. I showed in Chapter 5 how a sudden change in organizational change type destroyed a weak consensus and led to a loss of trust of the leadership, resistance and eventual collapse of the Take-Off 05 project. In this section, I will present the individual responses to the change process and how this affected attitudes toward change.

As presented in Chapter 5, attitudes toward the Take-Off 05 change process were initially rather positive:

> *"In actuality everything began very well ... with the whole Take-Off concept and that we would be more effective by reducing from four to two control centers ... and that we should have a more rational business model, I was absolutely agreed …* Bodø (04)

But not all were so confident, and this changed quickly after the Take-Off 05 plan was revealed:

> *"My attitude toward the change process has only been strengthen toward what I actually feared ... we did not get the employees with us in everything and we notice here in Bodø that there has been a sort of sound of injury tied up in this process and the working environment has been strongly changed"* Bodø (03)

> *"I was very open to the changes but I was a little skeptical …in some areas I believed that we could possible have opportunities to improve … and I was also of the opinion that some changes had to be made … no one would suggest that we were the most effective company in the world, so it was clear that we could be more effective in many areas."* (Bodø 05)

Attitudes toward change summary. Most of the respondents at the embedded units were either positive or neutral toward the initial phases of the change process including both the change from Luftfartsverket to Avinor, and the Take-Off 05 process. However, the reality of change implementation had significant negative effects on attitude in all cases. This change in attitude led to resignation in some cases, but for many this led to resistance to change.

6.7.1 Top-down change

All respondents thought that the implementation process was purely top-down with little room for participation. And this was reflected rather adamantly in the interviews:

> *"It was top-down. We had a visit of the top leadership team and it was a brutally tough one-way communication, not even to mention any discussion during the meeting at all."* (Bodø 04)

> *"There was a committee created to produce recommendations and ideas on how the control centers should be arranged … but we felt that our contributions were never heard and that everything had already been decided and that the control center would be in Stavanger. We feel that we were run over despite the fact that we were invited and contributed to the committee."* (Oslo 05)

> *"Very top-down I would say … I believe that all of the information that was sent from here was received but I believe that they had already made up their minds … so they had the result they only needed to go through the motions in a way they could get the numbers they needed to support the answers they had decided in advance before they sent them forward."* (Oslo 09)

Top-down change summary. The quotes above are representative of all respondents. The perception that individuals had no influence in the process was clear, and this had a strong effect on attitudes and perceptions toward the change process. Even more important, this clear impression of a top-down process was clearly focused on the top leadership, and this had a negative effect on attitudes and perceptions.

6.7.2 Pacing

However, no matter how positive individuals were to the possibilities of change, the reality of change was another matter, and the pace and breadth of the change implementation process was a focus of many respondents across all units:

> *"My personal attitude towards the change process was that I did not believe it would be fully implemented. I believe everything has happened too fast and despite supposedly talented people involved, they were not superhuman with clear vision. We should calm ourselves down a little and think through this a little more before we act further, I think we could have profited from this type of behavior."* Bodø (02 Leader)

> *"This could have been accomplished in a completely different way … but the leadership totally disagreed, this will be done quickly (with emphasis), and our union was not agreed so we find ourselves again in a combative mode … here it has been a type of local motivation that drives a certain speed and if you want to be a part you had better hop onboard when you have the chance otherwise you will be run over … and that is the type of strategy used in the entire organization."* (Bodø 03)

> *"No, I think that the change process was very ambitious and everything went too quickly, generally speaking. These types of activities need to proceed at a completely different tempo."* (Oslo 06)

> *"Had they chosen to listen to the tone within the organization, they would have used more time and the result would have been different. It was fatal not to take the organization with them."* (Stavanger 13)

Pacing summary. The tight timelines set down in the Take-Off 05 process put significant pressure on the entire organization. These timelines were never adjusted during the process even when key assumptions upon which the whole plan was based proved to be inaccurate. The reluctance to deviate from the original Take-Off 05 plan was never uncovered, however, it was clear that sticking to the plan was important for the leadership. This inflexibility by the leadership to change the pacing of the implementation plan led individuals to assume that priorities other than safety were responsible.

6.7.3 Trust

The change literature reflects the importance of attitude formation and trust in change processes (Lines, 2005). It was shown in Chapter 5 that trust in the leadership was gradually degraded after the Take-Off 05 implementation plan was made public, and this was also reflected in the interviews:

> *"One thing that I feel very strongly about is that we are struggling with the confidence in the top leadership, and this is leading to distrust, and this also included the middle management."* (Bodø 05)

> *"They go out in the media and say many things … but I do not trust them … I do not think that they have registered that we need more ATC assistants, we have complained but were told no … and it is affecting safety and we are tired and mad …* (Oslo 05)

Trust summary. When the Take-Off 05 plan was made public it became clear that the consensus upon which the initial support for the change process was built collapsed. This led to a loss of trust which was expressed in many ways. This was particularly evident in the perceptions of the leadership's commitment to safety revealed earlier but also reflected in individual expectations.

6.7.4 Expectations

Attitudes toward change are also affected by anticipated outcomes and how these expectations are fulfilled. This is an area were many respondents expressed significant disappointment:

> *"I was hopeful that the leadership would do a good job, and that they would take the time to do so, but this has happened at blinding speed and the result is not good, I do not think the leadership has done a good job at all."*(Bodø 08)

> *"Actually, I did not have very high expectations for the change, what I had was fear and negative expectations, and much of that has been realized, actually I would say that much of it has been realized and not everything has been implemented yet. The worst thing is the turbulence the whole process has created and those are the types of things the leadership must take into consideration. But they haven't considered these effects at all … they act as if they are shocked that our sick leave usage has risen to 10%, which is actually quite low in a large reorganization where so many jobs will be removed. They do not have any understanding over what is wrong with the process … and that is something we suffer with of course."* (Oslo 06)

> *My expectations have been met 100%. I feared the worst and even though the results were not exactly as bad as I expected, they were bad enough from what I have seen.* (Stavanger 03).

Expectations summary. It was clear that initial expectations for change were high by some individuals. Those who believed in the potential value of change were those most disappointed by the Take-Off 05 project. But many were sceptical to change due to the many failed changes undertaken by Luftfartsverket years earlier. For them, the difficulties encountered during the change process were expected.

6.8 Attitude toward change summary

It was clear from both the questionnaire data and the interview responses that there was a significant change in attitude toward the Take-Off 05 process during the implementation phase that differed at each unit depending upon where they sat in the change process. Responses in this area were often emotional, and based on personal experiences and reactions to real-life events, though many of the responses were reflections of experiences at other units that were known to all, often via the news media. It was clear that the group in Bodø were resigned to the fact that life had changed. The Oslo ATCC took a more aggressive stance, saw the potential to fight the decision, and was ready to take the battle to the leadership. This started with the air traffic controllers, but in the end the ATC assistants were also heavily involved. In Stavanger, there was relief but as a group they did not consider surviving a

victory and were already dreading the upcoming merger with the Oslo ATCC. In addition, the Stavanger ATCC was undermanned with no short-term solutions in sight.

It was also clear during the study that attitudes toward change, and the employees' ability to influence the outcome, was initially uncertain as the rules for action were decidedly different for a private company than a state-managed organization. But as the change implementation process began to experience problems, both internally and externally, individual attitudes against the change process began to solidify, and this eventually spread to other units and unions within the company. The responses above were taken at the height of the turbulence and reflected an environment under increasing stress. And the results of this stress negatively affected individual perceptions on safety, the company's highest stated priority.

6.9 Perceptions of safety

Zohar (1980) pointed out that shared perceptions guide appropriate and adaptive behavior in a safety setting. And this theme has received a great deal of focus over the past 20+ years (Zohar, 1980; Clark, 1999; Cox and Cox, 1991; Flin et al., 2000; Guldenmund, 2000). Many of these studies focus on cultural values and attitudes, and how they contribute to safe behavior (Hopkins, 2006). An important indicator of safety behavior is reflected in individual perceptions of safety that affect both cognitive processes related to safety and behavior itself (Mearns et al., 2000; Flin et al., 2000; Lawrie, et. al., 2005; Hopkins, 2006).

Each interview began with a simple question – how would you define safety? This proved to be more difficult than expected as most interviewees had a difficult time formulating a response. It was also difficult for respondents to admit, especially early in the interview, that safety had been directly affected by the change process as this was their most important job task:

> *"The attitude among the employees, particularly we that work operative, has not changed at all of course when you have personal responsibility for this type of job we carry out … so we have to strive to minimize the number of mistakes and risk that something might happen, and maybe due to the turbulence in the company more things do happen in regards to incidents and such things, but because we are responsible we handle it."* (Oslo 06)

> *"Taking all things into account, and considering everything that has happened and all of the noise and unrest … safety surely hasn't increased … we had many opportunities to get or create a better safety culture, if we had all pulled in the same direction … but we have brought in many disruptive elements, if I can call it that, into the control room that were not there before … that doesn't contribute positively to safety … there is a*

*large burden on many people … so we should be very happy that nothing has happened and none of us want that." (*Bodø 05)

However, as the interviews progressed, each respondent came forward with many comments that had a direct affect on their operative performance, such as: concentration levels, conflict, distraction, disturbances, exhaustion levels, frustration, loss of focus, motivation, personal and psychological reactions, stress, and uncertainty:

"The ATC assistants are sitting here knowing that they will be terminated but they do not know when … it is this uncertainty … and the other is the information coming from the leadership that feels very provocative and is very frustrating in that we feel we are being lied to via the media." (Oslo 05)

"What worries me most are human factors … what I mean is the uncertainty and disappointment caused by this process and the lack of cooperation that actually effects people in operative positions … and I believe people are affected in operative positions, at least Røyken and in Bodø. Sleep and sleep patterns are affected. The problems with the top leadership, no I think that human factors are the things that increase the stress levels and will have significant consequences for safety." (Stavanger 05)

"I have a good example, we have co-workers that absolutely do not want to be here … and they demonstrate their dissatisfaction all of the time … and things come up every day that have nothing to do with air traffic control. They are very often social problems that take focus away from solving traffic problems and it effects concentration when we discuss our house and home, travel and commuting and such things … and that's every day and it is exhausting." (Bodø 05)

Perceptions of safety and safety culture responses were the second and third most frequently coded interview responses, however, there were many other safety-related responses. Only 9 responses were coded as positive in nature and were not change related, and included: the new reporting system MESYS, greater activity by the civil aviation regulatory agency, and the institution of periodic air traffic controller refresher training and certification. There also seems to be a perceived difference in what is said internally, and what is actually done:

"They have gone out and have said that we will be the best in Europe for safety with all of these things they have done, but I have to place a large question mark as to whether they truly believe this ... this has been difficult and we are experiencing a deteriorating working environment, and it is affecting safety, and we try to tell them but they continue to stand there and say that safety is being taken care of" (Bodø 03)

"*If one says that safety is the area that we prioritize the highest, I must say that the actions do not support this, they just don't. It is not enough just to say the words, but you must reflect this in your actions, and that is the problem, we do not know what we should believe. If you say one thing you must step forward and show something*" Bodø (2)

Perception of safety summary. Admitting that safety was negatively affected during the Take-Off 05 process was difficult for most air traffic controllers. Most tried to talk around this issue, particularly early in the interview. As professionals, they believed that they were personally responsible for safe outcomes and as air traffic controllers this has been ingrained in every activity related to their job. However, it was clear in the responses that the change process had negatively affected their ability to operate at the highest level, and in the end most admitted that this was true.

6.9.1 Within and across-case analyses

As mentioned earlier, few items from the organization climate questionnaire were focused on safety but Table 6-7 gives some indication on how the change process affected safety routines.

