Exploring Risk Governance in a Global Transport System

by
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This thesis is dedicated in memoriam to my parents,

Thanks to both of you for trusting my choices.

Preface

This thesis work began in March 2005 as part of a project funded by the Norwegian Research Council program, Risk and Safety within the Transport Sector (RISIT), *'Every little bit helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector'* (2005-2007). Affiliation with the project and its portfolio gave me access to a nationwide research community, providing inspiration for my work.

This work has been demanding in several ways, and I have been deeply in need of other people during the thesis work.

I am very thankful to the actors within the Norwegian aviation transport system. My affiliation with the huge number of people in this system who were kindly interested in my work made an important contribution to my PhD project. A special thanks to Dag Magnus Saxeide, who made it possible for me to gain access to the aviation transport system when I was working on my master's thesis. Thanks in memoriam to Jan Asbjørnsen, who made possible the continuation of data collection. I am grateful to the AVINOR which contributed to fund my last part of the thesis work. I also want to extend a special thanks to Per Arnljot Nilsen, Leif Lorentzen, Grete Myhre, Jon Sneltvedt, and Signe Moe.

I stayed abroad for six weeks during the autumn of 2009 at the Ecole de MINES ParisTech, Centre for Research on Risks and Safety (CRC), with Erik Hollnagel and his colleagues, who welcomed me and gave me an interesting and stimulating research visit in the south of France.

I am very grateful to my supervisor, Karina Aase: you were a great mentor during this work, kindly shared your cleverness, and were strict, yet patient. I also want to extend thanks for good support to Preben Lindøe, who acted as supervisor when Karina was on leave. Thanks to other colleagues with whom I spent interesting and supportive time, both at lunches and in long-lasting theoretical discussions, you made my days! I especially want to mention Turid and Sindre who offered

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Without friends who believed in me, this work would have been impossible, thank you all! A special thanks to Ingunn and Astrid for continuously encouraging and invigorating me.

I appreciate the support my family has given me. A special thank to you, dear Eva, you have really understood that mamma's work is not a normal type of work. Thank you for letting me spend all those hours at work and for your support by showing interest and taking on your part of the housework.

Beloved Frode, you have patiently listened to my frustrations, showed that you believe in me, and encouraged me to stay cool. Thanks for your comforting support.

'When it comes to hazard, no one is an expert - especially not the experts.'

Ulrich Beck 2009:35

Summary

This PhD thesis explores how risk is governed within the Norwegian aviation transport system by using a risk governance framework. In recent years, the Norwegian aviation transport system has become more complex than ever due to increased air traffic, deregulation, relocalisation of the Civil Aviation Authority, globalisation of markets, and the introduction of supranational rules and regulations. The research problem is how risk is governed under such circumstances, focusing on the role of complexity, changes, and possible goal conflicts.

My aims in this thesis are:

1. to explore the risk governance system of civil aviation transport.
2. to gain knowledge about the role of complexity, change and goal conflicts in the risk governance of civil aviation transport.

As an analytical tool, the risk governance approach provides a terminology and typology for investigating risk governance processes and structures. Risk governance then meets the demand of covering different aspects of the process and structure of risk management, by focusing on the integration and inclusion of different actors, and by highlighting the importance of consistent and integrated processes throughout the system. In this thesis I incorporate the following elements into the risk governance framework: core risk governance, organisational capacity, actor network, social and economic climate and political and regulatory climate. This is an adaptation of the risk governance model described by Renn (2008).

The thesis is based on a case study design, where the Norwegian aviation transport system is studied by the Ministry of Transport and Communications (Ministry), the Civil Aviation Authority (Aviation Authority), and the Accident Investigation Board (Investigation Board) as the main units within the case. I have also utilised data from other parts of the system. The data was collected by interviews, documentary

analysis and observations. I conducted 46 interviews, read 22 accident investigation reports, a selection of public reports, and discussion papers from both EU and Norway, in addition to participating in meetings and seminars.

Article I highlights the relationship between national and supranational risk governance and the challenges this relationship poses for risk management. The results of the study show that the transition from national responsibility for risk governance, to EU governance, poses both possibilities and challenges for the risk governance process within aviation: possibilities, in the form of formal structures for participation, and challenges in the form of integration and implementation of contextual knowledge within the EU regulatory framework. The involvement of different actors meets new challenges within the EU framework. The decision-making process is more formalised, which fits some actors well--like the Ministry, the Aviation Authority, and the Investigation Board, all of which are familiar with bureaucratic processes. Nevertheless, actors from industry itself might have problems meeting the demands of participating in the extensive risk governance processes in EU. Important information might get lost and, ultimately, the body of rules might be missing contextual elements due to a lack of participation from operative actors in the decision-making process. This lack of important contextual factors, together with a prescriptive regulatory framework, might create a vulnerability to risk governance given the circumstances of complexity, change and possible goal conflicts. Less focus on contextual factors might make the operators of the system less able to adapt to the actual circumstances. The transition towards a more powerful EU might also undermine the mandate of the actors within the risk governance of Norwegian civil aviation. The extension of the legal authority of the EU due to air safety (by Basic Regulation 216/2008), will impact Norway's disposal of the national regulatory framework. When this change in regulatory framework is fully implemented, it will become questionable as to whether Norway is still an equal partner within the risk governance processes. The final risk governance conclusions are made in the EU Parliament and the EU Commission, the questions left to the Norwegian actors are contextual input to the risk assessment and

elaboration of decisions already made at top level within EU. As a non-member state, Norway's option is to agree and to take part in the input and execution phase of the governance processes.

In Article II, the aim was to study how the institutional part (the Ministry, the regulator, and the Aviation Authority, the legislator), of the governance system contribute to safety in a change intensive system. The study explores how political priorities at the legislative level, and enforcing practices at the regulatory level affect risk governance in the aviation transport system. Our findings indicate that the sum of external and internal forces of change has made the control of the aviation system more unpredictable, especially due to the pace and simultaneousness of the changes. The changes make it difficult to understand the 'big picture' of the aviation system, and thus poses challenges with respect to regulation and inspection. Our results have documented that within the two studied organisations, no explicit operational safety policy exists. Today, the resources and network activities with the legislator seem too scant for capturing and making explicit an overall safety policy. With respect to the regulator, the study documents that the work force is responsible, flexible and has a hunger for elaborating new work practices to match the current changes. The study did not identify an increase in resources or frequency of inspection activities, neither a clear move towards a risk-based inspection philosophy. The process of restructuring and relocation of the regulators head office have set the development of new inspection methods back. The strong sense of responsibility and self-organised networking within the legislator and the regulator seems to be a buffer against possible negative side effects from the current changes, and the degree of informality in which this takes place seems to strengthen the safety conditions, but also induces a certain vulnerability due to the dependency of individuals.

In Article III, we explored accident investigation practices in the Norwegian aviation transport system. The aim was to analyse whether the accident investigation practices mirror the complexity that features the aviation transport system. The study shows that a certain awareness of changes and complexity in the aviation transport system exists

among employees of the Investigation Board. This awareness and knowledge is only to a limited extent traceable in accident reports or accident models used by the Investigation Board. Results show that differentiation characterises the accident board's investigation philosophy and that its investigation practices and accident reports include a variety of perspectives and methods. Our study has documented the existence of a normative framework in the Investigation Board for conducting investigations, one that is rooted in international and national regulations and laws. On the other side, informants advocate that an 'open mind' perspective with no fixed accident models or investigation procedures is best suited to avoid biases and preferences. Every investigation is perceived as unique, and the accident characteristics determine the way investigations should be conducted. Complexity can, to a certain extent, be traced in the Investigation Board's practice through accident models such as the human-technology-organisation framework and an increased awareness of technological complexity. Nevertheless, complexity of organisational interfaces, interdependencies among actors, and historical and contextual factors are not identified as central aspects of the accident board's investigation philosophy and/or investigation practice.

Article IV describes some of the processes involved in balancing conflicting goals (e.g., between safety and operation) in a change-intensive environment by using examples from Norwegian civil aviation transport. Based on the finding that there might be a tension inherent in the double-edged objective of Norwegian civil aviation to be both safe and community-serving, we explored the system's ability to reach conflicting goals. The ability to meet multiple goals involves the use of both downward and upward resilience traits to address potential goal conflicts. By downward resilience, we mean that macro level directions and solutions prepare for resilience through clear goal structures, infrastructure, and procedures that handle the trade-offs between safety and efficiency. Upward resilience means that decisions made at the micro level in a system reflect a commitment to safety in case of goal conflicts. Changes, caused either by external or internal drivers, may alter these resilience traits by introducing loss of

oversight. Changes made at the macro level of the system might have unintended consequences on the micro level, and vice versa. Results show that the prioritisation of regional policy (community-serving) and an unwillingness to develop distinct goal rules for balancing safe and community-serving air transport, place downwards pressure on the aviation system. Despite deficiencies in the downward resilience, upward resilience traits at the micro level of the aviation system seem to counterbalance the picture by characteristics such as a clear commitment to safety, sacrificing decisions, and establishing resource buffers to handle safety in critical situations. A critical issue regarding resilience in the Norwegian aviation transport system seems to be an awareness towards vulnerability caused by the system's dependency on upward resilience.

Using the risk governance framework, this thesis concludes that the Norwegian aviation transport system includes a core risk governance process that comprises both deficits and surpluses. Surpluses are e.g., involvements of actors with requisite knowledge about the aviation transport system through hearings, work meetings and lobbying, while deficits are e.g. the lack of early warning detectors in form of risk based supervision, and lack of knowledge about vulnerabilities and trends within a change intensive system. Other surpluses come in the form of safety consciousness, willingness to learn, competence and flexibility within the work force, indicating a possibility to improve the core risk governance process.

The organisation capacity element of the risk governance within the Norwegian civil aviation transport system shows deficits related to the changes in interfaces within the system. Due to the dispersion of knowledge, transformation of interfaces, and alteration of the Aviation Authority competence, a demand for strengthening the focus on networking across the system is present. The surpluses like professional knowledge, safety consciousness and informal networks will form a base to develop the organisational capacity.