- V17 - Undesired events or deviations are often concealed or unreported in my division/unit
- V45 - In my division/unit mistakes are repeated too often

Table 6-7: Organizational safety - all cases

	Trondheim 2002	**Bodø 2002**	**Oslo 2002**	**Stavanger 2002**	**Bodø 2004**	**Oslo 2004**	**Stavanger 2004**
(V17) Undesired Events concealed	1.62	3.00	2.66	3.59	4.33	1.70	1.97
(V45) Mistakes Repeated often	2.25	3.13	3.36	4.47	4.53	1.98	3.11

Again, as in the leadership section and the organizational climate sections we see a significant degradation in both items for Trondheim/Bodø, and an overall improvement in Oslo and Stavanger. This again, shows that each unit experienced the change process, or more precisely the expectation of change, in a different way, and were affected differently.

And finally, in 2004 several general questions were asked of the employees that were not included on the 2002 questionnaire, they are reflected in Table 6-8:

- V81 For me Avinor is an attractive company to work in
- V82 I feel insecure with the reorganization process that Avinor is currently undertaking
- V85 I trust my leader's leader
- V86 The leadership in Avinor clearly communicates which goals the company works toward
- V87 I have faith that Avinor will reach its long-term goals
- V89 I get great pleasure from my work

Table 6-8: 2004 Special interest items – all cases

	Bodø 2004	Oslo 2004	Stavanger 2004
(V81) Attractive company	2.40	1.87	3.11
(V82) Insecure In process	5.52	6.78	5.20
(V85) Trust Leader's Leader	2.36	1.11	2.44
(V86) Leadership Communicates clearly	2.60	2.84	3.09
(V87) Faith in reaching goals	1.91	1.25	2.39
(V89) Pleasure From work	4.13	4.78	5.43

Here the responses are very similar except for V81 (Attractive workplace). People are insecure in their positions, distrust the top leadership, are critical to the quality of communication within the company, and doubt the company will reach long-term goals. Yet, despite the many negative factors demonstrated earlier, individuals still get pleasure from their jobs.

6.9.2 Perception of safety summary

Safety is clearly a high priority for the employees working in operative positions where they realize the potential disastrous consequences of their actions, and this (high priority amongst employees) does not seem to them personally to be affected by the change process. However, there are many indications that downsizing, and the numerous operational changes that have taken place are putting added stress on the system at all units. And although they acknowledge the affect on personal performance they believe their own commitment to safety is unchanged and will ensure safe performance. There are also many change dynamics that are negatively affecting each individual's ability to optimally perform the complex tasks assigned.

6.10 Summary

In this chapter, I have analyzed how the Take-Off 05 implementation process affected employee attitudes and perceptions during the most turbulent phase of the change process. Using a mixed-methods approach, it was clear that each embedded unit experienced the change process differently, and this was particularly evident in the questionnaire responses. But this was also confirmed by the interview data giving further strength to the results. The analyses also showed that attitudes toward local leadership again varied depending upon

location and the context within the change process. But attitudes toward the top leadership were consistently negative, and did not vary significantly between the three remaining embedded cases in December 2004.

One interesting result of the analyses was the strength of employee *perceptions* of the leadership's commitment to safety in a change context, and the implied effects this construct had on both *attitudes* toward change in a high-risk environment, and also *perceptions* of safety. The results here were so strong that I have chosen to focus on this construct in the next chapter.

Another interesting finding from the interview data analysis was the individual reluctance of air traffic controllers to admit that safety was affected in any way due to change as they considered this their personal responsibility. But as each interviewee described their experiences it became clear that safety was being affected, even for them personally, and many admitted later in the interview that they worried that something bad might happen.

It was also clear that the questionnaire data were not optimal for evaluating safety climate, and particularly perceptions of safety, with no questions directly addressing this issue. And although many of the items were reflective of both organizational climate and safety climate, and this was verified through triangulation techniques using interview responses, the effects on perceptions of safety were only observed in the interview data.

In the next chapter, I will introduce a refined Safety Measurement Model that will use a modified safety climate questionnaire that also includes items specifically addressing attitudes toward change and individual perceptions of safety.

7 A snapshot of safety

In this chapter, I will follow-up on the findings from Chapter 6, and further refine and explore the causal relationships between the latent variables of interest for the research questions by testing a conceptual safety measurement model using Structural Equation Modeling (SEM) to take a *snapshot in time* of safety perceptions. However, in this chapter, I will expand the focus of the analysis away from the four embedded cases used in Chapter 6, and elevate the focus to include the aggregated subset of air traffic controllers and ATC assistants within the larger Avinor organization using safety climate survey data from the Havarikommisjon study taken during the same timeframe analyzed in Chapter 6. The purpose of this expanded focus is to increase the sample size for statistical purposes, and to reduce any potential context-related bias effects from individual units.

7.1 Structural equation modeling

Structural equation modeling (SEM) was chosen as the statistical method for analyzing the results of the Havarikommisjon safety climate survey data as it is an extension of several multivariate data analysis techniques, such as multiple regression and factor analysis, but goes further by allowing the analysis of several dependence relationships between complex latent variables simultaneously (Hair et al., 1995). This is particularly interesting for the Avinor case as all of the constructs of interest to the research questions are latent in nature, and rather complex in their interactivity. A latent variable (also known as a construct or factor) is a hypothesized and unobserved concept that can only be measured through other observable or measured variables, such as, items in a questionnaire. SEM also "*allows the researcher to draw upon theory, prior experience, and the research objectives to distinguish which independent variables predict each dependent variable"* (Hair et al., 1995: p. 622), and can be used either for confirmatory factor analysis (CFA), or for exploratory purposes. The CFA approach is used to confirm that the *a priori* set of variables specified in the model define the constructs or factors.

In this study, I will only use SEM for confirmatory factor analysis of the conceptualized model presented later in this chapter (See page 154), supported by appropriate theory and fine-tuned to reflect the results from the findings in Chapter 6. The purpose of CFA is to determine if the pattern of variances and covariances in the data is consistent with the conceptualized structural model that I have specified, and to determine the strength and direction of influence of the latent variable loadings upon the main dependent variable –

perception of safety. In this way, I can determine the direction and strength of the causal relationships in the organizational change process related to safety. In addition, SEM can be used to simultaneously model variables that are both dependent for one part of the model, and independent for the main dependent variable. These variables are often called mediating or intermediary variables, and are considered important for this study as I am interested in learning how deliberate change in a high reliability organization affects safety, and specifically, how *attitude toward change* acts as a mediating variable between the latent independent variables specifically: individual perceptions of the *leadership's commitment to safety* and individual perceptions of the *safety climate.* And finally, how these causal relationships, together, produce an additive effect on the main dependent variable *perception of safety*. This will allow me to identify the direct effects of the latent variables on the dependent variable, but also reveal any indirect effects affecting safety.

7.2 The model

The conceptual safety measurement model, depicted in Figure 7-1, consists of two (exogenous) latent independent variables perception of the *leadership's commitment to safety* (LC) and perception of *safety climate* (SC), one (endogenous) mediating variable *attitude towards change* (AC), and one (endogenous) dependent variable *perception of safety* (PS). It is expected that both of the independent variables (*LC* and *SC*) and the mediating variable (*AC*) will have direct positive effects on the dependent variable (*PS*). In addition, *LC* and *SC* are expected to have indirect positive effects on *PS* through the mediating variable *AC*. It is further believed, based on the literature, that changes in attitudes and perceptions will have direct effects on individual cognitive processes and safety behavior.

7.3 Hypotheses

The role of employee attitudes and perceptions in safety behavior

The conceptual safety measurement model in Figure 7-1 depicts the four refined latent constructs of interest in this study, and the five hypothesized causal relationships having direct and indirect effects on the main dependent variable perception of safety (PS).

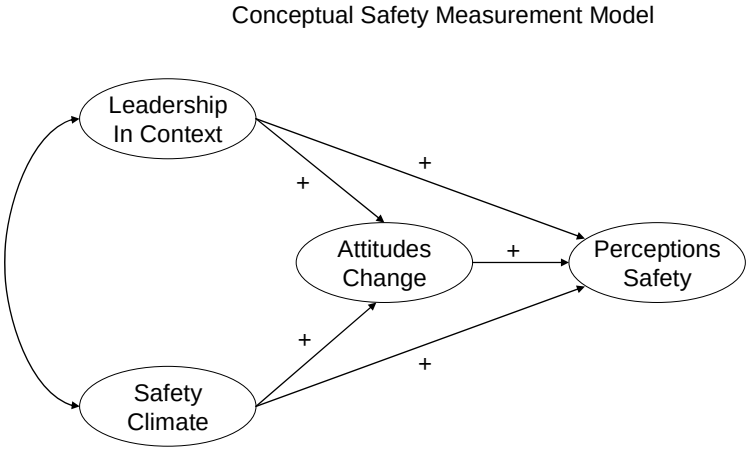

Figure 7-1: Conceptual Safety Measurement Model

7.3.1 Leadership commitment to safety (LC)

High-risk organizations, and high reliability organizations, in particular, develop strong safety cultures to ensure safe outcomes (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Weick and Sutcliffe, 2001:2006). But these cultures are complex, and evolve over time, and deficiencies are usually only discovered after catastrophic events (Shrivastava, 1987; Vaughn, 1996; Gehman, 2003; Johnson, 2004). Often, these results are attributed to gradual changes in employee attitudes and perceptions toward safety, and numerous studies have found that employee perceptions of safety directly affect cognitive processes and safety behavior (Díaz and Cabrera, 1997; Flin et al., 2000; Rundmo, 2000; Guldenmund, 2007). Most of these studies focus on changes in safety culture, over time, but this can only be done in retrospect. And even though there has been a great deal of interest in the study of safety cultures (Pidgeon, 1991; Cheyne et al., 2002; Mearns et al., 2004), using a cultural approach has been criticized for lacking a normative framework (Grote and Künzler, 2000), in other words lacking a predictive quality.

Recently, however, there has been a shift in focus from measuring safety cultures to safety climates which have been described as the surface manifestation of the underlying culture, and, as such, are observable directly using a combination of psychometric and qualitative approaches (Zohar, 1980; Flin et al., 2000; Ciavarelli, 2003; Gordon et al., 2007). These methods are often conducted in the form of safety audits with the intent of revealing

deficiencies in developing safety climates before disaster strikes. This allows leaders to take proactive corrective actions before a safe system erodes to a level were disaster is essentially inevitable. Ek et al. (2007) support the focus of this study by arguing that change processes based on grounded theory from high-profile accidents, can have a negative effect on existing safety cultures, the foundation of safety related work, and ultimately, on safety. However, the effects of change do not have to be negative, and I will argue that improvements in the latent constructs measured relative to safety perceptions will improve safety performance over time. Based on these arguments, and the findings from Chapter 6, I have formulated the following hypotheses:

H1: Employee perceptions of the leadership's commitment to safety (LC) are positively related to attitude toward change (AC).

Although there is a general lack of academic study on high reliability organizations undergoing deliberate organizational change, the importance of the leadership's role in change outcomes is clear in the change literature (Pettigrew 1985; Aldrich, 1999; Isabella, 1990; Lines, 2003). And as deliberate change tends to activate strong emotions, both positive and negative, which are deeply associated with organizational culture, it is important that the leadership consider these effects that can produce strong reaction to change (Piderit, 2000). Since safety is a primary focus in high-risk industries, it is natural that the leadership's commitment to safety in a deliberate change process will have a powerful affect on individual perceptions toward change, and this is also reflected in the safety culture/climate literature (Flin et al., 2000; Ek et al., 2007). Grote (2007) argues that even leadership actions designed to minimize uncertainty are limited due to the system's reduced capability to adequately act in the face of requirements stemming from internal and external disturbances of normal operations (p. 639). Strong positive perceptions of the leadership's commitment to safety will reassure the employee that the leadership is indeed, committed to safety and that all changes made will be analyzed for potential risk, and compensating measures will be taken, if required, so that safety processes will not be compromised. This will also encourage employees to be more mindful of potential risks and take corrective action at an early stage through reporting. However, negative perceptions of the leadership's commitment to safety will have the opposite effect. In cases where individuals have negative perceptions of the leaderships commitment to change, all changes will lead to doubt, distrust, and as observed in Chapter's 5 and 6, resistance to change.

H2: Employee perceptions of the leadership's commitment to safety (LC) have a positive causal relationship to perceptions of safety (PS).

There is little agreement in the literature as to the most important mix of dimensions for measuring safety climate, but most studies rank the leadership's commitment to safety among those dimensions having the strongest effect (Zohar, 1980:2003; Díaz and Cabrera, 1997; Flin et al., 2000). The leadership's commitment is reflected in both *what they say* and *what they do* (Schein, 1985). A strong perception of the leadership's commitment to safety positively affects employee confidence that safety is indeed a primary focus. This leads to increased vigilance and *mindful* actions (Weick and Sutcliffe, 2001:2006) under normal operating conditions but is potentially more important during periods of change.

Inconsistencies between words and actions, on the other hand, can lead to distrust, will have a negative effect on cognitive processes, and will have a potentially negative effects on mindful action and reporting. Since safety is the stated number one goal, the leaders will always communicate this. However, it may be an institutional goal that is not properly analyzed in terms of other organizational processes like Brunsson's hypocritical organizations (Brunsson, 1989). Thus, perceptions among workers may arise that the leadership has other issues, and that safety is cared for only in a symbolic manner without true conviction and emphasis. And this is particularly relevant during change processes where potentially conflicting goals that are not adequately communicated to the employees create mistrust and scepticism toward the change process. This can lead to increased risk-taking based on the premise that the leadership is really not focused on safety but other performance measures such as cost savings. Schneider (1975) argues that these individual perceptions serve as a frame of reference for guiding appropriate and adaptive behavior. And although this change in behavior may not produce immediate measurable effects on the classic indicators of incident and accident reporting, as confirmed by the HSLB study (2003), safety processes will be affected – over time. Here it is important to remember that it is the individual perceptions of the leadership's commitment to safety, and not necessarily the leaders' own perceptions of their commitment, that affect cognitive processes and behavior.

7.3.2 Safety climate (SC)

Zohar (1980) was one of the first to examine the implications of safety climate on safety results in organizations based on the study of 20 industrial organizations in Israel. And although follow-up safety climate studies (e.g. Flin et al., 2000; Gordon et al., 2007) have

found other prioritizations of appropriate measurement dimensions, the five original areas of focus are still valid: management commitment to safety, safety training, communication, environmental control and good housekeeping, and a stable workforce (Zohar 1980). Yet, the literature also reflects that the usefulness of these dimensions is context specific, and, therefore, needs to be matched to the context within which they are employed, therefore:

H3: Safety climate (SC) has a positive causal relationship to attitude toward change (AC).

"Every organization has a safety culture (or perhaps a series of sub-cultures), and that culture can be expected to affect safety" (Hopkins, 2006: p. 876). This applies equally to safety climates that are the surface manifestations of culture itself. But I will argue that this is even more evident under conditions of deliberate organizational change in high reliability organizations, particularly if individual units or sub-cultures experience different levels of change within the same organization. The question is whether employee perceptions of safety climate react only to changes related directly to safety, or if this reaction also includes other organizational issues. In this regard, change not considered linked to safety would be interpreted with scepticism. But the change process in this case was also supposed to maintain or improve safety performance which meant that all changes, whether part of the planned process or externally generated, were to be risk analyzed to preclude adverse affects on safety processes. It was clear in Chapter 6 that the embedded units experienced the change process differently but levels of concern for safety did not vary. Accordingly, it is expected that safety climate conditions will have a positive causal relationship to attitudes toward change.

H4: Safety climate (SC) has a positive causal relationship to perception of safety (PS).

Safety climate, as a reflection of "*the way we do things around here*" (Deal and Kennedy, 1982), has several interactive elements that affect perceptions. Emphasis on training, reporting systems, internal communications mechanisms, technology, and personal relationships vary by location, and over time. Though many of these elements are externally generated, many evolve differently in local settings, and this was also evident in the analysis conducted in Chapter 6. Accordingly, safety climate is expected to have a positive causal relationship to perceptions of safety.

7.3.3 Attitude toward change (AC)

Attitudes toward change have a direct positive effect on change implementation, and these attitudes are often formed early in a change process (Lines, 2004). Negative reactions stemming from emotionally enabled bias associated with change, are often manifest by clashes between an organization's culture and its organizational leadership, and can significantly affect strategy implementation (Dasborough, et al., 2003). We saw in Chapters 5 and 6 that there was a significant shift in attitude toward change when the Take-Off 05 change process shifted from participatory to a purely top-down process, and this led to internal conflict, therefore:

H5: Employee attitudes toward change (AC) have a positive causal relationship to perception of safety (PS).

Attitudes toward change, even in organizations unfamiliar with deliberate organizational change, are expected to have a positive causal affect on change implementation, and correspondingly, is expected to have a positive causal affect on perception of safety, particularly in high reliability organizations. However, negative attitudes toward change will lead to loss of trust, and, in the worst case, resistance. And this was reflected in the analysis conducted in Chapter 6.

7.3.4 Perception of Safety (PS)

As I have presented earlier, there is little agreement in the literature for a definition of safety. For this study, I have used a variation of the definition provided by Hollnagel (2008) by focusing on safety as a process that produces outcomes that are safe. But, since these processes are embedded within complex *socio-technical* systems, as represented by high reliability organizations, they cannot be measured directly but only indirectly through other indicators. And, though there is no agreement on a definition of safety, there is agreement in the literature that individual perceptions of safety guide cognitive processes and have a direct influence on behavior (Rasmussen, 1986:1990; Hollnagel, 1998, Mearns et al., 1997; Flin et al., 2000). And it is also argued that these changes in behavior have a direct affect on safety performance. All of the hypotheses above imply either direct or indirect positive causal influences between the latent constructs and the dependent variable perception of safety (PS), and it is the strength of these causal influences, together, that affect safety behavior. This is reflected in the safety culture literature where studies have shown that "good" safety cultures, described as cultures with strong, supportive attitudes and perceptions, perform better than

"bad" safety cultures (Gordon, 2002; Gordon et al., 2007). In the next section, I will present both the measures and the results of the structural equation model.

7.4 Measures

The safety measurement model used in this study includes a combination of constructs taken from the safety climate literature and organizational change literature that effect perceptions of safety, and was tested using Lisrel 8.7 (Jöreskog et al., 1999). A departure from the literature is the addition of the moderating variable attitude toward change (AC), which is one of the focus areas in this study. Dependent and independent variables were measured using multi-item measures based on a 5-point Likert scale. The questionnaire was created using a composite of questions forming modules from corresponding international civil aviation databases, as well as, specific interest areas requested by the Norwegian Transportation Safety Board. Questions pertaining to safety climate were taken primarily from the Global Aviation Information Networks (GAIN) "Operator's flight Safety Handbook" (GAIN, 2001), and also from a questionnaire on the Reporting of Errors and Incidents: ATCOs Attitudes and Perceptions (Boje-Andersen, 2003).

The Havarikommisjon study questionnaires were originally designed to measure responses across the entire aviation industry using 25 common safety climate items from the Operator's Flight Safety Handbook (Gain, 2001), but other portions of the questionnaire were tailored to specifically examine eight individual professional groupings within the civil aviation industry, including: air traffic controllers and ATC assistants, pilots, cabin crew, ground crew, engineers, technicians, leaders, and regulatory agencies. The air traffic controller and ATC assistant questionnaire consisted of 171 items broken down into four broad areas of interest: leadership, safety climate, change, and safety.

Upon initial examination of the data, I found that there were many questions that were unclear or not relevant for the constructs used in this model, so the number of useable questions was reduced to 72 sorted into the four constructs of interest, specifically: leadership commitment to safety, safety climate, attitude toward change, and perception of safety. The leadership commitment and safety climate measures used in the model were based on the five dimensions of safety climate as described by Zohar (1980) but modified slightly to include later research (Flin et al., 2000; Gordon et al., 2007; Flin, 2007), and to reflect the context of change within a high reliability organization (HRO). Specifically, I have included a stronger focus upon the effects of *human factors* on safety performance, rather than purely technical

failures, that Weick et al. (1999) argue are the prime causes of accidents in high reliability organizations. I could also argue that this was necessary due to the special pivotal role that air traffic controllers occupy that puts them in a special position in relationship to safety outcomes. This also improves the fit of the constructs to reflect the *socio-technical* nature of high reliability organizations, and more appropriately weights the *socio-technical* aspects in the interactive phase of the safety management model presented in Chapter 2.

7.4.1 Descriptive statistics – examination of the data

The first step in analyzing multivariate data is to examine the data. Hair et al. (1995) warn that the use of multivariate data, due to its diverse character, can be quite powerful but can also tempt a researcher to substitute this technique for necessary conceptual development (p. 21). However, once the conceptual development is complete, the burden then shifts to understanding, analyzing and interpreting more complex results. One danger for the validity of the model is to ensure that the data satisfies the statistical requirements and assumptions needed to support the conceptual model. Accordingly, the first step was to conduct a graphical examination of the data to achieve a better understanding of the data. The second step was to conduct a missing data analysis. And finally, the statistical assumptions of the data were inspected.

7.4.1.1 Graphical examination of the data

An initial evaluation of the data was conducted using SPSS and Lisrel 8.7. Histograms and frequency tables were used to gain a better understanding of the data and interrelationships of the 72 selected items from the Havarikommisjon questionnaire. This initial analysis revealed no particular visual non-normality in the data other than some potentially problematic levels of skewness and kurtosis for some items but no items were excluded for this reason during the initial screening. In fact, some skewness and kurtosis was expected due to the intense turbulence experienced in the company during the period that the data were collected. And this was also reflected in the analysis in Chapter 6.

7.4.1.2 Missing values analysis

The second step in evaluating the quality of the data was to conduct a missing data analysis. Of the original 72 items chosen for evaluation in the database, 1 item demonstrated a significant number of missing responses (Chng 14), and this item was excluded from the model. Otherwise, no clear pattern for missing data was observed in the remaining items and none of the items used in the final model exceeded 2.5 % missing values. Accordingly, to

maintain the size of the database, I chose to replace missing values with the mean of the other respondents. Corresponding items used in the final structural equation model are attached in Appendix D.

Table 7-1: Missing value analysis

Univariate Statistics

	N	Mean	Std. Deviation	Missing		No. of Extremes[a]	
				Count	Percent	Low	High
Lead01 (V1)	420	2.65	1.179	2	.5	0	0
Lead03 (V2)	421	2.84	1.175	1	.2	0	0
Lead05 (V3)	420	2.80	1.181	2	.5	0	0
Lead08 (V4)	422	3.08	1.231	0	.0	0	0
Lead09 (V5)	419	2.68	1.252	3	.7	0	0
Lead13 (V6)	417	2.91	1.255	5	1.2	0	0
Clim01 (V7)	421	3.59	.999	1	.2	9	0
Clim04 (V8)	418	3.16	1.094	4	.9	0	0
Clim06 (V9)	420	2.27	1.008	2	.5	0	0
Chng05 (V12)	414	1.55	.821	8	1.9	0	22
Chng06 (V13)	415	1.73	.893	7	1.7	0	24
Chng13 (V16)	415	1.60	.854	7	1.7	0	23
Safe01 (V18)	418	3.43	1.026	4	.9	21	0
Safe02 (V19)	420	3.09	1.410	2	.5	0	0
Safe08 (V22)	412	3.32	1.116	10	2.4	21	0

a. Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR).