The social and economic climate, combined with the political and regulatory climate, forms the backdrop for the core risk governance

process. The study shows that the supranational EU-focus on standardisation and harmonisation in the regulation framework might come at the expense of implementation of contextual knowledge. Furthermore, the lack of national directing safety goals with the legislator and elaborated operational safety goals with the regulator, are a deficit for the risk governance processes. A system subjected to several changes, and with an economic climate focusing on cost-effectiveness is in need of strong institutional focus and commitment to safety.

Part I

1 Introduction

This PhD thesis focuses on the risk governance of a global transport system in light of changes, complexity and goal conflicts. The purpose of the thesis is to explore how a global transport system governs risk under complex circumstances. Such systems are exemplified here by the Norwegian civil aviation transport system, which is part of the International Civil Aviation Organisation (ICAO) and the European Union (EU), significant organisations that promote safety in accordance with corporate aviation regulations.

1.1 Background

According to Alamberti (2001), civil aviation is an ultrasafe system. The civil aviation transport is a highly competent system with regard to safety, one managed through common worldwide agreements, extensive procedures, and a detailed regulation framework. Recently, a negative trend has been identified in accident statistics within the international commercial aviation business. The general trend for accident rates has shown an increase since 2005 in countries that are members of the European Civil Aviation Community[1] (ECAC) (Eurocontrol 2009). Furthermore, the accident rate measured in European Aviation Safety Authority[2] (EASA) registered, scheduled operations shows a decline from 2001 until 2005, followed by an increasing trend (EASA EU 2009). The negative trend is partly a result of two major accidents: the Spanair accident on August 20, 2008, in which 154 people died, and the Air France accident on June 1, 2009, that killed 228 people. The fact that Russian accidents are recorded in

[1] ECAC is an intergovernmental organisation of 44 member states that has the aim of harmonising civil aviation policy and procedures.

[2] EASA is the EU agency responsible for developing and implementing safety rules and providing technical expertise, training and research. EASA consists of 31 member states.

European registers has also contributed to this negative trend (Richardsen, Director of Civil Aviation Authority Norway 02.09.2009).

Previous research within the Norwegian aviation system shows that relationships among actors in the systems may be altered by different change factors, such as new business structures and geographical relocations (SL/REP 35/2005, Høyland et al., 2008, Aase et al., 2009). Changed relationships intended to reduce inefficiencies may, for example, also reduce the slack within the system and, thereby, influence the buffer capacity (Pettersen & Aase 2008, Pettersen 2008). Changed relationships might introduce tight couplings, and result in increased interdependencies within the system. An event in one part in the system may have effects on quite another part of the system (Aase et al., 2009), according to times and locations. The indications of altered interactions within the civil aviation transport system form the backdrop of this PhD thesis. The main question to be answered, therefore, is how risk is governed in a setting of complex and changing circumstances.

This thesis focuses on the institutional parts of the aviation system in trying to grasp how risk is governed under the circumstances described above. Studies were conducted within the Norwegian Ministry of Transportation, the Civil Aviation Authority, and the Accident Investigation Board Norway. In addition, empirical data and results from a research project on parallel changes and aviation safety (Norwegian Research Council), of which my PhD thesis was a part, have been consulted to support my study.

In the following section, I will describe the two main concepts used in this thesis: risk governance and global transport system.

1.2 Risk Governance

Governance describes the processes and structures related to collective decision making and policy making that involve both governmental and non-governmental actors (Nye & Donahue 2000). Risk governance applies these processes and structures to the regulation of risks by

focusing on principles where networks exercise authority, take and implement decisions (Mørth 2009). Governance became an issue within the EU in the late 1990s and was materialised through 'European Governance, a White Paper 2001' (EC 2001). The governance concept was introduced in response to the citizens' distrust in institutions as tools for risk management, a distrust that induced reflection by the EU on the demand for extension of the knowledge base (Craye & Funtowich 2009). The aim of the risk governance framework was: '*to provide a structure for combining the conventional practises of risk assessment, management and communication with the principles of good governance'* (IRGC 2009:3). By transitioning from risk government[3] toward risk governance, the EU wanted to strengthen its role as a regulating body.

The purpose of risk governance is to identify, assess, manage and communicate risks with the principles of accountability, transparency and participation in mind (Renn 2008, IRGC 2005). This movement towards more inclusiveness and participation in the risk rule work has occurred since the mid-1990s, partly as a result of the transition from public to private ownership (Hutter 2006a), of the difficulties with balancing complex issues (Mørth 2009), and of a governmental lack of knowledge in the face of complexity and multiple feedback (Bell 2004).

Several analytical frameworks are available to govern risk, most of which are techniques based upon accident data. There is also a new attention to risk-based techniques that illuminate the possible future risks to anticipate. Still, as the American National Research Council has pointed out, even if '*techniques can illuminate the choices that society must make, they cannot substitute for a deliberative process by artificially simplifying complexity*' (NRC 1996:80). Techniques

[3] Government as concept, symbolise an understanding of "steering" in a hierarchical manner, carried out by the process of electing and voting on representants that would take care of public interests in between the election period (e.g, Pierre & Peters 2000).

implemented without consideration of the context are of limited value and might even understate possible risks caused by focusing in the wrong direction and, thereby, understate other possible risks. Rather than implementing techniques, risk management must take into consideration the ongoing picture. Parson (2004) points out that complexity, uncertainty and flux have implications for diversity, dynamism, and decentralism of input in the process of risk governance, which, thereby, results in better output than employing a traditional command and control perspective.

The Risk Governance White Paper (EC 2001) published by the EU Commission initiated the risk governance framework as a means of developing an integrated, holistic and structured approach to risk governance. The International Risk Governance Council[4] (IRGC) (2008) followed up the 2001 white paper by focusing on systemic risks and gaining knowledge on how these risks are embedded in the larger scientific, societal, political and economic context. The IRGC stated that systemic risks are not confined to national borders and, thus, need to be managed by cooperation among actors from government, industry, academia and civil society. The main goal in risk governance is *'to enable societies to benefit from change while minimizing the negative consequences of the associated risks*' (IRGC 2008:4).

In relation to the white paper on governance, (EC 2001) (a working group was established in 2002 to improve the quality and design of laws (EC 2002). The group tries to connect regulations to the governance principles in producing and implementing policy rules. According to the group, the following principles were important in a governance framework of regulation:

[4] In 2003, the IRGC was founded at an annual risk conference by scientists, governmental leaders and industry leaders as an initiative that reflects an experience of the knowledge society's problem with delivering factual certainties, risk communication decision-making based on voluminous information, fast pace in technological development, demand for effective risk management, and changing organisational responsibility.

- Impact assessment, for making policies capable of handling the side effects of risks at both the EU and national levels.
- Consultation, early and effective conferring with interested parties.
- Simplification, making compliance with the rules more effective and easier.
- Access to regulation by the affected parties, meaning that laws must be coherent, consolidated, and available.
- Structures, to handle these principles.
- Implementation, to ensure that the consequences of the laws are fully understood and considered.

To gain insight into risk, researchers have traditionally searched for answers by conducting accident analyses. Extensive analyses using thick descriptions have functioned as an eye-opener regarding the complex and interconnected origins of accidents. Accident analyses of for instance, Three Mile Island (Perrow 1999), Challenger (Vaughan 1996), Friendly Fire (Snook 2000), and Columbia (Vaughan 2005) show that accidents in complex systems and organisations have a variety of explanations: 'interactive complexity' and 'tight coupling' (Perrow 1999) 'deviation from normal operations' (Vaughan 1996), 'practical drift' (Snook 2000) or 'performance variability' Hollnagel (e.g., 2004). The analyses shows that multiple and diverse actions and goals within organisations or systems might result in unintended consequences.

In order to acquire an understanding of risk in a global system perspective, accident analyses are only partly sufficient. Other sources of information are necessary to broaden the picture of what constitutes risk and how it may be governed.

1.3 Global transport systems

Traditionally, transport systems have been a national public responsibility, with public ownership. Market deregulation has removed restrictions on businesses between national borders, which

means the transport systems are not only more available to private businesses, but are also more in need of supranational risk governance.

Freedom is a hallmark of a global system, freedom for both the actors to operate across borders and freedom for the workers to move across national borders. During the last few centuries, there has been a movement towards globalisation, not only within the EU and the European Economic Area (EEA), but also worldwide. This globalisation is first and foremost encouraged by the economies of scale (Lemonie & Dagnæs 2003), resulting in a focus on economic efficiency; hence, merging, outsourcing, downsizing, and relocation have become important features of globalisation. Within transportation, structures have been reorganised, meaning that transport systems have become transnational and now appear fragmented, with differentiated units of actors.

The market situation within transportation has been globalised during the last 30 years. This is especially valid within civil air transport, where market deregulation occurred in the early 1980s in the EU, when the creation of One Single Market began. Deregulation hit Norway in from 1994 to 1998, opening the market to free competition and giving different suppliers access to both market entry and market exit (Starkie 2008). Public ownership was phased out in favour of the private actors, and the actor picture within the aviation transport system has expanded with several national and international airline companies. The air traffic is more integrated across borders and has become more complex and interrelated. Thus, the deregulation of the economic borders calls for a safety regulation of the market that takes into account the new hallmarks of the transport system, trying to govern risk in a system of competition, complexity, and interrelationships on a global scale, as well as within each of the units that form the aviation transport system.

1.4 Research problems and aims

In this thesis, I will explore the Norwegian aviation transport system with respect to essential aspects within the risk governance framework.

Important features are common goals, structures, deliberation, networking, and influence in the decision-making process related to risk (Zürn 2000, Bell 2004, Renn 2008, Mørth 2009). My focus is on the institutional level of the risk governance system of aviation.

The research problem is how risk is governed in a system that is characterised by complexity, changes, and possible goal conflicts.

Based on the research problem, the research aims of this PhD study are twofold:

1. To explore the risk governance system of civil aviation transport.

2. To gain knowledge about the role of complexity, change and goal conflicts in the risk governance of civil aviation transport system.

I explored risk governance by searching for structures and processes in four different studies. The first study was an examination of the governance structures of the aviation transport system (Tjørhom forthcoming). The second study explored the role of the legislator, the Ministry of Transport and Communication, and the regulator, the Civil Aviation Authority, and their relationship (Tjørhom & Aase 2007). The third study analysed accident investigation practices within aviation transport related to interdependencies, complexity and uncertainty (Tjørhom & Aase 2010). The fourth study explored goal conflicts as part of risk governance, referring to the difficulties in handling trade-offs between safety and efficiency (Tjørhom & Aase forthcoming).

1.5 Research questions

The following research questions have guided my analysis of the four studies on risk governance:

1. How is risk governance conducted within the global aviation system?

2. How do the national legislator and the regulator conduct their roles in change intensive settings?

3. Is the framework for conducting accident investigations in accordance with the current complexity and change picture within the aviation system?

4. How are trade-offs between safety and efficiency (goal conflicts) handled within the Norwegian aviation transport system?

1.6 Limitations

An exploratory study has the purpose of building '*rich descriptions of complex circumstances that are unexplored in the literature*' (Marshall & Rossman 2006:33). In order to explore the risk governance framework of the aviation transport system, one must capture the actors' perspectives from units in the entire globalised system. In this thesis, I focus on the upper, or institutional, levels of the system. All data are collected at the institutional level (EU, National Ministry, Aviation Authority, and Investigation Board) and may limit the analysis of relationships between the institutional level and the rest of the aviation system. The interviews and observations were all conducted within the Norwegian aviation transport system, which means that I relied on these informants' experiences, written documents and web pages to explore the EU system. The focus on data collection at the institutional level has been compensated for by my participation in a broader research project, where data from other parts of the aviation system were made available to me (airport operation, air traffic control, airline maintenance). I have also benefitted from my master's thesis, in which I collected data on technical airline maintenance.

As a theoretical framework, I have used risk governance terminologies and typologies (De Marchi 2003, Renn 2008, Hutter & Jones 2007**)**, together with governance in regulation (Parson 2004, Bell 2002, Craye & Funtowicz 2009). This has been useful but challenging, since the

framework is relatively new (1990s) and lacks the development of operational concepts. This PhD study can be seen as a contribution to the empirical exploration of risk governance. I have chosen the risk governance framework because it calls attention to contextual and relational issues, in addition to pinpointing the actor perspective (Renn 2008). Institutional theories (e.g., Scott 2001, Powell & DiMaggio 1991) that may have been a natural alternative choice have, therefore, not been pursued.

1.7 Structure of the thesis

This thesis comprises two parts. Part 1 forms the background to my research. It introduces my empirical field, the theoretical framework and methodological issues, and then discusses my findings related to the research questions, then work is concluded and further implications of this research study presented.

Part 2 contains the four articles that have been part of my thesis work:

Tjørhom, B. B. (forthcoming) Risk governance within aviation. Accepted for publication in *Risk Management: An International Journal*.

Tjørhom, B., & Aase, K. (2007). Safety and changes in the Norwegian aviation transport system– What is the role of the legislator and the regulator? In: Aven, T & Vinnem, J.E (Eds.) *Risk, Reliability and Societal Safety*, Vol. 3, pp. 2143-2149. Taylor & Francis, London.

Tjørhom, B. B., & Aase, K. (2010) The role of complexity in accident investigation practice. *International Journal of Emergency Management,* Vol. 7, No.2, pp.167-189.

Tjørhom, B. B., & Aase, K. (fortcoming) *The art of balance: Using upward resilience traits to deal with conflicting goals.* In Hollnagel, E., Woods D & Wreathall, J. (Eds.) Resilience Engineering in Practice: A Guidebook.

2 Context

In this chapter, I start by defining the kinds of risk I am examining in this thesis. Thereafter, I give an overview of the risk level within the aviation transport system, followed by a short introduction to the regulatory framework within aviation. I then provide condensed descriptions of the main actors in the aviation transport safety governance system. Within the thesis, the Norwegian Ministry of Transport and Communication is mentioned as the Ministry, the Civil Aviation Authority Norway as the Aviation Authority and the Accident Investigation Board Norway as the Investigation Board.

2.1 The risk types within aviation

The risks my thesis is concerned with are those in which the knowledge about outcomes and probabilities is not only missing, but also very difficult to establish (Stirling 2009, 1999, Renn 2008). The risks that challenge the decision-making process, are thus in need of an integrative systemic approach, risks that are ambiguous, uncertain and complex (Renn 2008). Ambiguous risks are those that have many possible outcomes; uncertain risks are those where the level and burden of scientific proofs are scanty; and complex risks are characterised by scant scientific proof and many possible outcomes that are caused by the interdependencies and interrelatedness within an extensive system. One example of such complexity in the risk picture is a result of increased aviation traffic, which has caused a new density in air space. Such density creates a new picture of complexity in air traffic management. Within this thesis, risks that can be handled by statistical risk analysis, named ‘simple’ by Renn (2008) are not discussed, as my focus is on those risks where lack of knowledge characterises them as ambiguous, uncertain and complex. To make prudent choices about

such risks, the aviation transport system needs to understand the concerns of its stakeholders[5] (Renn 2009, 2008).

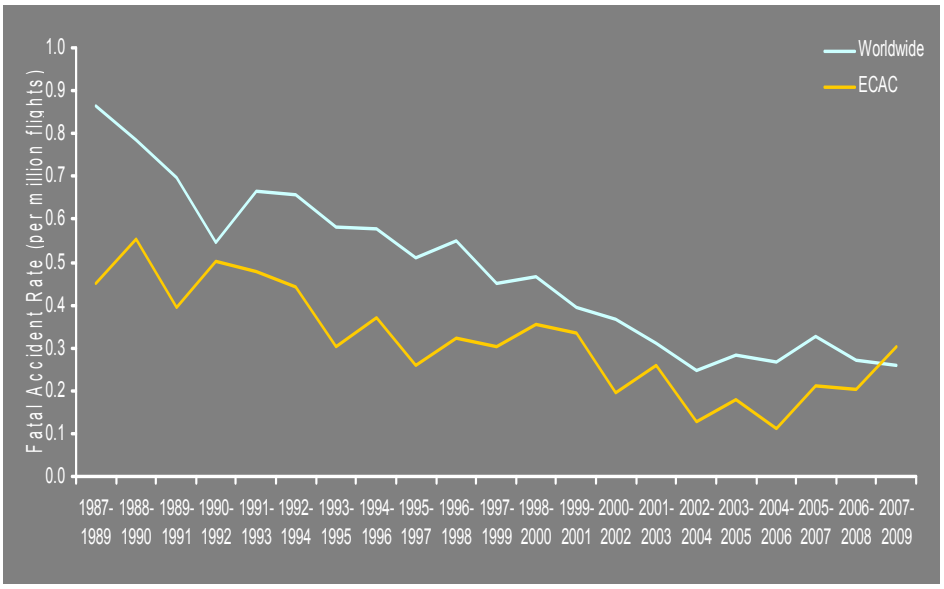
The aviation transport system is considered a very safe system and might have the appropriate requisites to sustain such a risk level, even in the changing circumstances caused by a systematic and thorough risk focus. *'Flying is the safest way of travel'*, as stated by Stoop and Kahan (2005:115), is a common statement. Civil aviation transport is a fascinating system in terms of safety issues. Given that parts of the system have tight couplings, and operation of the system is highly complex (Hollnagel et al., 2006, Leveson 2004, Perrow 1999, Rasmussen 1997, Vaughan 1996), it seems counterintuitive when statistics tells us that it is the safest transport system in the world (Amalberti et al., 2005).

Studies (Wreathall 2008, Høyland 2007, Baker et al., 2005, Sexton et al., 2000) have documented the value of knowledge transfer related to safety issues from the civil aviation transport system to other sectors. The system is heavily regulated and employs a highly professional workforce that values teamwork as important to accomplishing its daily work. The workforce is highly aware of the risks of air transport (Pettersen & Aase 2008, Høyland et al., 2008, Tjørhom & Aase 2007, SL/REP 35/2005, Tjørhom 2001).

But regardless of the fact that the aviation transport system seems to feature an extensive focus on safety work, the worldwide accident rates in the last years show a negative trend. This negative trend is even more pronounced within the European Civil Aviation Conference ECAC (consisting of 44 European countries), which has shown an increase in accidents since 2004.

[5] Stakeholders are actors with interests in either the outcome of negative adverse affect of an activity or by the risk management options to act resilient (Renn 2008) Stakeholders in my case are structured into organised groups (Tjørhom forthcoming).

The recent statistics show a decrease in the accident rate worldwide and within ECAC countries from 1990; since 2002, the worldwide curve has straightened out, while the accident rate within the ECAC has increased since 2004, as depicted in Figure 1.1.



Figur 1.1 Large Western Built Jets – Passenger Flights Fatal Accident Rate. Worldwide, ECAC Member States. 1st January 1987 – 30th June 2009 (3-year moving average) (Source ECAC).

With regard to the numbers related to Norwegian aviation accidents, Table 1.2 shows that the positive trend in the accident rate between 1970 -2006 seems to have been reversed by an increasing trend in the accident rate:

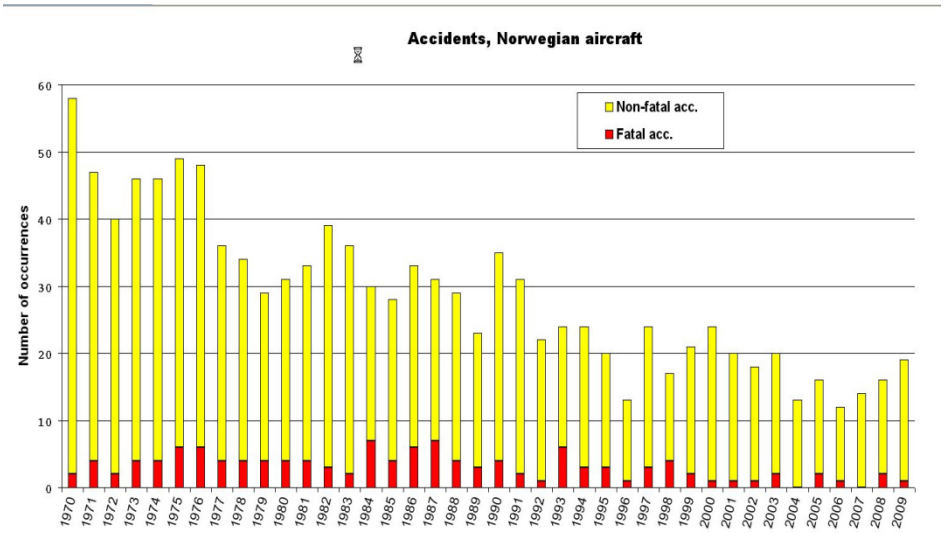


Figure 1.2 Accident within Norwegian aviation. (Source Aviation Authority).