7.4.1.3 Statistical test to assess normality

The final analysis of the data was a statistical test to assess normality. To check for violations of the normality assumptions, a rule of thumb test was run to check for skewness and kurtosis using Lisrel 8.71. The literature recommends that if the data exceeds certain critical values or limits indicating non-normality, this might bias the results and influence the model fit (Bagozzi and Yi, 1988; Hair et al., 1995). If data proves to fall outside of normal limits, they should either be deleted before proceeding with the analysis or evaluated using alternative methods. A summary of the descriptive statistics provided by Lisrel 8.71 is shown in Table 7-2.

Table 7-2: Descriptive statistics of the sample, N=422

	Factor Loading	Mean	Std. Dev.	Skewness	Kurtosis
Var nr.	**LC**				
1	LC 1	2.957	1.163	-0.125	-0.826
2	LC 2	2.843	1.173	-0.065	-0.982
3	LC 3	2.805	1.178	0.069	-0.799
4	LC 4	3.083	1.231	-0.067	-0.949
5	LC 5	2.678	1.248	0.121	-1.096
6	LC 6	2.914	1.247	-0.057	-1.001
	SC				
7	SC 1	3.594	0.998	-0.541	-0.353
8	SC 2	3.156	1.089	-0.180	-0.769
9	SC 3	2.274	1.005	0.429	-0.580
	AC				
12	AC 1	1.546	0.814	1.925	**4.100**
13	AC 2	1.728	0.886	1.248	1.189
16	AC 3	1.595	0.847	1.714	**2.993**
	PS				
18	PS 1	3.433	1 .021	-0.518	-0.144
19	PS 2	3.090	1.406	-0.126	-1.264
22	PS 3	2.110	0.725	-0.107	-1.008

Though there is differing guidance in normal-theory parametric inference procedures regarding acceptable cut-off limits for skewness and kurtosis, particularly in large samples, Hair et al. (1998) have proposed a cut off of +/- 2.58 indicating that the assumption of normality can be rejected at the 0.01 probability level.

The results in Table 7-2 show that two of the 15 items chosen for use in the safety measurement model (AC 1 and AC 3) fall outside of this guidance and appear to be potentially problematic for both skewness and kurtosis using these limits. For this reason, I have chosen to use a nonparametric inference technique as suggested by Bhattacharyya and Johnson (1977). This approach is especially useful in situations were individuals are asked to express responses that are difficult to measure on a specific and meaningful numerical scale and/or when individuals are asked to express their views on a 5-point scale where 1 represents

strongly disagree and 5 represents strongly agree (p. 506). In these cases, a preferred approach is to use ordinal data because only the order of the numbers is meaningful, and the distance is not necessarily interesting. Jöreskog (2004) explains that a person who has chosen a specific category on a scale has more of a certain characteristic (such as attitude, for example) than if they had chosen a lower category but we do not know how much more. As such, ordinal variables have no origin or units of measure so that means, variances and co-variances have no meaning (p. 10). Accordingly, the data used in the model has been changed from continuous to ordinal, and will be used throughout the remainder of the analysis.

In the final, and revised, measurement model, a selection of 15 questionnaire items were taken from the Havarikommisjon questionnaire bank to use as measures for the four latent variables (Appendix D). Perception of the *Leadership's commitment to safety* (LC) was represented with 6 measures reflecting top leadership level qualifications, communication, and actions. Perception of *Safety climate* (SC) was represented by 3 measures reflecting training, communication, and internal reporting (Zohar, 1980). *Attitude toward change* (AC) was represented with 3 items measuring reactions to the change process, and the effects of change implementation decisions. *Perception of safety* (PS) was represented with 3 measures addressing overall safety performance, individual ability to perform, and comparative performance over time.

7.4.2 Goodness of fit

Hair et al. (1995) claim that assessing overall goodness of fit for structural equation models is not as straightforward as other multivariate dependence techniques, and SEM has no single statistic that best describes the strength of the model's predictions (p. 682). The only statistical-based measure for goodness of fit in structural equation modeling is the likelihood-ratio Chi-square statistic (χ^2). Here a large Chi-square relative to the number of degrees of freedom is important. However, with large samples this statistic is almost always significant so other measures have been developed for Lisrel. The most common measure for assessing model fit is the Root Mean Square Error of Approximation (RMSEA) where values ranging from 0.050 to 0.080 are deemed acceptable. Values under 0.050 are considered good fit, meaning that the data fits well into the model. An RMSEA of 0.030, the result for this model, is a very strong indication of good fit. Other appropriate tests include: Non-normal Fit Index (NNFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Adjusted Goodness of Fit Index (AGFI). All of these are measured on a 0 to 1.0 scale where values greater then 0.90

percent represent acceptable levels of fit. According to these tests, the measurement model based on ordinal data received good fit in all categories. In addition, I ran the same model with continuous data to compare the results, and these results can be found in Enclosure E. The results for the ordinal data models are reflected in Table 7-3:

Table 7-3: Goodness of fit indexes of measurement model

	Goodness of fit		Specification
Model 1	Fit index	Evaluation	*Ordinal data*
	$\chi^2 = 221.19$ (P = 0.00)		
	Degrees of Freedom = 84		
	RMSEA = 0.030	Good fit	
	NNFI = 1.00	Good fit	
	CFI = 1.00	Good fit	
	IFI = 1.00	Good fit	
	AGFI = 1.00	Good fit	
	CN = 427.37	Good fit	

7.4.3 Reliability

The data in the previous section shows that the model exhibits reasonably good fit but it is still possible that the measurement model is unacceptable due to reliability. Bagozzi and Yi (1988) argue that the model also needs to be justified through internal fit based on three reliability measures as evaluated in the following sections. These measures: individual item reliability, average variance extracted, and composite reliability are presented in Table 7-4 using standardized data from Lisrel 8.71.

Table 7-4 Measurement Model: Reliability measures and factor loadings

Factor loadings		/T-values	Error terms		/T-values	Item Reliability	Average variance Extracted	Composite reliability
Leadership commitment (LC)								
$\lambda_{1,1}$	**0.81**	**35.29**	$\theta_{1,1}$	**0.34**	**3.34**	**0.66**	**0.72**	**0.94**
$\lambda_{2,1}$	**0.82**	**40.18**	$\theta_{2,2}$	**0.32**	**3.18**	**0.68**		
$\lambda_{3,1}$	**0.87**	**55.72**	$\theta_{3,3}$	**0.24**	**2.44**	**0.76**		
$\lambda_{4,1}$	**0.89**	**53.83**	$\theta_{4,4}$	**0.21**	**2.14**	**0.79**		
$\lambda_{5,1}$	**0.84**	**46.88**	$\theta_{5,5}$	**0.29**	**2.90**	**0.71**		
$\lambda_{6,1}$	**0.85**	**40.92**	$\theta_{6,6}$	**0.28**	**2.75**	**0.72**		
Safety climate (SC)								
$\lambda_{7,2}$	**0.50**	**9.89**	$\theta_{7,7}$	**0.75**	**6.88**	**0.25**	**0.45**	**0.70**
$\lambda_{8,2}$	**0.76**	**26.15**	$\theta_{8,8}$	**0.42**	**4.03**	**0.58**		
$\lambda_{9,2}$	**0.72**	**22.89**	$\theta_{9,9}$	**0.48**	**4.56**	**0.52**		
Attitude toward change (AC)								
$\lambda_{10,3}$	**0.96**	**0**	$\theta_{10,10}$	**0.08**	**-0.77**	**0.92**	**0.71**	**0.88**
$\lambda_{11,3}$	**0.81**	**17.78**	$\theta_{11,11}$	**0.35**	**3.08**	**0.65**		
$\lambda_{12,3}$	**0.75**	**14.44**	$\theta_{12,12}$	**0.44**	**3.74**	**0.56**		
Perception of safety (PS)								
$\lambda_{13,4}$	**0.80**	**0**	$\theta_{13,13}$	**0.37**	**3.50**	**0.63**	**0.56**	**0.79**
$\lambda_{14,4}$	**0.80**	**24.64**	$\theta_{14,14}$	**0.36**	**3.41**	**0.64**		
$\lambda_{15,4}$	**0.63**	**15.01**	$\theta_{15,15}$	**0.61**	**5.44**	**0.39**		

The individual items above are all unidimensional, and the reliabilities were computed by Lisrel in the .out file, and are listed under squared multiple correlations. Reliability refers to consistency of measurement (Bollen, 1989). Evaluating these items is not straightforward, and there is no generally accepted minimum value for individual reliability. However, one rule of thumb proposed by Gulbrandsen (1998) is 0.25 based on fit criteria derived by Bagozzi and Yi (1988). The average variance extracted was calculated using the formula $p_v = \Sigma\lambda_i^2 / (\Sigma\lambda_i^2 + \Sigma\theta_{ii})$ for standardized data, where values greater than 0.5 are considered adequate (Bagozzi and Yi, 1988). And finally, composite reliability is defined as $p_c = (\Sigma\lambda_i)^2 / ((\Sigma\lambda_i)^2 + \Sigma\theta_{ii})$ for standardized data with a cut-off values of 0.60 (Bagozzi and Yi, 1988).

Only item 7 approaches the individual reliability limit (SC1 at .25) and, therefore, is potentially problematic. This item also only explains a small part of the construct which it reflects. And the results of this item are further reflected in a slightly lower than adequate average variance extracted value of 0.45 for the safety climate construct, but this is also is

partially due to the fact that the construct is only measured by three items. Item 7 measures adequacy of training and it is not surprising that it scored poorly on reliability since air traffic controllers and ATC assistants receive different levels of initial training, and also different levels of refresher training. However, despite the low reliability of item 7, the composite reliability for this construct is 0.71, and is well within the acceptable limits of 0.60. Accordingly, all items were retained.

7.4.4 Validity

In addition to reliable measures, different types of validity need to be considered specifically within structural equation modeling. As discussed in Chapter 4, construct validity addresses whether you are actually measuring what you intended to measure. In addition, Bollen (1989) adds that "*construct validity assesses whether a measure relates to other observed variables in a way that is consistent with theoretically derived predictions"* (p. 188). But Bollen also argues that defining validity, in itself, is also problematic and suggests that there are some weaknesses in traditional validity approaches and provides some guidance as to measures to compensate for these weaknesses. However, Bollen proposes that in the end, the question of validity really boils down to the question of whether a causal relationship exists between the latent variable and the observed variable (p. 197).

One way to confirm this causal relationship is to look at two sub-categories of construct validity, specifically, convergent and discriminant validity. Convergent validity addresses whether individual items that should be theoretically related, are related. Discriminant validity, on the other hand, addresses whether individual items that should not be related, are, in fact, not related. An approach for assessing convergent and discriminant validity is provided by Andersen and Gerbing (1988). Convergent validity can be assessed by determining whether each item's estimated pattern coefficient on the underlying hypothesized construct is significant. This is represented by the T-values in the λ's of Table 7-3 above. As all values are significant, convergent validity is assured based on Andersen and Gerbing (1988).

Discriminant validity is assessed by determining that the 95% confidence interval around the correlation estimates between two factors should not include 1.0 (absolute value). The necessary information is provided by Lisrel, and is depicted in Table 7-5.