In this thesis, the accident rate is not valued as sufficient for measuring safety level; nevertheless, the trends in aviation safety are one of several indicators by which to measure risk levels.

A report to the Norwegian Parliament states that safety in aviation is a result of the way organised aviation is carried out (SL/REP 35/2005). To maintain such a high safety level, the report recommends that different actors within the civil aviation transport system prioritise their safety responsibility. The recommendations are directed towards system oriented approaches to safety in order to follow up the ongoing changes to which the aviation system is subjected.

Even though the aviation transport system have the features of prioritising safety in a sufficient manner, the complexity and changes pose challenges to sustaining the risk level. It is an unfortunate fact that in a dynamic situation, people tend to behave as if the risk situation is still following the old routines (IRGC 2009) and thus continue to maintain the previous regulatory framework. Or, if there is a willingness to react to fundamental changes, the response is often too

slow due to the challenges of recognising the effects of these changes on safety issues (IRGC 2009).

2.2 A brief summary of the regulatory framework

The regulatory framework for the global aviation transport system was shaped by international conventions and adopted into supranational bodies as a commonly agreed upon rule. This framework was then adjusted to contextual factors and implemented by the different nations' aviation laws. As a result of the establishment of the European Union (EU) and the European Economic Agreement (EEA), these conventions were elaborated as the body of laws, rules and procedures according to a supranational framework.

The conventions were shaped by the International Civil Aviation Organisation (ICAO) as a comprehensive set of common regulations, the International Standards and Recommended Practices (SARPS). The SARPS comprises a set of standards, or annexes, one for each of the defined areas within aviation transport, e.g., personnel licensing, airworthiness of aircraft, and accident investigation (SL/REP 35/2005). In Europe, the Joint Aviation Authority (JAA) was organised to elaborate, develop and implement common certification codes to the industry, based on the ICAOs annexes. In 1987, the JAA's work was extended to operations, maintenance, licensing and certification/design standards for all classes of aircraft, with the Joint Aviation Regulations (JARs) regulating the different areas within aviation. Norwegian aviation is regulated by the Norwegian Act of Aviation, June 11, 2003.

A new regulatory framework was created as a result of the adoption of EC No 1592/2002 by the European Parliament and the Council of the European Union. The JARs were converted into 'Parts', where the main content within the standards were retained. The European Safety Agency was set up in 2003 to elaborate and supervise the rule work.

With the transition from a JAA to an EU framework for regulation, a supranational European legal authority for regulation was established. This has resulted in the European Economic Area (EEA) adjustments

within the Norwegian Act of Aviation. When the new Basic Decree 216/2008 and the Single European Sky are implemented in EEA, Norway must ratify this extension of the legal authority of the EU and make new adjustments to the Norwegian Act of Aviation, June 11, 2003.

2.2.1 ICAO

The Convention of International Civil Aviation, also known as the Chicago Convention, was signed by 52 states in 1944 to deal with aviation subjects worldwide. Based on the Chicago Convention, the worldwide organisation, International Civil Aviation Organisation (ICAO), was founded in 1947 as a United Nations organisation. ICAO's mandate is to secure international cooperation and the highest possible degree of uniformity in regulations and standards, procedures and organisations regarding civil aviation matters. There are currently 190 member states in the organisation. ICAO is governed by a Council consisting of 36 of the member states. The Council elaborates the standards and recommended practices, denoted as Annexes. The Annexes seek to harmonise standards related to safety, as well as to facilitate audits of the member states (ICAO 2009). According to the ICAO, safety management depends upon two cornerstones: a State Safety Programme (SSP), in which each state works out its own guidelines according to the safety annexes, and a Safety Management System (SMS) within the organisations, proving that they have performed systematic safety work in accordance with such principles as accountability and having structures for safety, policies and procedures (ICAO 2009).

2.2.2 EASA

The European Aviation Safety Agency (EASA) is the European Union's community agency for aviation issues. The EASA was established to implement EU rules. A gap existed between the number of internal market directives elaborated by the EU Commission and the number of directives in force in the member states. As a result of the

widening of this gap, the EASA was established to achieve better implementation (Groenleer et al., 2008).

The EASA's regulatory framework is built upon Joint Aviation Authority (JAA) guidelines for aviation safety. As a community agency, EASA is governed by European public law and has its own legal regulatory authority through the EU Commission, the Council of European Union and the EU Parliament. Community agencies are initiated by the EU with the aims of decentralisation, higher profile for the tasks, development of know-how, and integration of different interest groups in a dialog about the tasks, thereby facilitating the dialog at a European and an international level. The EASA was established by the EU in 2002 and has two missions (EASA 2009):

1. To provide expert advice to the EU for drafting new legislation;

2. To carry out executive tasks such as the certification of aeronautical products and organisations involved in their design, production and maintenance.

The Commission of the European Communities decided that there would be an extension of the tasks for which EASA was responsible. This extension should encompass air operations and flight crew licensing together with authorisation of third-country operators (operators outside the EU or EEA). This extension is laid down by Regulation (EC) (No 216/2008), and has to be ratified by the member states and the members of EEA.

All the member states and the non-member states, with the participants from the Commission, are part of the management board, which defines the agency's priorities.

2.3 The Norwegian aviation transport system

The Norwegian civil aviation transport system is part of the global risk governance system of civil aviation through the above-mentioned

organisations; it also is a member of other international organisations (e.g., Tjørhom forthcoming).

The Norwegian civil aviation transport system is strongly influenced by the military system. The main reason for developing the civil aviation transport system is NATO's influence in the Norwegian infrastructure and the simultaneous demand for a civil infrastructure around the military bases (Høyland et al., 2008). The civil infrastructure for air transport made it accessible to governmental and private actors entering the market. Scandinavian Airlines (SAS) and Braathens pass into the market and developed the main airports and infrastructure. In 1966-67, the short take-off and landing ports were also included in the route network. The infrastructure for aviation was of great importance to Norway to shorten the distance between the north and south parts of the country. The scheduled service on the outskirts of Norway was handled by private companies, which submit tenders to the government. From 1994 to 1998, there were changes in the competitive situation. Deregulation gave private actors access to the infrastructure and the airports, provided that they met the safety regulation demands. This made a great shift in the competitive conditions and increased the focus on efficiency and earning power. The changed competitive situation resulted in large-scale production and, thus, business merging, downsizing, and restructuration (Høyland et al., 2008).

The partly government-owned company, SAS, bought the private company Braathens in 2001, which meant that SAS had a monopoly in Norwegian air transport. This situation changed when the private company, Norwegian Air Shuttle ASA, entered the market in 2002; it started with domestic flights and entered the international market in 2003.

The Norwegian aviation transport system also comprises several other business actors. Globalisation has resulted in the representation of all the big aviation companies in Norway. As a result of the changes in the business structure, technical support has been organised in independent juridical units. There are several handling companies, and, due to the focus on aviation security, security companies are important parts of

the system. Other companies are related to cleaning, food, design and production of various types of equipment.

In 2003, the Norwegian Air Traffic and Airport Management Agency became two separate divisions: the Civil Aviation Authority Norway (Aviation Authority) handles supervision and AVINOR handles operation of the airports/airport security. At the same time, there was a political decision in 2002-2003 to localise the governmental supervision outside the capital of Norway (SL/REP 17/2002-2003, SL/REP 32/2004-2005). In addition, there was a new focus on cost reduction in AVINOR (Take-Off-05).

The Ministry of Transport and Communications (Ministry) has the overall responsibility for aviation safety. During all those years with ongoing changes, the Norwegian governmental regulatory framework has been quite consistent in stating its goal of being a society-serving and safe air transport system. The responsibility for carrying out the work in order to fulfil these goals is delegated to the Civil Aviation Authority and the Norwegian Investigation Board.

As a result of the EU entrance into aviation regulatory framework, the rulemaking process left over from common agreements made by member states in collaboration with the Joint Aviation Authority (JAA) and International Civil Aviation Authority (ICAO) has been transitioned into a decision-making process in the EU, made by European Aviation Safety Agency (EASA) as the legal authority. This transition means not only that the decision-making process has changed and that the rules have been made legally valid, but also that the nature of the rule making process has gone from being a framework to a more detailed rule work (Tjørhom forthcoming). Simultaneously, there has been a transition from detailed supervision that checks to pinpoint compliance at the worker level to supervision that focuses on system audits, checking the procedures within the company.

Given these changes (SL/REP 35/2005), the Norwegian Parliament ordered a report that would evaluate the safety situation within the aviation transport system. That report concluded with recommendations

to the NCAA about system-oriented, risk-based supervision and extension of the relocations process. The AVINOR were recommended to evaluate some of the processes within their cost reduction program and to stop further progress in Take-Off-05. Aviation companies were told to evaluate the consequences of merging and to focus on cultural integration.

2.3.1 The Ministry of Transport and Communications

The Ministry has a superior responsibility for managing the Norwegian aviation transport system. Its responsibility covers four categories of work (SL/REP 46 99/2000): 1) administration of framework conditions, laws and regulations, 2) aviation safety work in general, 3) the department of government for the Norwegian Civil Aviation Authority and the Accident Investigation Board Norway, and 4) international collaboration and negotiation. Administrative work is delegated to the Air, Post and Tele Department, which has a separate aviation unit and reports to the political direction. The aviation unit consists of 13 employees, reporting to the manager. The employees have backgrounds and competences in political science, economics and law.

2.3.2 AVINOR

In 2003 the Norwegian Air Traffic and Airport Management became AVINOR, a state-owned stock company with approximately 3000 employees. The main objective of AVINOR is to plan, develop and operate the Norwegian aviation network consisting of 46 airports. The operations within AVINOR encompass responsibility for air traffic, control towers, control centres, and the technical infrastructure for aircraft navigation. AVINOR introduced an ICAO-initiated, cost-reduction project, Take-off-05 (SL RAP 35/2005, Høyland et al., 2008, Lofquist 2008), subsequently to their constitution in 2003. The project had considerable significance due to the resulting reorganisation, downsizing and relocation (Lofquist 2008).