Table 7-5 Estimated correlation matrix between the latent constructs

	AC	PS	LC	SC
AC (Attitude toward Change)	**1**			
PS (Perception of Safety)	**0.75**	**1**		
LC (Leadership Commitment)	**0.63**	**0.93**	**1**	
SC (Safety Climate)	**0.50**	**0.83**	**0.81**	**1**

As no values violate the 95% confidence interval described earlier, discriminant validity can be claimed for all of the latent variables examined.

7.5 Concluding comments on the measurement model

Considering the analyses above, I have concluded that the model is good. The model is parsimonious yet demonstrates good fit, is valid, and has acceptable reliability. In the next section I will address the results of the model.

7.6 Results

The results of the Safety Measurement Model specified by the data presented in the previous section are depicted in Figure 7-2:

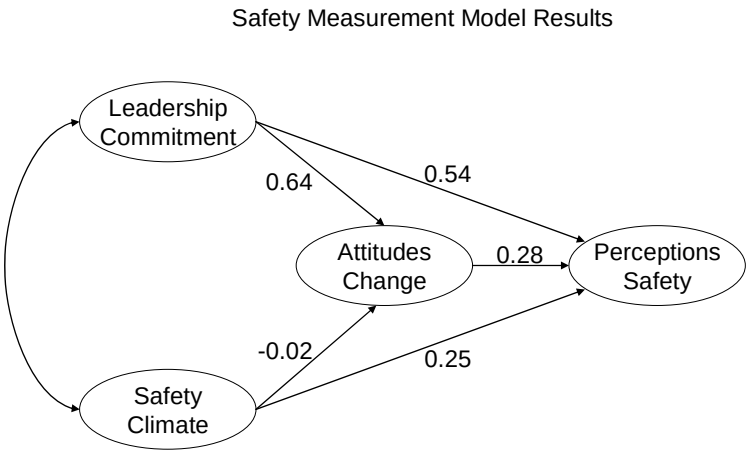

Figure 7-2 Final Safety Measurement Model results

The results show that there are several strong positive causal relationships between the latent independent constructs and the main dependent latent construct perception of safety. The total and independent effects for the ordinal data model are presented below. Corresponding results for the continuous data model are available in Appendix E. The model is specified by the following two equations for the dependent variables perception of safety (PS) and attitude toward change (AC):

Equation 1: $PS = b_{11}LC + b_{12}AC + b_{13}SC + e_1$

Equation 2: $AC = b_{21}LC + b_{22}SC + e_2$

By analyzing the path coefficients above, I can decompose correlations in the model into standardized direct and indirect effects on *perception of safety* (PS).

For the Ordinal model:
LC→PS = 0.54
LC→AC→PS = 0.64*0.28 = 0.18
Total causal effect of LC on PS = 0.72

SC→PS = 0.25
SC→AC→PS = -0.02*0.28= -0.01
Total causal effect of SC on PS = 0.24

AC→PS = 0.18
Total causal effect of AC on PS = 0.28

The corresponding results for the continuous model are attached in Appendix E.

7.7 Summary of hypotheses based on results

Based on the results above, it is clear that individual perceptions of the leadership's commitment to safety have a strong total positive causal relationship to both attitude toward change and perception of safety for the ordinal data model. In addition, there is a moderate indirect positive effect on perception of safety via the moderating variable attitude toward change. Safety climate has a moderate positive direct effect on perception of safety but no effect on attitude toward change in the ordinal model, and therefore, no significant indirect effect on perception of safety. Based on these results, evaluations of the 5 hypotheses are listed in Table 7-6.

Table 7-6 Summary of hypotheses

Constructs	Hypothesized Effects	Findings	Sign. Level (t-values)
H1 Employee perceptions of the leadership's commitment to safety have a positive effect on attitude toward change	+	+	5.57
H2 Employee perceptions of the leadership's commitment to safety have a positive effect on perceptions of safety	+	+	5.67
H3 Employee perceptions of safety climate have a positive effect on attitude toward change	+	**0**	**0.12**
H4 Employee perceptions of safety climate have a positive effect on perception of safety	+	+	2.62
H5 Employee attitude toward change have a positive effect on perception of safety	+	+	5.41

The results of the analyses show that four of the five hypotheses were supported. H3 received a t-value of 0.12 which falls under the minimum acceptable limit of 1.96, and was not supported. The direct effects of: LC on PS, LC on AC, SC on PS, and AC on PS were all significant and supported. The relevance for these findings for this study will be discussed in detail in Chapter 8.

7.8 Summary and discussion

In this chapter, I have presented a structural equation model showing the conceptual causal relationships between two key latent independent variables (perception of the leadership's commitment to safety and perception of safety climate), one moderating latent dependent variable (attitude towards change), and the main dependent variable for this study (perception of safety). I have argued previously that safety itself, as a process and not a product, cannot be measured directly, so I referred to the literature for guidance. The literature strongly reflects that individual perceptions of safety guide both cognitive processes, but more importantly, also directly influence safety behavior, particularly in the area of risk taking (Flin, 2007). And perceptions can be measured using psychometric techniques. It is this influence on safety behavior that guides individual actions that affect safety processes in a *socio-technical* system, over time, that sometimes result in disaster. But it has also been shown that changes in safety behavior may have no effect on the traditional safety metrics of incident and accident reporting in the short term, particularly in *ultra-safe* environments (Johnson, 2004; HLSB, 2005). But high-profile failures in high-risk industries have shown that these gradual reductions in safety margins can result in disaster as evidenced by both space shuttle disasters and the Überlingen mid-air collision discussed previously.

The constructs used in this model were based on the research questions for this study, supported by the academic literature on safety climate audits, and modified to fit the context of this study based on the findings from the analysis in Chapter 6. Based on those findings, I found that individual perceptions of the leadership's commitment to safety was a complex construct that is strongly linked with both attitudes toward the organizational change process itself, and also to the perception of safety within the organization. But traditionally the literature considers the leadership's commitment to safety a sub-category of safety climate, and not a construct in itself. However, the results of Chapter 6 show that this construct has strong effects both on perceptions of safety and also attitudes toward change. Therefore, I chose to separate the perception of the leadership's commitment to safety from the perception of safety climate in the model. However, the link between leadership commitment to safety and safety outcomes is well-documented in the literature (Zohar, 1980: 2000; Hopkins, 2006; Flin, 2007; Gordon et al., 2007), and this construct was by far the most influential causal factor in individual perceptions of safety with a 0.72 total effect.

The academic literature reflects that the two latent independent variables used in the model have demonstrated positive causal relationship to safety performance, specifically: leadership commitment to safety and safety climate. But these variables have not been studied specifically in the context of strategic organizational change that is of particular interest for this study. Accordingly, I have also added the moderating latent variable attitude toward change that has not been covered previously in the academic literature, and has both direct and mediating causal affects on perception of safety.

The results of the safety measurement model show strong causal relationships between all of the independent variables originally specified and the main dependent variable perception of safety. This is true for both the ordinal data model and the continuous data model (See Appendix E). Indirect effects on perception of safety through attitude toward change were significant for leadership commitment to change but not for safety climate. This was not totally surprising as the results of the analysis in Chapter 6 showed that although attitudes toward the top leadership was negatively affected, local conditions did not seem to be significantly adversely affected. The implications for the results of these models will be addressed in the discussion section of Chapter 8.

8 Summary of empirical findings

In this chapter, I will present a summary of the empirical findings presented in Chapters 5, 6 and 7. These chapters build upon each other with the intention of first presenting the chronological sequence of events describing the change process leading to the ultimate collapse of the Take-Off 05 project and how individuals in four embedded cases experience the change with particular focus on the final turbulent 12 month period. Chapter 6 uses a mixed-method analytical approach to map individual changes in attitudes and perceptions in the four embedded cases both before the change process commenced and during the turbulent final 12 month period. Chapter 7 uses the findings from Chapters 5 and 6 to fine-tune the four latent constructs used to take a "snapshot of safety" using a structural equation model.

8.1.1 Aborted Take-off – Chapter 5

In Chapter 5, I presented a three-year chronological account of the deliberate strategic change process known as Take-Off 05 from the decision to change, through the change planning process itself, and finally, the implementation of the planned change leading to the departure of the top leadership team and the eventual collapse of the project. This presentation began at the macro level to put the change process into perspective within the entire civil aviation industry, and to identify key stakeholders. Then, through a series of deliberate research design modifications and unexpected real-world outcomes, I narrowed the focus of the presentation to four embedded cases within Avinor that experienced the most controversial changes in the change project that led to resistance to change, specifically the decisions to close two of four air traffic controller centers in Norway.

The presentation showed that the decision to change the business model for the civil aviation authority in Norway came in response to legitimate deteriorating economic conditions within the international civil aviation community post-911. And this trend was also reflected in increasing operating costs and declining revenues for the state-managed, air traffic services organization – Luftfartsverket in 2002. In response, the Norwegian government decided that the state-managed, civil air traffic services provider would be better served if they were transformed into a state-owned, private company. It was believed that through the implementation of a new business model, this new entity would become more efficient and would have access to a full range of financial markets to improve economic performance and would enable growth. This was also in line with the international civil aviation initiative

known as corporatization. Hence, Luftfartsverket was officially transformed into the state-owned, private company Avinor effective on January 1st, 2003.

The deliberate strategic change initiative was contained in a project called Take-Off 05, a process that was advertised by the leadership as participative in nature, where all employees could contribute. And, indeed, many employees were directly involved in the eleven planning groups that formulated the final change implementation plan. And there was broad internal agreement in the beginning - in principle - both for the need for change, and also for reducing the number of air traffic control centers in Norway. But this consensus was short-lived, and ended shortly after the Take-Off 05 planning document was made public. At this point, many employees felt that their inputs had not been taken into account in the final planning document as they had expected. In addition, the breadth, scope and timing of the planned implementation process were deeper, faster, and less flexible than expected. And as reflected in Chapter 5, this resulted in a state of shock and disbelief for many employees, especially those who had personally contributed to the results. This also marked the point where Avinor's strongest internal culture, represented by the Norwegian Air Traffic Controllers union (NFF), registered their strong disagreement with many of the basic assumptions upon which the Take-Off 05 plan was based, particularly the number of air traffic controllers needed to operate the new air traffic management model but also in the choices and timing for closing air traffic control centers in Norway.

The public release of the Take-Off 05 planning documented marked the beginning of a split between one specific sub-culture and the leadership. And this was further exacerbated when the leadership's approach to change during the implementation phase of the planning process abruptly changed from participative in nature to clearly top-down. This change in implementation method became painfully evident during the decision processes resulting in the decisions to close the Trondheim ATCC, and was followed shortly thereafter by the decision to close the Røyken ATCC. From the Trondheim closing decision onward, consensus for the change project known as Take-Off 05 was essentially lost, and this led to a general loss of trust in the leadership and started a pattern of resistance that would intensify during the remainder of the Take-Off 05 project.

The internal struggle within Avinor gained external attention already in the spring of 2004 when significant regional air traffic delays caused by reduced productivity of air traffic controllers due to illness at the soon-to-be-closed Trondheim ATCC, gave the nation a

glimpse into the troubles ahead. However, the conflict did not become critical on a national level until the leadership announced the recommendation to close the second ATCC at Røyken in September 2004. The spontaneous reaction to the Røyken closure announcement resulted in the grounding of all air traffic movements (national and international) in southern Norway for two days, had severe economic consequences for national airlines, and would prove to have long-lasting effects on all air traffic movements in Norway having both national and international consequences. The top-down decision to close the Røyken ATCC raised the intensity of the conflict internally, but also alerted key stakeholders, specifically the government and key regulatory agencies, as to the severity of the conflict and the potential risks to safety.