2.3.3 The Norwegian Civil Aviation Authority

The Civil Aviation Authority Norway (Aviation Authority) is an independent public administrative body under the jurisdiction of the Ministry, with approximately 160 employees. The Aviation Authority's main objective is to oversee aviation safety within the Norwegian transport system. The Aviation Authority constitutes the rule work and runs the supervision of airports (aviation safety, companies, and aircrafts. Due to regional considerations a political decision was made (SL/ REP 17/ 2002–2003), to relocate the Aviation Authority from Oslo, Norway's capital, to Bodø, a town 1230 kilometres north of Oslo. This had implications for its competence and knowledge, since a large number of its employees resigned their positions (Eriksen et al., 2009).

2.3.4 The Accident Investigation Board Norway

The Investigation Board was established in 1989 in accordance with ICAO's recommendation. The board has been gradually expanded; by 2005, it had become a multimodal investigative board with the mandate to investigate incidents and accidents on the seas, roads and railways. The Investigation Board has a director and a staff of 13 administrative and safety specialists, plus seven inspectors in the aviation unit. The Investigation Board is an independent, non-punitive unit with the mandate by the Ministry to establish post-accident knowledge in order to prevent future incidents and accidents. The non-punitive investigations identify conditions that might be beneficial in preventing incidents and accidents, a goal-based mandate that leaves it up to the Investigation Board to decide the scale of its investigations.

2.3 Government-initiated studies of aviation safety

Several governmental initiatives have surveyed the risk level within aviation in order to maintain safety within a system subject to deregulation, privatisation, relocation and mergers. Rosness et al., (2005) cite studies in Sweden, the US and the UK in the Norwegian

government-initiated report on aviation safety in 2005, SL/REP 35/2005. Deregulation was initiated in 1978 in the US by the Airline Deregulation Act; in 1992 in Sweden, and in 1994 in the UK. The results from the UK and the US have shown no increase in the accident rate after deregulation. Because of the media's attention to aviation safety, the industry became more aware of and focused on safety issues, and the media focus has been given as one factor influencing the steady accident rate. The conclusions indicate that new businesses have been under observation, because start-ups need one to two years to reach the same safety level as well-established businesses. With regard to near accidents, the increased numbers are explained by the simultaneous actions taken to reduce the number of air traffic controllers and to implement deregulation, which highlights the importance of monitoring simultaneous changes to the system in order to identify the eventual impact on safety, due to the alteration of the former system (Rosness et al., 2005).

The changes in Sweden's aviation system were initiated in 1975 when its supervision was relocated; deregulation started in 1992 and changes in business structures in 1993. Results of deregulation, relocations and mergers in Sweden have been positive, with no increase in the accident rate. But the mergers were challenging, especially due to the new collaboration. The report called attention to the importance of strong supervision during times of change and the associated challenges resulting. Continuous observation of the aviation transport system is essential, as is allowing enough time to adjust safety management practices in accordance with the changes (Rosness et al., 2005).

In the Switzerland, a report on aviation safety was ordered after a five-year period with four serious accidents and several near accidents (NLR 2003). The report studied whether or not the structures for managing aviation safety within Switzerland were sufficient. This study focused on aviation safety as a product of the safety management system. The NLR study made several sector-wide recommendations, such as governmental development of safety objectives, addition of safety personnel resources, creation of more divisions between units

responsible for safety and production, and creation of an investigation board.

The Norwegian government ordered a report in 2005 (SL/REP 35/2005) whose objective was to '*investigate how aviation safety will be maintained in the light of the major change processes taking place in the Norwegian civil aviation sector'* (SL/REP 35/2005). The study encompassed the period from 2000 to 2005; several research institutes and universities participated in this process. The conclusions and recommendations were directed to issues that would prevent adverse events resulting from the initiated changes. These recommendations included:

- The creation of systematic, holistic and risk-based supervision by the NCAA and a holistic safety perspective by the Ministry and the airline companies.
- The provision of double staffing in the NCAA's relocation phase.
- The performance of a review of AVINOR's cost-cutting program, Take-Off 2005.
- Consideration of the need for extra staff in AVINOR.
- A focus on the collaboration between management and employees in the cost-cutting programme.
- Requiring the NCAA and the business operators to perform overall and systematic safety administrative routines.
- Consideration by the Ministry to conduct a safety impact assessment due to the initiated change.

3 Theory

This chapter presents a brief introduction to risk perspectives, to the development of risk governance as an analytical framework, and to relevant theoretical contributions concerning complexity, change and goal conflicts.

3.1 Risk perspectives

Risk Management of Everything by Power (2004), states that factors such as a more demanding context for the organisations, followed by a political need to maintain the myths of control, have set the stage for a risk management society. The huge number of crises, scandals and possible future happenings discussed in the media create an urgent need for solutions. As Power said, *'Individuals, organisations and society have no choice but to organise in face of uncertainty, to act 'as if' they know the risks'* (2004:59).

Risk as an interdisciplinary research area stems from the realisation of the practical challenges in risk management (Renn 2008, 1992, Taylor-Gooby & Zinn 2006a,b, Krimsky & Golding 1992). Risk management and assessment started out with a technological scientific perspective, followed by a realisation of the impacts of psychological and sociological risk issues (Taylor-Gooby & Zinn 2006a,b, Slovic 1992, Funtowicz & Ravetz 1992).

Given the features of the Norwegian aviation transport system, which is a complex sociotechnical system, the risks might be connoted as systemic (OECD 2003), meaning that the main part of the risks are embedded in a social or political context (Renn & Klinke 2004) and are therefore not simple (Renn 2008). In order handle systemic risks (Renn & Klinke 2004), an interdisciplinary approach with input of data from various functions and geographical areas of the system is required. The continuous expansion of complex systems has given rise to a demand

for further attention to contextual factors and the extensions of knowledge bases. The scientists who claim to possess superior knowledge (Taylor-Gooby & Zinn 2006a) were challenged by the scientific tendency to pretend to be dependable even when their models failed to capture possible unforeseen interdependencies between operations at different parts of the system (e.g., Snook 2000, Vaughan 1996,) or contextual variables (Wynn 1996, 1992)

My risk perspective includes different scientific approaches depicted in a model elaborated by Taylor-Gooby & Zinn (2006a). Figure 3.1 presents the constructivist-realist continuum and the individual/subjective-social/collective continuum of risk approaches in Taylor-Gooby and Zinn's analysis. My perspective on risk is positioned in the middle of the figure made visible by adding the risk governance concept to the model.

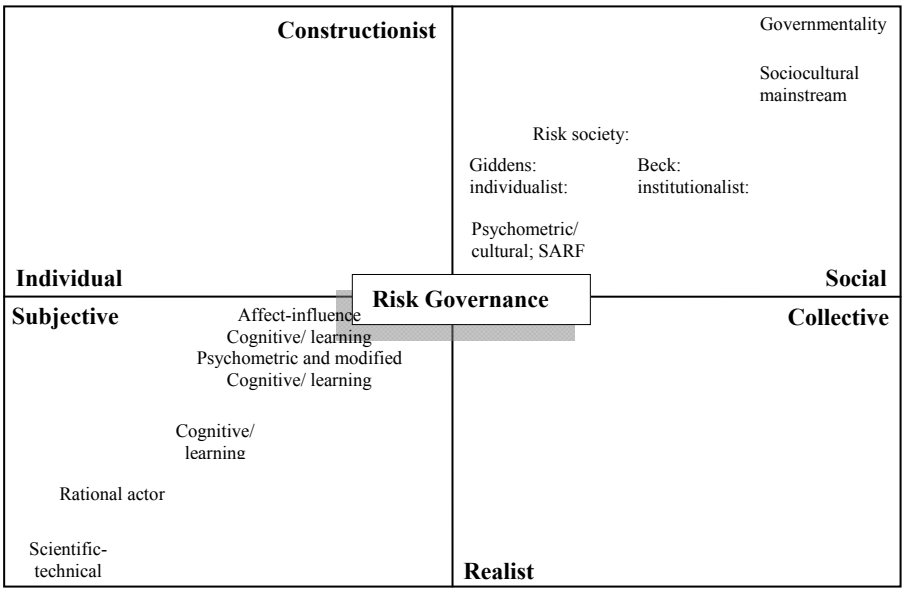


Figure 3.1 Different approaches to risk. Adopted from Taylor-Gooby and Zinn (2006a:407).

Within the realist perspective, the methods have been inherited from the positivist tradition, stating that the scientist's work is about naturalistic facts that can be observed and counted, and about which agreement can be gained, caused by their appearance in the world. Using the probabilistic yardstick, one might be able to calculate the probability of a future event. Such calculations are helpful tools that are prevalent in medicine, insurance and technical estimates, where the scientists translate expected gains and losses into objective measures. The challenges with such calculations may be a result of scant data and an inability to depend on the stability of the causal agent over time (Cohen 1996). It will also cause difficulties by deriving individual probabilities from estimations done over groups of events. A third problem is in those cases where interdependencies intervene between the cause and the effect (see chapter 3.3, 3.4, and 3.5).

At the opposite end of the figure where the constructivist approach is placed, the risk perspective is based on approaches occupied with the variability in risk perceptions. The constructivists assume that the risk perceptions vary either at an individual level or within the social context (Taylor-Gooby & Zinn 2006a). The sociological approach view the context as influencing how risk is focused within a regulatory framework or risk regulation regime, and thus the regulatory framework directing the risk decisions (Hood et al., 2001). As Figure 3.1 shows, the governmental way of regulating risk is seated in the social constructivist end of the continuum. The governmentality view notions risk as being calculative discourses (Reith 2004) illustrating the fact that the professed detachment of science from politics needs to be contested (e.g., Jasanhoff 2004, Weingart 1999). The risk decisions are taken within the closed circle of politicians and 'experts' and thereby preclude further discussion. When people with a stake in the outcome of risk decisions (e.g. the farmers in Wynne's example from the handling of Chernobyl 1996), became aware of the shortcomings within the expert risk assessment, they start distrusting the government's assessments. Wynne's study showed that expert calculations lacked knowledge of local conditions (1996). In addition, expert assessments are of scant value unless people trust the experts or the institutional systems (e.g., Power 2007), and especially if there is no

transparency in the process (White & Eiser 2006). The Challenger Space Shuttle accident in 1986, the Bhopal accident of 1984, and the Chernobyl accident in 1986 are all disasters that gave rise to distrust in the scientific contribution to risk assessment.

The precautionary principle also became important in situations with social or political ambiguity (Stirling 2007) in order to secure a trade-off between risks and benefits. Additionally, the interconnection of science and politics (Jasanoff 2004, Webler & Tuler 1999) calls for either variety in expert knowledge (Beck 2009, Liberatore & Funtowicz 2003) or refraining from reserve the word 'experts' for scientists.

As mentioned, I place risk governance in the middle of the axes in figure 3.1., in order to demonstrate my view of an appropriate framework for risk decisions. To establish a sufficient risk perspective given the systemic risks, we need several knowledge bases. The differentiation between expert and layman fades away and the operator of a system might then become as much of an expert as the scientist, due to the establishment of the sufficient knowledge of risk governance. In addition, the dimensions between the individual and the social have to be less distinct so that the contribution from both psychology and sociology may function as a theoretical framework in order to establish appropriate governance structures and processes.

Given the risks associated with uncertainty, ambiguity and complexity, there is clearly a need for more sophisticated risk assessment and risk management procedures in situations where risks might not be simple (Renn 2008). In order to extend the knowledge base, stakeholders have to become part of the risk decision making in a deliberate manner in forms of, for example, a dialogue-based risk communication (e.g., Löfstedt & Boholm 2009). In my opinion, the scientific deliveries from technical, psychological and sociological research make a valuable contribution to risk management, but, they must be related to the context in which they are going to be used (Renn 2008). Given a cause-effect relationship, scientific probabilistic risk assessments offer an adequate foundation for policy making. When complexity, ambiguity

and uncertainty characterize the risks, one must adjust the risk assessment and risk management accordingly.

Millstone et al., (2004), conducted a comparative study of different risk assessment policies within the EU and USA in which three different models for risk assessment policies were outlined. These models offer insight into various views of the implementation of knowledge, and what kind of knowledge is valued in the risk policy assessment stage. The report identified the technocratic model, the decisionist model, and the transparent model (Millstone et al., 2004).

The *technocratic model* states that the policy decisions should rely on scientific risk assessments free from political and economic values. Within this linear model, the communication flow goes from experts to government and then down to the industry and public.

The *decisionist model* questions the reductionist risk assessment model. The possibility of decomposing the risks into analytical assessments for use in policy making seems to be out of the question. The judgement and trade-offs between benefits and risks are not fully understood until they have materialised. The science alone is insufficient as input in the judgement about the acceptable risk level. The decisionist model then differs among actors within the assessment and risk management stages of the process. Scientists are making the assessments; other actors are involved during the risk policy making and management. The social, economic, cultural and evaluative considerations are important for estimating the existence, likelihood and magnitude of the risks and to have sufficient information to define the acceptable risk level.

The transparent model differs from the previous models by pinpointing the importance of the political bias that might be inherent in the expert assessments. Therefore, the assessments should rely on different viewpoints. The policymakers should explicate what risks they expect to prioritise, while relying upon multiple inputs during a deliberate process in which assumptions and world views are criticized. The risk managers then are responsible for the transparency within the process

of trade-offs between risks and benefits. Such a transparent model is in accordance with my view on risk policy making.

Within this thesis I focus on the types of risks in which there are uncertainties about the future (Zinn 2006). Such risks are in need of deliberate decision making (Habermas 2004, 1995) involving the application of knowledge, from stakeholders in different parts of the system, familiar with the hazards and affected by risk producing outcomes (Pestre 2009, Stirling 2009, 2008, Renn 2008, 2004, Renn et al., 1995, Klinke & Renn 2002, Wynne 1996, 1992).

3.2 Risk governance

3.2.1 Governance theory

As a concept, governance is replacing democracy in political science (e.g., Mørth 2009, Gaventa 2006, Pierre & Peters 2000). When different forms of democracy are emerging all over the world, there seems to be a hollowing out of democracy as a concept (Gaventa 2006). The way of practicing democracy may be questioned due to the real participation of citizens. Governance is superseding democracy as a concept to describe the processes of citizen involvement and participation in collective affairs, or the collective decision-making made by governmental and non-governmental actors (Renn 2008, Bauer & Schneider 2007, Gaventa 2006, Van Kersbergen & Van Warden 2004, De Marchi 2003).

The literature offers a wide range of definitions of governance. According to Bauer and Schneider (2007), governance might be described as: '*a system of rules in action (i.e. applied by social actors) by which desired societal states of affairs are approached (positive control), and undesired states avoided (negative control). In this respect, governance also refers to feed-back mechanisms by which the difference between a desired state and the status quo is de-tected in order to enable a society to keep itself in a viable range'* (2007:11).

Bell uses the following definition (2002: 1) ‘ (*[governance is about]the use of institutions and structures of authority to allocate resources and coordinate or control activity in society or in any other relevant environment; including the economy.‘*

‘*European Governance, a White Paper’* (EC 2001) described governance as ‘rules, processes, and behaviour that affect the way in which power are exercised at European level, particularly as regards *‘openness, participation, accountability, effectiveness and coherence*’ (EC 2001:10).

Van Kersbergen & Van Waarden (2004) reviewed the governance literature and arrived at some conclusions about commonalities within the definitions:

- Focus on pluricentric processes.
- Pay attention to autonomous but interdependent networks where hierarchies are less important.
- Point to processes.
- Pinpoint the facts that relations between actors pose specific risks caused by each actor’s autonomy, which calls for institutions to handle the relationships.

Additionally, many of the governance approaches are normative, rather than empirical.

Van Kersbergen & Van Waarden (2004) concluded that these common features makes the concept of governance into a bridge among different disciplines, defining a new way of organising both the process and structure of management.

The governance turn within the EU might be viewed either as a turn towards more a participatory style of exercising power (Caporaso & Wittenbrink 2006), caused by a need for broadening the expert pool (Hutter 2006a,b, Wynne 1996, 1992, Liberatore & Funtowicz 2003) or

as progress towards more influence by the market (Hutter 2006a,b, Pierre & Peters 2000). According to Mørth, these two ways of looking at governance impose quite different interpretations on legitimacy processes. When viewing governance as a turn towards the market, this is legitimated through output legitimacy or efficiency; the reverse is a means towards better democratic processes, input legitimacy (Mørth 2009). The two that tend towards governance, input and output legitimacy are part of the same coin; governance structure is a result both of the need for more knowledge and of a move towards outsourcing risk management (Hutter 2006, Zürn 2000). Within this thesis it will be interesting to determine whether both input and output legitimacy seems to be of interest to risk governance of the Norwegian aviation transport system.

3.2.2 Different perspectives to risk governance

In table 3.2.2, various scientific disciplines with their belonging approaches to risk governance are presented. To gather the perspectives in such a simplified manner has the advantage of giving a general idea of the main arguments within each discipline. Yet, it has the disadvantage of leaving out important distinctions and progression elements within each perspective to risk governance. Within each discipline there may exist controversies according to risk decision and policy making, and the researchers themselves often hold a multidisciplinary scientific perspective. Nevertheless, in table 3.2.2 main arguments within risk governance of an economic/technical/psychological perspective, a political perspective (political science and law), a sociological perspective, and an anthropological perspective are presented.

Perspectives / Arguments	*Economic/technical/ psychological*	*Political*	*Sociological*	*Anthropological*
Ontology	Risk is a given object. Individual rationality.	Risk is uncertainty about the future Values and risks are intertwined (Jasanoff 2004).	Risk is sociological processes, interactions, and context. Culture frame risk perceptions.	Risk is perceptions and representations of collective belief systems (Rosa 1998).
Epistemology	Probabilistic Psychometric	Precautionary principle (De Marchi 2003). Transparency within the decision making process (Jasanoff 2004). Inclusion of divergent perspectives (Stirling 1998).	Descriptive framework to explore hidden power structures (Foucault 1991).	Knowledge as a social product (Rosa 1998). Descriptive framework to explore the knowledge of the insider of a system (e.g., Wynne 1996, 1992).
Risk communication systems	Linear systems	Participatory governance (De Marchi 2003).	Lay people equal partners in the risk communication (Webler et al., 1992, Wynne 1996)	Interactive risk communication (e.g., Boholm 2008, Löfsted & Perri 2008).

Rationality	Rational choice	National institutions and political forces influence what is seen as potentially harmful (Jasanoff 2005). Audit society (Power 1997). Risk regimes (Hood et al., 2001).	Risk society (Beck 1992) Reflexive modernity (Giddens 1991), governance (Foucault 1991).	Sensitivity to divergent assumptions about risk (Stirling 1998). Capture the context.
Power structures	Hierarchical	Both hierarchical and vertical	The modern world holds power structures according to ways of organizing the society	Bottom up focus to secure relevant knowledge

Table 3.2.2 Perspectives to risk governance

The risk governance perspective as outlined in Renn (2008) and also described and discussed by others (e.g. Stirling 2009, 2008, Rosa 2008, Løfstedt & von Asselt 2008, IRGC 2005, De Marchi 2003) offers a framework that incorporates and encompasses the generated knowledge from the above mentioned perspectives. Instead of resting the risk policies on single theoretical frameworks, risk governance adapts knowledge from the interdisciplinary research community (Renn 2008). An integrative framework offers the advantage of appealing to risk policy makers, researchers and managers at all levels of society from various scientific disciplines (Rosa 2008). Such framework is therefore timely in this PhD work given the transnational risks within the aviation transport system. When deregulation becomes a fact, one must reconsider geographical borders across nations with regard to risk regulation. The movement from government to governance is also a movement from national economies towards a transnational economy, with the hallmarks of interdependencies and complexity. '*They [risks] tend no longer to be geographically, regionally or nationally restricted, but are global. They [risks] are complex and increasingly entangled with different areas*' (Taylor-Gooby & Zinn 2006b:25). Removal of trade borders creates more complexity within a system and calls for new tools, methods and varied knowledge to handle the risks. The governance ideal has entered into risk management, due to the acknowledgement of uncertainty, and ambiguity within scientific results and, the complexity that feature our systems, thereby, following a need for precautionary principles and broadening of the knowledge base (Stirling 2009, 2008, 2007, Wynne 1996, 1992, De Marchi 2003, Klinke & Renn 2002, EC 2001).