The increased internal tension within Avinor, and the regular national disruption to air traffic services that the Take-Off 05 process caused, was only part of the larger civil aviation problem in Norway. During this same time period, the Norwegian civil aviation regulatory agency was also experiencing large-scale change in the form or a politically motivated move from Oslo to Bodø. The growing media coverage of these two disruptive change processes, combined with similar problems in national airlines undergoing large-scale changes, became a growing concern for the government, and several of the opposition parties to the ruling government called for action. This resulted in the government tasking the Norwegian Transportation Safety Board (HSLB) to conduct a national evaluation of air traffic safety in the Norwegian civil aviation industry that was obviously struggling through organizational change processes. The results of the study raised many critical questions regarding the leadership in Avinor, but found no evidence that safety had been affected in one way or another based on traditional safety metrics. The HSLB study took place during the final turbulent 12-months of the Take-Off 05 project and is the focus of the analysis in Chapter 6.

8.1.2 Mapping the effects of change

In Chapter 6, I used a mixed-methods approach to triangulate two distinctly different data sets (one quantitative and one qualitative) to map the effects of deliberate organizational change on employee attitudes and perceptions during the volatile 12-month period leading up to the collapse of the Take-Off 05 project. The intention was to map these attitudes and perceptions against the four latent constructs of interest to the research questions, specifically: leadership in context of change, safety climate, attitudes toward change, and perceptions of safety. The

results of this analysis were used to further develop and refine these latent constructs for use in a conceptual safety measurement model for use in Chapter 7.

The analysis was based on the premise that a mismatch between organizational culture type and change implementation method caused strong employee reactions that directly affected employee attitudes and perceptions. The analysis also showed how these attitudes and perceptions differed significantly across four embedded cases by triangulating statistical results from two sets of questionnaire data with coded interview responses. Additionally, I explored how these differences affected reported behavior related to the change process though individual interview responses. I also examined how these distinct reactions affected individual perceptions of safety which the literature argues has a direct effect on safety behavior.

I found that the individuals in each embedded case reacted differently to leadership implementation decisions depending both upon the decisions made, as well as, the specific phase of the change process in which they were located. One surprising outcome was the consistency in which individual responses varied depending upon the organizational culture - in place - and the phase of the implementation phase they were experiencing. The data showed that even though the four embedded cases were similar in size, performed the same operational tasks, and were governed by the same rules and regulations, each was distinctively different from an organizational climate perspective, and each reacted differently to change.

Another interesting finding was the importance of the local leadership in acting as a mediator between the employees and the top leadership, especially during the volatile phase of the change implementation process. This was not, however, the case with the top leadership where employee perceptions of the leadership's commitment to safety deteriorated significantly - over time - from before the start of the Take-Off 05 project through its collapse in December 2005. The effect of employee perceptions of the top leadership's commitment to safety was so strongly reflected in the analysis that this latent construct was chosen for use in Chapter 7.

The most striking finding of Chapter 6 was the importance of employee perceptions of the leadership's commitment to safety in a high reliability organization, and how this perception affects both attitude toward change and perceptions of safety. This was also the only area

where the embedded units did not vary significantly based upon the specific phase of the change process they were experiencing or differences in organizational climate. One surprising dimension of the leadership's commitment to safety that is not well-documented in the literature is how employee perceptions of the top leadership's competence to perform their tasks in a high reliability organization are specifically related to safety outcomes. This dimension was mentioned often during the interviews, and was usually related to conflicts between safety outcomes and economic results.

8.1.3 Measuring perceptions of safety through modeling

Based on the findings of Chapter 6, I presented a conceptual structural equation model of the four refined latent variables: individual perceptions of the leadership's commitment to safety (LC), individual perceptions of the safety climate (SC), individual attitudes toward change (AC), and individual perceptions of safety (PS). The conceptual safety measurement model presented in Chapter 7 (See page 154) shows that all five of the original hypotheses (See page 153) were expected to have positive causal relationships toward the dependent latent variable *perception of safety* (PS).

The results of the safety measurement model depicted in Figure 8-2 (See page 168) show that the leadership's commitment to safety has a strong direct positive causal effect on perception of safety (0.54), and that there is an additional moderate indirect causal effect through the moderating variable attitude toward change (0.64 x 0.28 = 0.18) for a total effect on perception of safety of 0.72. The results also show that safety climate has a moderate direct causal affect on perceptions of safety (0.25) but no indirect causal effect via attitude towards change. And finally, the model also shows that attitude towards change has a moderate direct causal effect on perception of safety (0.28).

The results confirm that all of the latent constructs in the model have direct positive causal effects on perceptions of safety and, as such, are important leading indicators of changes in safety behavior. The model also shows that the leadership's commitment to safety has a powerful influence on individual perceptions of safety, and this is also supported by findings from the academic literature. But the model also shows that the leadership's commitment to safety has strong affect on attitudes toward change in a high-risk environment which, in turn, also causes an indirect affect on perceptions of safety. This is considered an important contribution in itself, and an area requiring further research.

One hypothesis that was not support was the causal effect of safety climate on attitude toward change. One reason may be that much of the effect was already captured by the leadership commitment latent construct which is often studied as a part of the safety climate construct. In addition, many of the dimensions of the safety culture were physical attributes such as training and technology, and these were not a focus in this model.

The results in Chapter 7 are supported by the findings in Chapter 6 where the analysis reflected a significant negative change in all of the embedded units with regards to both individual perceptions of the leadership's commitment to safety and also perceptions of safety and safety climate. In addition, all of the respondents in the semi-structured interviews expressed strong negative attitudes for the change process. Based on the results of the model, this would indicate that all of the direct and indirect influences on perception of safety had strong negative effects on individual perceptions of safety, and thereby, strong negative influence on safety behavior. And this was supported by the findings in Chapter 6.

Part V: DISCUSSION AND RECOMMENDATIONS

In this chapter, I will present a discussion of the findings relative to the theory and formulate conclusions based on the results. I will then discuss the theoretical and managerial implications of the findings followed by limitations of the study and suggested areas of future research. And finally, I will end with some concluding remarks addressing the contributions of the study.

9 Discussion and conclusions

9.1 Discussion

The goal of this dissertation has been to study the effects of deliberate strategic organizational change in a high reliability organization (HRO), and to measure the effects of potentially destabilizing change processes on safety as an outcome variable – over time. Specifically, I was interested in learning how leadership choices and actions during deliberate organizational change in a complex, high-risk organization characterized by stable processes, affected individual attitudes toward change and perceptions of safety. And, more importantly, I wanted to identify the main influences on these changes in attitudes and perceptions, and how they might affect safety as an outcome. These three disparate theoretical areas of interest (strategic change, HROs and Safety) were linked together in a conceptual structural equation model based on the findings during the study presented in Chapter 7.

The literature describes high reliability organizations as organizations in high-risk industries that achieve high levels of safety performance through common managerial structures, supporting safety cultures, redundancy, local ownership of tasks, and learning environments often associated with *mindful* behavior (Rochlin et al., 1987; Roberts, 1990; Weick and Roberts, 1993; Weick and Sutcliffe, 2001:2006; Reason, 1997). HROs are characterized as learning organizations where stable outcomes are achieved through learning environments that implement continual incremental organizational change. But the literature does not address how HROs react to potentially destabilizing deliberate organizational change as experienced in this study, or how disruptive changes might affect safety as an outcome. Accordingly, this study makes several substantial contributions to the literature.

The first contribution of this study addresses the process of implementing potentially disruptive deliberate organizational change in an HRO. Although previous studies have identified evolutionary or incremental changes as contributing factors to disastrous events (Perrow, 1980; Vaughn, 1996; Snook, 2002, Gehman, 2003; Johnson, 2004), all were conducted after the disastrous event occurred, and none of these studies focused on deliberate organizational change. Today, there is a general lack of literature studying HROs during deliberate organizational change processes that do not necessarily result in disastrous events, at least not over the short term. And this study provides an important contribution in this area as more and more organizations described as HROs conduct deliberate organizational change.

This is particularly true for HROs in the civil aviation industry, but equally important for HROs in other industries such as: healthcare, energy production and other non-aviation transport sectors.

The second contribution of this study addresses the deliberate change process itself, and the implications for organizations in high-risk environments that rely heavily upon the human element in *socio-technical* systems to achieve safe performance such as those found in HROs. The literature reflects a substantial base of knowledge for organizations experiencing deliberate organizational change, but most studies focus either on *structural-technical* or *behavioral-social* change (Waldersee and Griffiths, 2004), with few studies following mixed-type change that incorporates both types of change simultaneously (Forehand & Gilmer, 1964; Porter and Lawler, 1965; Waldersee and Griffiths, 2004). And the literature also reflects that most of these studies have taken place after the change process has been completed, and usually with satisfactory results (Meyerson and Martin, 1987; Beer and Nohria, 2000; Chapman, 2002). And few studies, if any, have followed mixed-type changes in complex organizations that fail, such as experienced in this study. Closely associated with change outcomes is the importance of matching organizational change types with organizational cultures in place. Again, few studies, if any, have followed culture-change matching in a mixed-type change, and no studies have followed an HRO during deliberate organizational change, and this study provides new knowledge in this area. In this regard, this study augments organizational change theory by filling two gaps in the literature.

The third contribution of this study addresses the problem of measuring safety in high-risk environments that have reached *ultra-safe* levels of performance (Amalberti, 2001) where the traditional measures of incidents and accident reporting fail to capture developing latent conditions leading to disaster. As discovered early in this study, safety is, at best, a latent concept representing a process (Hollnagel, 2007), and not a product, that can only be measured indirectly through other indicators. And although the literature reflects the frustration of many researchers for finding an alternative to the traditional safety measures of incident and accident reporting, few studies provide alternative measures. One area of particular interest for this study is the growing interest in finding proactive measures of evolving safety processes in *socio-technical* organizations using a combination of psychometric tools and qualitative approaches to reveal the contribution of safety culture to performance outcomes (Schneider and Gunnarson, 1991; Cox and Flin, 1998; Hale and

Hovden, 1998). These efforts, sometimes called safety audits, allow researchers to fine-tune the individual constructs of interest, and may even allow some form for benchmarking safety performance in ultra-safe industries. These findings lead to a shift in focus in safety measurement away from reactive forms of measurement to what I have called the interactive phase of a safety management system (See page 13) that relies more heavily on the human element in a socio-technical system, and the idea of mindfulness (Weick and Sutcliffe, 2001:2006). One particularly important contribution from this study is the differentiation between individual perceptions of the leadership's commitment to safety and the traditional focus on leadership commitment from a leader's perspective as part of a safety climate construct. The distinction lies in how the leadership communicates or signals their commitment. And, as shown in this study, it is the individual perception of this commitment that influences cognitive processes and ultimately behavior, and not necessarily the leader's actual commitment.

The fourth contribution of this study introduces a safety measurement model based on the results of a safety climate survey that effectively takes a *snapshot of safety* at a specific point in time. This model shows how important latent constructs (individual perception of the leadership's commitment to safety, individual perceptions of the safety climate, and individual attitudes towards change) combine directly and indirectly to affect the main dependent variable (individual perception of safety) in a deliberate change environment. More importantly, this model shows how strongly the perception of the leadership's commitment to safety affects both attitudes toward change and perceptions of safety in an HRO.