3.2.3 Risk governance models

The governance model opens up and includes more actors during the process of appraisal, assessing, evaluating and managing risks. Renn (2008) uses the concept of the 'transparent inclusive model' as a way both to assess and manage risk. This model views risk assessment within the previous models (the 'technocratic' and the 'decisionistic') as framed by the political and societal context (Jasanoff 2004)

Millstone et al., (2004) stated about the 'transparent model': *'In this model, scientific risk assessments are seen as framed by legal requirements and by social, economic and political judgements, and those up-stream assumptions therefore contribute to setting the agenda of the scientist responsible for risk assessment'* (2004:22). By making the risk model transparent, the coupling between science and politics is taken into consideration. This transparent model is inclusive with regards to actors and stresses the framing of risk, the stage of characterisation, and the evaluation. The model can be represented as in Figure 3.2 (adapted by Millstone et al., 2004, Renn 2008:10).

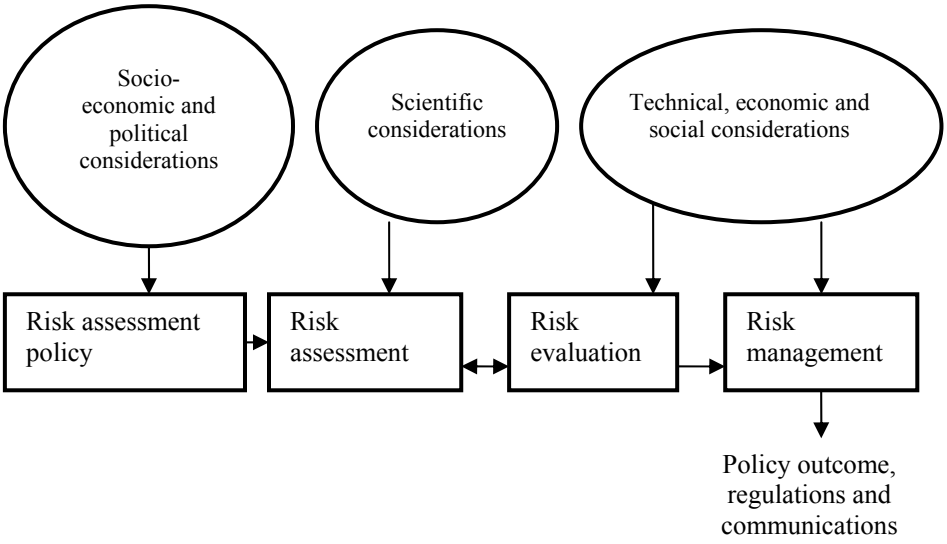


Figure 3.2.2 The transparent risk model, adopted from Millstone et al., 2004[6]. A core risk governance model.

[6] Renn (2008:48) and IRGC (2008:8) describe the five phases in core risk governance in another model, a model which illustrates the phases, by linking them as an ongoing process of pre-assessment, appraisal, management, and communication., where communication is an important part of the ongoing process with all the other elements. Within this thesis I have chosen Figure 3.2 since it illustrates the

The elements of core risk governance process are well known in the literature: risk assessment, risk evaluation and risk management. The transparent model is remodelled by Millstone, inspired by the National Research Council 1996 (NRC), Washington, D.C. The NRC focuses on involvement, interactions and transparency throughout the stages in the model. Previous models used scientific input, or expert assessments, as a starting point to dialogue. Adding this risk assessment policy and pre-assessment steps means to include the various perceptions of risk in the input phase of the risk management process (Millstone et al., 2004, Renn & Klinke 2004, Pidgeon 1998, Wynne 1996), when facing new risks with elements of uncertainty, complexity and ambiguity (Renn 2009, 2008, Renn & Klinke 2004). The transparent model is realising the coproduction of science and politics (Jasanoff 2004, Liberatore & Funtowicz 2003, Webler & Tuler 1999, Otway 1992), the democratisation of risk and regulation (Hutter 2006b), and the fact that scientific knowledge is hardly value-free (Renn 2008, Jasanoff 2004, Liberatore & Funtowicz 2003, Webler & Tuler 1999, Weingart 1999, Funtowicz & Ravetz 1992, Otway 1992, Wynne 1992).

As the NRC pointed out in 1996, many analytical frameworks and techniques are available for measuring the adverse output of an event (e.g., fault trees and hazop analysis), but it is important to remember that risk assessment techniques come up short in cases of uncertainty, complexity and ambiguity: '*techniques can illuminate the choices that society must make, they cannot substitute for a deliberative process by artificially simplifying complexity*' (NRC 1996:80).

Within a transparent risk model, the process of risk assessment and management must be deliberative (Renn 2008, 2004, Renn & Klinke 2004). Deliberation in risk governance means that the process has to '*debate the criteria of truth, normative validity and truthfulness*' (Renn

differences among the technocratic, decisionist, and transparent risk models in an appropriate manner.

2008:303). More precisely, the relevant issues must be discussed by exchanging observations and viewpoints, so that the discussion within the decision-making process might search for balance among the arguments. A discussion based on the new information follows the realisation of arguments. According to Renn, this discussion should be '*putting the facts into a contextual perspective'* (2008:285). Establishing meetings and arenas that reflect the criteria of a deliberate process should then give the opportunity to frame risk challenges based on broader knowledge. The advice from the NRC is that a good decision-making tool is made up of an analytic deliberative process where the search for solutions captures as many as possible of the adverse effects of an activity (NRC 1996). The mutual learning through the deliberative process is essential (Renn 2008, 2004, Renn & Klinke 2004, Daniels & Walker 1996, Habermas 1995).

The core risk governance framework consists of the core elements as presented in Figure 3.2 -- risk assessment policy, risk assessment, risk evaluation and risk management -- but it also stresses the deliberative elements of inclusive communication, both to enunciate the information to stakeholders and to establish a two-way dialog in all the stages of the risk handling process (Renn 2008). The core elements described in the transparent risk governance model constitute the core risk governance process within the risk governance framework. However, the framework also covers the conditions that affect the core risk governance process. These conditions might be described as contextual elements as the IRGC model 'Risk governance in context' (2007:20, Renn 2008:354), which illustrates core risk governance processes surrounded by elements that impact risk management (Figure 3.3). This is in line with Hood et al., (2001) who make a corresponding distinction between the context and content of a regulatory regime. Where context refers to the policy backdrop to the risk regime, and content concerns the 'inner life' of the regime, Hood et al., (2001) refer to structuralism (e.g., Parson, Luhman, and Foucault) by using context as anchored in the backdrop, whether or not the content is pointing to the arguments of an organisation's inherent nature of creating its own order independent of social policies (e.g., March & Olsen 1989, Vaughan 1996, Perrow 1999, Snook 2000). The governance model then

creates an analytical tool to describe the '*collection of organizations that made up the regulatory system rather than of the operation of any one of them in isolation'* (Hood et al., 2001:185). The risk governance model is also consistent with Rasmussen and Svedungs' (2000) view of modelling risk management and regulatory rule making as several nested levels of decision making.

According to Renn (2008), good governance rests on three components: sufficient knowledge, legally-prescribed procedures, and social values (like the statement of goals, objectives and contextual factors).

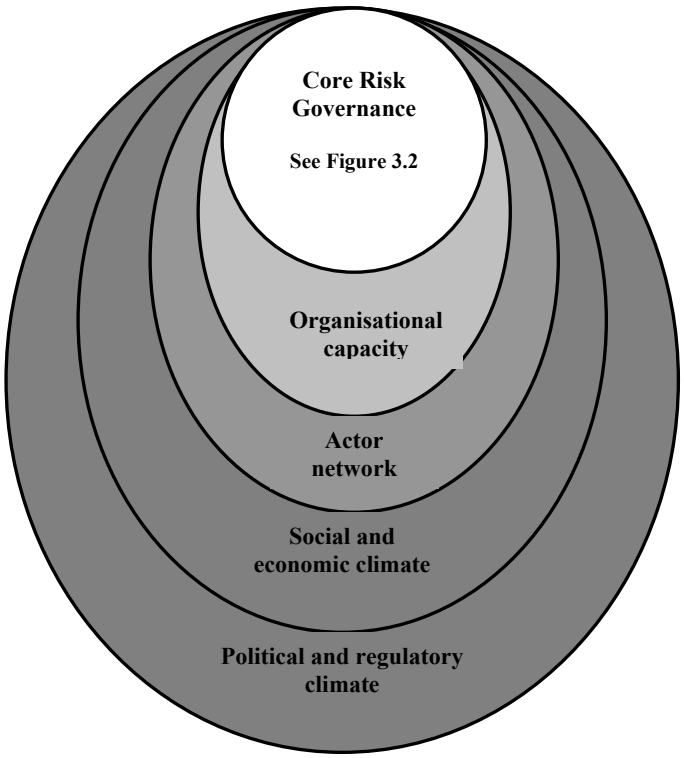


Fig 3.3 The contextual risk governance model, adopted from IRGC 2007:20

The organisational capacity, the actor network, the social and economic climate, and the political and regulatory climate operate as the context of the risk handling processes. The layers in the model have to be considered in a risk governance framework, as elements that both impact and are reflected in the core risk governance process. In an ideal world, the elements might have been viewed as a whole existing in an integrated process, wherein the entire system is capable of a nimbleness in the case of complexity and the call for continuous learning (Paquet 2001). The contextual elements that influences the core risk governance processes illustrated in Figure 3.3, will be elaborated below.

The organisational capacity refers to the assets, skills and capabilities within the organisation (Renn 2008).

The assets comprise the knowledge base and structural design of risk management. Organisational assets encompass the established rights and duties, the resources in the form of the economics, and the appropriate structure to handle the risk, the knowledge, expertise and experience. These elements must be integrated as a whole by the fourth asset, organisational integration. Without a comprehensive system to handle the organisational assets, they will be of less value for risk governance.