9.2 Conclusions

When I started this study, I made the deliberate choice to use a sensemaking strategy by temporally bracketing key events within the larger change process to "*examine how the context affects processes, and what the consequences of the processes are on the future context, and other relevant variables of interest*" (Langley, 1999: p. 703). To my knowledge, no studies have followed a High Reliability Organization in the context of a disruptive deliberate organizational change process as experienced by the Avinor case. More importantly, no studies have tried to measure changes in safety during deliberate organizational change using alternative methods to the traditional metrics of incident and accident reporting. In fact, the Norwegian Transportation Safety Board found that it was impossible to determine, one way or the other, if the volatile organizational change process

experienced by the Norwegian civil aviation industry had affected safety in any way based on traditional metrics during the same time period of this study. However, the report also noted this fact and encouraged further research to uncover proactive forms of safety measurement.

The results of the study confirm the difficulty of leading deliberate organizational change in complex organizations, particular organizations with strong subcultures. And although the leadership in the Avinor case used what could be described as a mixed-type change that combined both participative and top-down approaches, the implementation of these approaches was unsuccessful, at least for 20% of the change process represented by Avinor's strongest subculture – the air traffic controllers and ATC assistants. One important finding that was not a focus of this study showed that approximately 80% of the planned change process was successfully completed. This 80% represented the part of the company not directly associated with air traffic control, and were primarily responsible for the management of airports, infrastructure and administration.

The study also revealed the importance of individual perceptions of the leadership's commitment to safety in safety outcomes during change. And although the results of the study would indicate a significant reduction in safety margins during the timeframe studied based on the causal relationships in the safety measurement model, the model also shows that a reversal in the perceptions of the leadership's commitment to safety would have an equally dramatic improving effect on perceptions of safety and. ultimately, behavior.

9.3 Limitations

9.3.1 General

To follow a large and complex *socio-technical* organization, such as Avinor, consisting of 45 regional airports, a separate headquarters staff, and over 2,800 employees, through a complex and dynamic deliberate strategic change process was a daunting task for a single researcher, and one could argue that this was a weakness in itself. This problem was made even more complex by the fact that Avinor is only one actor within a larger civil aviation industry where many influential stakeholders with considerable *coercive power* were both directly, and indirectly, involved in the change process. This created many externally generated subtle incremental changes – over time - that created significant unexpected effects on the Take-Off 05 planned implementation process.

9.3.2 Deliberate choices

Managing the scope of the study, as well as, the sheer volume of primary and secondary data collected, was a continual challenge and concern, and required that I make many choices underway. Many of these choices were made deliberately to better focus the study to support the research questions, but others were made to accommodate unexpected environmental changes both internal and external to the study. In addition, as I was not co-located with any of the embedded units studied, resource limitations restricted the amount of direct physical contact I had with any one group. However, this may also have been fortunate as it became clear over time that as the internal struggle increased within the organization my presence was often seen by some as potentially threatening.

One could easily argue that choosing a single case study is a limitation in itself, and this is, of course, true. And it is often argued that this is because findings cannot be generalized to other populations. However, I would argue that generalizing the effects of change on a similar population and culture, specifically air traffic controllers and ATC assistants, within other high reliability organizations with similar structures and supporting cultures, particularly within the civil aviation industry, does have utility. But this can only be assessed through future studies.

Another weakness for studies that are largely qualitative in nature is the question of objectivity. This was addressed, in detail, in Chapter 4 but this must still be considered a potential factor in the findings as there is always a risk that my own subjective views of the events shaped my conclusions. These views were potentially influenced by my professional background, experience and training, but also my own personal knowledge and relationship to individuals within, and outside, of Avinor. To combat this, I used several techniques to reduce the danger of my own subjectivity. First, I excluded the local Avinor environment, where I have strong personal ties, in all matters relating to my study. The only exception was the use of two local operative experts with whom I had no personal relationship to validate the interview protocol used in the semi-structured interviews for language, accuracy and content. Second, all interviews used in the analysis were transcribed verbatim, and these, together with all secondary data are available in a database and can be recoded and analyzed again.

Another issue is the question of validity. This was discussed in detail in Chapter 4, and also covered briefly in Chapter 7 for validity issues directly concerning the structural equation model, but it should be emphasised that most data that was not obtained in written form was

validated through several key informants. In addition, selected key informants representing both the top leadership and the employees were used to review the final thesis for accuracy before being published.

As the study focused on the effects of deliberate change on safety as an outcome in a high reliability organization, I initially chose to study three embedded cases within Avinor that were directly involved in air traffic control operations which were also considered most closely associated with safety outcomes. These three cases - the tower, approach and Air Traffic Control Centers (ATCCs) at Bodø, Stavanger and Oslo proved, in reality, to be 7 different entities with distinctly different tasks, and, more importantly, distinctly different organizational climates. Accordingly, I further narrowed the focus for the initial analysis to only cover the three remaining ATCCs. However, it became clear early in the analysis of these three embedded units that the dynamics of the fourth ATCC (Trondheim), that had been closed down as part of the Take-Off 05 process were too important to ignore, so I decided to include this group into the final analysis. Narrowing the study focus to these four embedded cases was a deliberate decision that meant that only 11% of the entire Avinor employee population base was actually included in the qualitative portion of the study, and only in one particular area of operations. This also meant that many other interesting areas within the company were deliberately excluded. This was improved to 20% of the Avinor population base in the safety measurement model where the entire air traffic controller and ATC assistant database were used, but this still excluded approximately 80% of the Avinor organization. It should also be mentioned that a large portion of Avinor excluded from the study had completed most of the planned change process successfully, and indications were that many of these groups were satisfied with the changes. However, it should also be mentioned that many of these groups focused on business aspects within the organization that did not have direct air traffic safety consequences, and so these were not particularly interesting for this study.

Another deliberate choice was to focus the study primarily from the point of view of the operative employees affected by change, and not the leadership itself. This was not the original intention, but it became clear early in the study that there was a very complex dynamic evolving between the four levels of leadership (local leadership, middle management, top leadership, and the owners/stakeholders) which made it difficult for leaders at all levels to contribute openly. An early attempt to get managers to keep weekly journals to

reflect personal experiences during the change process failed. Many claimed that they were just too busy, but a few confirmed that they did not feel comfortable putting these experiences down in writing.

9.3.3 Externally driven changes

The original research design called for a preliminary round of top leadership presentations of the Take-Off 05 project followed by individual site orientation visits to be used for design of an interview protocol to be administered in the spring of 2005. The results of the individual interviews were to serve as a basis for the design of a customized safety climate survey to be administered in the fall of 2005. However, in the spring of 2005, the Norwegian Transportation Safety Board (HSLB), under the tasking of Norwegian Ministry of Transport, began to investigate the state of safety in the Norwegian civil aviation industry which created a direct conflict between my work, and the government tasking. I adjusted my research design at this point by postponing my interview round pending the outcome of the HSLB study. One positive outcome from this change was that I was allowed to collaborate directly with the HSLB team conducting the study, and discuss areas of mutual interest. As the focus of the government study and my study were very similar, the results of the safety climate survey were sufficient to meet the needs of my study.

One limitation of the survey results was that the HSLB study was designed to cover a larger civil aviation audience than just Avinor, so the individual questions were not optimized for the individual constructs used in the safety measurement model. In addition, even though my inputs were well-covered – in principle - in the safety climate questionnaire designed by the Norwegian Transport Economic Institute (TØI), they were not optimum for my purposes and many questions were discarded. However, the academic quality of the survey was very good and was based on international aviation databases, so I chose to use these data instead of creating and administering a new round of questionnaires. One reason for this decision was that during the semi-structured interviews it was clear that the employees were becoming increasingly irritated by the volume of external interviews and questionnaires to which they were being subjected to, and this would have a potential bias effect on the results of follow-on questionnaires.

9.4 Practical Implications

There is little academic research today addressing the effects of deliberate organizational change in high reliability organizations and this is an area where this study makes its strongest contribution. And this is an area of increasing interest as HROs from diverse industries implement various forms of organizational change connected with corporatization, either to become more competitive or just to survive. This is particularly true for the entire civil aviation industry where corporatization is an international initiative, but is also relevant for other sectors experiencing some type of New Public Management initiatives including, in particular, the health and energy sectors.

The findings in this study have practical implications in several areas, including: (1) increased focus on the interactive phase of a safety management system as a proactive management tool to supplement classical safety measures; the importance of matching organizational change types with organizational cultures in place; the use of safety climate surveys in the form of safety audits to map and even benchmark changes in employee attitudes and perceptions during change processes in high-risk industries; and modeling attitudes and perceptions for use in proactive measures in *ultra-safe* environments where traditional measures of fail.

9.5 Theoretical implications and suggestions for future research

The findings of this thesis have several important theoretical implications for deliberate strategic change in high-risk industries, and for change implementation research in high reliability organizations, in particular. In addition, this thesis has shown that change processes can affect safety without being reflected in traditional measures. And these implications lead naturally to further research.

9.5.1 Change-related research

Theoretical implications relating to organizational change include more focus on matching strategic change types with organizational cultures - in place - in longitudinal-type studies where interactions can be observed and interpreted real-time. This includes all phases of organizational change from building consensus for change, change planning, and, ultimately, change implementation and monitoring. In this study, the leadership changed its change implementation type in mid-stream with devastating consequences. In addition, the leadership did not consider altering the planned change even when indications revealed that key assumptions underlying the foundation of the scope of change had evolved away from initial

projections. The reasoning for not modifying the plan were never revealed, and an area for further study.

Another related theoretical implication that was not an area of focus of this study, but was clearly evident, was the effects of power and politics during deliberate change in organizations with many diverse and potentially powerful stakeholders. In this study, the leadership was not only increasingly opposed by the employees and a strong employee union with professional and positional power, but over the course of the change process other external actors played an increasing role that contributed to the internal turbulence.

Still another theoretical implication that was not pursued in this study was role of middle managers during deliberate organizational change in high-risk industries where conflicting goals stretch middle manager allegiances, especially during periods of conflict. And this could also be expanded to include the effects on individual leaders on all levels during, and after, a failed change initiative. At the beginning of this study, there were 16 identified leadership positions directly influencing the strategic change process within the original scope of the study, including: The Norwegian Minister of Transport, the Chairman of the Avinor Board of Directors, The CEO, the Director of the Air Navigation Services Division, 4 operational directors, the divisional safety manager, and 7 chief air traffic controllers. As of this writing, only 1 position is still occupied by the original leader. Many of the others, particularly from the top middle management, are no longer a part of the organization.

9.5.2 Safety-related research

It was clear from the results of the safety measurement model used in this study that organizational change does have a potential effect on safety as an outcome, and this is an area of interest for future research. But the results of the model also show that the effects of change on safety can also be positive. In fact, after the collapse of the Take-Off 05 project, a new leadership was put into place that projected a completely different commitment to safety, and this has been reflected in very positive terms by several key informants at different levels within the Avinor organization including the three remaining ATCCs. A follow-up survey could be used to confirm the effects presented in this study, but could also be used as a basis for benchmarking this organization over time, and also against other similar organizations experiencing change.

I have already addressed some of the limitations of the current study, particularly the fact that I could not tailor the individual measurement dimensions to precisely fit the constructs used in the model. And although the individual items used to describe the latent constructs were judged as adequate for this study's purposes, the results could be improved through further research. And this is considered important as this study showed that traditional metrics were not effective in capturing changes in safety due to changes in attitudes and perceptions related directly to the change process. In this regard, the literature has demonstrated a growing interest for finding proactive measures for detecting subtle changes in safety processes in *ultra-safe* environments before conditions deteriorate to dangerous levels. The current body of academic work related to safety audits using a combination of quantitative and qualitative measures has been mentioned. But this work is still in an early phase, and it is also clear from the literature that there is no general consensus regarding the best combination of latent constructs or dimensions for measuring safety climate, and there is no current work studying the effects of strategic change on safety in a high reliability organization. And this is an area that should receive increased focus in the future.

Another area of interest mentioned in Chapter 2, but not included in this study, is the close potential relationship between the HRO school of thought and Resilience Engineering. In fact, the use of modeling in safety measurement bridges a gap between these two schools of thought, and could be an area of mutual interest. Another modeling form that I used earlier in the study to help understand the complexity of the safety issue in relationship to manning was systems dynamics. The structural equation model used in this study focused mainly of the human aspects of a socio-technical system. Systems dynamics would enable incorporation of both social and technical behavior with the added benefit of manipulating inputs to determine alternate outcomes.

9.6 Managerial implications

The results of this study reflect the difficulties facing leaders and managers responsible for planning and implementing deliberate organizational change in HROs. Conflicting goals can lead to sub-optimized change decisions that can have negative effects on individual attitudes and perceptions, which in turn, affect safety. Strong subcultures often require special handling in the form of participation. But this is not enough, leaders must gain initial consensus for change and maintain this consensus during the entire change process through communication, monitoring and continual adjustment. Adjustment to the implementation phase during

organizational change is a leadership responsibility, and this often requires tough negotiation with strong sub-cultures to win approval. The literature shows that failure to match change implementation types to cultures in place can lead to collapse. But this study shows that improperly applying mixed-change types can also lead to collapse. This is particularly relevant when strong subcultures also possess high levels of positional and professional power as is the case with air traffic controllers.

This study also highlights the leadership's collective responsibility in creating a perception of their commitment to safety through words and actions that convey the proper signals to those individuals responsible for safe outcomes in high-risk organizations. Failure to communicate this commitment has a strong negative effect on individual cognitive processes and influences behavior.

9.7 Final comments

It is clear from the results of this study that safety within Avinor was negatively affected by the strategic change process known as Take-Off 05 at the point in time that these data were collected. And this was confirmed through triangulated data in Chapter 6. The safety measurement model does not tell us how much safety was reduced, only the direction and magnitude of change. And as presented earlier, ultra-safe environments found in high reliability organizations have large safety margins and redundant systems so in all likelihood, Avinor was never unsafe, and this was the conclusion of the HSLB - but the real question is for how long? The Überlingen mid-air collision demonstrated that an erosion of safety margins due to corporatization processes, can lead to disaster – over time - if latent conditions deteriorate to a level where simple active errors create a window of vulnerability that can result in a catastrophic undesired event.

The good news from the results of this study is that the model shows that changes in the latent constructs can also lead to positive changes in both attitudes toward change and, more important, changes in individual perceptions of safety. And due to the strength of the causal relationships demonstrated by the model (0.72), positive and effective efforts by the leadership will have strong, positive causal effects on perceptions of safety and on safety behavior. And I can report that follow-on discussions with key informants have confirmed that the overall perceptions of the new leadership's commitment to safety is significantly improved, and that the effects of leadership actions subsequent to the Take-Off 05 collapse

have already demonstrated positive effects. Yet, there has still been no change reflected in the traditional measures of incident and accident reporting.

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PART VI: APPENDIXES

Appendix A – Interview Protocol

Interview Object Number: _____

INTERVIEW PROTOCOL
"SAFETY AS AN OUTCOME VARIABLE: THE EFFECTS OF STRATEGIC CHANGE ON SAFETY AND SAFETY CULTURE"
STUDY

(Interviewee information – Confidential)

Name:
Position:
Workplace:
Gender:
Years in Avinor/Luftfartsverket:

- **In your opinion, what is safety culture and what are the most essential elements of a positive safety culture?**
  - **Do these elements exist in your unit?**
  - **Do these elements exist in Avinor?**
  - **What could be changed to improve the safety culture in Avinor?**

- **When you first learned of the changes to take place within Avinor, including the process known as Takeoff 05, what were your expectations?**

- **Was your attitude toward the planned changes positive, negative or ambivalent? Why?**

- **Have your expectations been met, and has your attitude changed during the change process?**

- **How would you characterize the level of safety in Avinor today, compared to the level of safety found before the initiation of the change process?**

- **Tell me about situations that you have experienced, or have heard about, that serve as:**
  - **Positive examples of how change has affected safety.**
  - **Negative examples of how change has affected safety.**

- **Tell me about some of the operative areas most likely to contribute to the next serious incident or accident in Avinor.**

- **Tell me about what concerns you most about the current situation.**

- **What does Avinor do today to manage operational risk regarding:**
  - **Risk management process for implementing change actions**
  - **Training and qualification programs for operative personnel**
  - **Management of the Safety program including SMS and MESYS**

- **What do you think about?**
  - **Adequacy of education and training for operative positions**
  - **Level of employee experience and competence in managing high risk tasks**
  - **Leadership qualifications and knowledge related to positions and tasks**
    - **Local leadership (Chief Air Traffic Controller)**
    - **Middle management (Department/divisional leaders)**
    - **Senior leadership (CEO and Headquarters Staff)**
  - **Leadership commitment to safety**
  - **Do leadership actions reflect what is said about commitment to safety?**
  - **Effectiveness of the safety management system (SMS)**
  - **Effectiveness of the MESYS incident/accident reporting system**
  - **Adequacy of resources to perform your tasks safely**
  - **What is your perception regarding pressure to complete operative tasks**
  - **Avinor's compliance with work hour limitations and use of overtime**
  - **Level of fatigue of employees in your unit**

- **How would you describe the role of Avinor's leadership in creating a safe environment?**

- **Does Avinor have a blame culture? Give specific examples.**

- **Is there anything else on your mind regarding safety culture or do you have any ideas on how to improve performance and safety?**

Appendix B – Avinor Study Interview contract

AVINOR STUDY INTERVIEW CONTRACT

INTRODUCTION:

My name is Eric Arne Lofquist. I am a researcher from the Norwegian School of Economics and Business Administration conducting a study entitled ”Safety as an Outcome Variable: The Effects of Strategic Change on Safety and Safety Culture” in Avinor. This study has been formally accepted by both the leadership and the employees of Avinor, and the results of the study will be published and made available to the public as part of my PhD dissertation.

PURPOSE:
The purpose of this study is learn more about how strategic change decisions and subsequent change implementation processes affect safety, and the role safety culture plays in the strategic change process.

INTERVIEW PROCESS:
The type of interview that we will be conducting is called a Semi-structured Interview which means that I have a basic framework of standard questions that all subjects will be asked to answer, but follow-up questions may vary depending upon your particular answers, in order to expand and clarify specific points of interest. The questions that will be asked are meant to be completely straightforward, unambiguous, and with no hidden meanings. Please ask for clarification if you are unsure of what is being asked of you. It is important that your responses reflect only your own feelings and impressions of the change process within Avinor, and particularly your own evaluation of how these processes have affected safety within your unit and within your organization.

CONFIDENTIALITY:
The interview is completely confidential and we will conduct the interview in your language of preference. The interview will take approximately one-hour. When we are finished, I will paraphrase your responses into English (the working language of the study), and I will only refer to your responses in the study, if required, by an assigned interview object number to ensure confidentiality. Comments that can be traced back to the individual source will not be used in any written reports or as part of any written articles.

AGREEMENT:
I understand the purpose of the study and I accept and agree to the method that has been described.

_____	_____
	Eric A. Lofquist
Avinor	Norges Handelshøyskole

Appendix C – Trondheim/Bodø Comparison - 2002

	Trondheim/Bodø 2002	N	Mean	Std. Deviation	Sig. of diff. in means
(V01) Leader motivates	Trondheim	28	4.96	1.598	
	Bodø	28	4.96	1.527	1.000
(V02) Personal conflicts	Trondheim	29	2.03	1.614	
	Bodø	31	2.55	1.588	.219
(V07) Leader Discussion	Trondheim	28	5.36	1.615	
	Bodø	30	4.80	1.606	.193
(V15) Work conditions	Trondheim	29	1.76	1.662	
	Bodø	30	1.50	.974	.467
(V16) Cooperation problems	Trondheim	28	1.71	1.013	
	Bodø	30	2.03	1.189	.278
(V17) Undesired Events concealed	Trondheim	28	1.61	.832	
	Bodø	29	2.97	1.991	.002
(V19) Leader Distributes Information	Trondheim	28	5.21	1.707	
	Bodø	31	4.74	1.897	.321
(V21) Employees Harassed	Trondheim	28	1.46	.744	
	Bodø	29	1.86	1.529	.220
(V25)Leader unity/commitment	Trondheim	28	5.00	1.563	
	Bodø	30	4.37	1.474	.118
(V26) Working Environment	Trondheim	27	2.59	1.886	
	Bodø	30	2.27	1.660	.491
(V37) Power struggles	Trondheim	28	1.61	1.286	
	Bodø	31	2.03	1.516	.253
(V41) Trust in Leader	Trondheim	29	6.17	1.513	
	Bodø	30	5.80	1.448	.338
(V45) Mistakes Repeated often	Trondheim	27	2.26	1.559	
	Bodø	30	3.10	1.954	.080
(V46) Poor motivation	Trondheim	29	2.90	2.059	
	Bodø	31	2.32	1.469	.217
(V52) Job burden	Trondheim	29	2.66	1.895	
	Bodø	31	3.65	2.199	.068
(V63) Low work	Trondheim	29	2.03	1.426	.370

Morale	Bodø	31	2.39	1.585	
(V64) Different Opinions	Trondheim	28	2.57	1.620	
	Bodø	30	3.63	1.903	.026
(V72) Pride in Avinor	Trondheim	29	4.59	1.862	
	Bodø	30	5.30	1.512	.111
(V73) Top Leader performance	Trondheim	28	3.32	1.467	
	Bodø	25	3.44	1.530	.775

Appendix D – Structural Equation Model items

Leadership Commitment (LC)

V1 - Leaders in my organization are personally involved in activities that promote safety
V2 – The leaders in this organization are cognizant of the most important safety problems affecting operations
V3 – The leaders in this organization do all that they can to prevent accidents
V4 – The leaders consider safety as very important in all work operations and activities
V5 – The leaders have an adequate technical/operative understanding for making correct safety choices
V6 – The leadership is genuinely interested in safety

Safety Climate (SC)

V7 – Employees in my organization receive adequate training to perform assigned tasks in a safe manner
V8 – Everyone is informed about each change that will affect safety
V9 – All failures and deficiencies are reported and processed in a short period of time

Attitude Toward Change (AC)

V12 – The changes in Avinor
V13 – Reorganization of Luftfartsverket to Avinor
V16 – Disruption and "noise" in Avinor has not had an affect on safety in the long run

Perception of Safety

V18 – Safety in this organization is generally well handled
V19 – Safety is the first priority in my organization
V22 – Safety in the Norwegian Civil Aviation Industry as become worse in the past 5 years

Appendix E – Continuous Data Model Fit

Model 2 Fit index *Continuous data*

$\chi^2 = 140.80$ (P = 0.00010)
Degrees of Freedom = 84

RMSEA = 0.035	Good fit
NNFI = 0.99	Good fit
CFI = 1.00	Good fit
IFI = 1.00	Good fit
AGFI = 0.94	Good fit
CN = 386.84	Good fit

For the Continuous model:
LC→PS = 0.61
LC→AC→PS = 0.55*0.11 = 0.00
Total causal effect of LC on PS = 0.72

SC→PS = 0.25
SC→AC→PS = 0.00*0.25= 0.00
Total causal effect of SC on PS = 0.25

AC→PS = 0.25
Total causal effect of AC on PS = 0.25