Skills are of importance to make use of the assets. Important skills related to risk management are flexibility, vision and directivity. Flexibility is required to maintain the organisation's functioning even during disturbances (Weick & Suthcliffe 2007); vision is helpful to imagine the unimaginable by, for instance, scenario building. Directivity refers to the importance of perception. By being willing to extend the scope of one's perception, the skills will be strengthened.

Capabilities might be viewed as a structure with several successive layers, constituting the ability of an organisation to make use of its assets and skills. Capabilities consist of the relations acting as inclusive decision making, alleviating any conflict that has a negative impact on risk. In addition to the relations, structural networks have to be

constituted, and, finally, there must be regimes that take care of the overall rules to manage risk.

Actor network

Power (2007:2) proclaimed that *'the dominant discourse of risk management has shifted from the logic of calculation to that of organization and accountability.*' This statement underlines the movement from relying solely on experts in the assessment phase of risk governance. The risk governance framework stresses the requirement of opening up participation in both the formulation and the information part of governance (Stirling 2008, 2007, Liberatore & Functowicz 2003, Wynne 1996, 1992) and of gaining the approval of non-state actors involved in shaping the regulatory framework (Craye & Funtowitz 2009, Hutter 2006a,b, 2001, Kirwan et al., 2002, Rasmussen & Svedung 2000). The actors that should be involved in risk governance processes are those with a stake in the outcome of an event or activity.

Risk governance covers both structure and process. The appropriate structure must be constructed in order to involve the actors. 'European Governance, a White Paper' (EC 2001) mentioned several tools for involvement, from information by green and white papers on communications, through communication by advisory committees, business test panels and ad hoc consultations. But, they also stated the need to make these tools more effective and open, especially in cases with hearings.

Within the aviation transport system, stakeholders can be defined as all of the actors constituting the system, from the employees at the institutional part to the employees at the operational part of the system as well as the passengers (Leveson 2004, Rasmussen & Svedung 2000, Rasmussen 1997). They might be involved as socially organised groups with interests in the outcome of the regulatory framework. It is necessary to understand all the actors in order to frame the risk, make an appropriate assessment and follow with a judgement of acceptability and tolerability regarding the risk level. An understanding of the actor

network is important in order to have a communication flow and decision making based on all the relevant knowledge within the system. The involvement of actors can take different forms, but establishing an arena that empowers the participatory bodies, beside transparency and accountability in the processes, is important to a foundation of trust (Renn 2008).

The closing part of the risk assessment process, the way to reach the solution, is just as important as the inclusiveness of the actors. Based on the risk governance ideas of acquiring different knowledge bases within a risk domain, it is important to foster a dialogue hallmarked by a deliberative approach (Renn 2004) in order to provide an appropriate bridge to this knowledge.

Much of the activity on this level focuses on networking and meeting activities due to risk-related issues in different organisations. The inputs to the decision processes are based on the importance of contextual knowledge from all parts of the system. The deliberative approach is rooted in Habermas' (2004, 1995) ideas of communicative action, where he points to the need to engage the citizen in joint, rational decision making. A deliberate approach could also be related to dialog-based risk communication (Löfsted & Boholm 2009). Risk decisions are both knowledge- and value-driven (Renn 2004). The normative standards should be attributed to the actors involved and to the society, as such (Renn 2008, 2004).

Social and economic climate

In this layer of the governance model, I include the economic and social climates as constituting this contextual level. Renn (2008) mentioned the following as elements of a social climate:

- *Trust in regulatory institutions*. Jasanoff (2004) has claimed that in times of change, the trustworthiness and authority of individuals and institutions are questioned. Trust in regulatory institutions allows the citizen to leave most of the risk issues to the government (Giddens 1991, Lupton 1999, Jeffcott et al.,

2006), state that individuals relate their actions, attitudes and expectations to the social system that constitutes their context. Trust, then, makes the society more efficient by fostering a high degree of informal collaboration across various actors within the society (Svendsen & Svendsen 2006). In a study built on European Social Survey numbers, the Norwegians expressed a relatively high degree of trust in political institutions. (Listhaug & Ringdal.08 in Aftenposten 20.07.08).

- *Perceived authority of science.* Beck (2009) stated that the uncertainties about scientific contributions have created a scepticism towards the experts' risk assessments, thus realising the challenge with 'sound science' (Blair 2003) and thereby the need to expand the knowledge base (Wynne 1996, 1992, Stirling 2008). This dawning experience of the absence of 'sound science' implies the need for a shift within the risk assessment phase of the core risk process from expert deliveries towards a deliberately transparent framework (e.g., Renn 2008, Millstone et al., 2004) Nevertheless, the scientific results are valued as an important knowledge base within risk assessment where the causal effects are simple to derive. In situations that are complex, uncertain and ambiguous, the scientific results and expertise from other involved stakeholders are part of the knowledge base.

- *Degree of civil society involvement*. As just stated, a framework wherein the citizens experience trust towards institutions will foster engagement by civil society.

Hovden (2002) described, by research on the oil sector, economic trends that might influence a industry's regulatory framework:

- Income, financial pressure and market uncertainties. These factors have been prevalent since deregulation and the ensuing changes in competitive conditions. Due to the financial situation, there is a cost pressure also within the aviation industry (Tjørhom & Aase forthcoming).

- Cost cuts that impact the regulations. Hovden (2002) referred to the Norwegian Offshore Cost Effective Initiative (NORSOK) process (changing the regulatory regime within the Norwegian oil sector due to the need for cost cuts) as resulting in decisions that satisfied requirements within an economic framework rather than seeking safety improvement.

- Economic incentives in contracts. The framework for tendering is based on competitive issues, which is caused by the relative challenges with measuring safety compared to economy (Gaba 2000), thus creating a tension due to the lack of safety indicators within the tender.

During the last decade, the social and economic climate factors within civil aviation have been characterised by liberalisation, competition, cost effectiveness, regional politics, and a public demand for protection against terror attacks. The study from oil industry might then be worth noticing in risk decision making in the aviation industry.

Political and regulatory climate

According to Renn (2008), regulatory climate reflect a country's way of governing or the features of the risk domain. Renn (2008) differentiates several styles of empirical risk regulatory culture, for instance, the consensual and the corporatist. Renn (2008, 2001) has also described a new normative regulatory climate, the meditative regulatory climate, which may fit well to meet the demands of openness and public participation.

The consensual approach is more like 'clubs', where decisions are made behind closed doors. According to Renn (2008), the collaborations take form among closed circles of actors with the aim of reaching their predefined goals. There are few discussions within the group. Trustworthy communications among public and other groups are important. The discussions are only extended to other actors when further insights are needed, or in cases where the constitution of the club is threatened. This consensual approach is in line with the former

aviation collaboration on common agreements within the International Civil Aviation Organisation (ICAO) and the Joint Aviation Authority (JAA).

The corporatist approach is distinguished from the consensual approach by having more formalised structures and a focus on transparency during the process. The network is built by representation of stakeholders valued as important due to their knowledge bases. Different actors like scientists, experts, and employees are invited into the network in order to provide comprehensive input to the discussions. There is predictability within the meeting structure and the actors invited. This approach also seems to focus on risk communication to gain trust. The corporatist approach has been the dominant style in EU, but, according to the white paper on risk governance (EC 2001), the focus has changed to involvement. The white paper stated that principles of good governance focus on opening up the policy process in order to involve more stakeholders.

As mentioned earlier in this chapter, there are many initiatives and thoughts about involving the actors. And these initiatives, along with the 'European Governance, a White Paper', have produced a movement towards more transparency and communication, both in Europe and in the US (Renn 2008). Renn denotes this way of regulating as the meditative manner, a regulatory style that is open to negotiations among stakeholders at all levels, providing all the actors with scientific expertise and strengthening the interpretative role of scientific expertise. According to Renn (2008), this meditative risk governance style can only be realised as an evolution of close interactions by governmental and non-governmental actors.

Risk is a borderless phenomenon (Smith & Fishbacher 2009), which means that the risks we are facing depend upon others', as well as our own, choices (Renn 2008). This interdependency implicates common regulations that capture the challenges pertaining to interrelation, interactions and emergence. The management of risk should, then, at the institutional level, reflect the complexity and interwoven nature of risks. To establish a framework that ensures that each participant

complies with the rules, one has to be careful while making the regulations. The regulator has to structure a process that involves the actors in a partnership manner. The partnership model related to the information process, together with inspections to determine compliance, will, in Renn's (2008) opinion, ensure that each of the actors is working to reach the same safety goals.

The former JAA and ICAO frameworks for establishing common rules were highly in accordance with the consensual approach. The system's structure was much less formal, and it left the common agreements, elaborated as a framework or 'goal rules' (Grote 2008, 2004), to the national government to complete the rule work. With the transition to the European Aviation Safety Agency EASA, the structures for the collaborations were strengthened and the rule work was established by law, two factors that have made the regulatory climate more transparent and powerful (Pierre & Peters 2009). But when stating some features of the EASA as a regulatory climate, it is worth mentioning that this system is in the melting pot, yet to come in force. Morgan & Yeung (2007) referred to the decision-making process within the EU as a negotiation between actors relatively narrow in their reflection mode. Smith and Fishbacher (2009) ask if it is possible to develop a framework to rule that addresses the complexity, interdependencies, interconnections and emergence that follow a transnational transport system.

3.3 Critical comments to the risk governance framework

The holistic interdisciplinary perspective proposed within risk governance holds several challenges regarding both structural and processual elements. Some of these issues are discussed in Renn and Walker (2008). Below I will present some of the critical comments to risk governance as a comprehensive framework for risk. The comments are structured according to three challenges: risk as a concept, the purpose of the model, and the deliberative approach.

Risk as a concept

According to Rosa (2008), a risk governance framework is in need of a clear definition of risk, a definition he finds absent in the International Risk Governance Council's work (IRGC 2005). Rosa claims that definitional clarity in forms of premises for generating knowledge is the foundation of a sufficient theoretical framework. Such knowledge forms the basis for the methods of exploring, measuring and managing the risk field. In other ways, the way risk is defined and understood gives rise to the way risk issues are treated. As shown earlier in the chapter, risk may be understood along a scientific continuum from realist to constructivist, or from an individual/subjective end to a social/collective (figure 3.1). Different scientific disciplines relate to, or perceive differently, the ontology, epistemology, rationality, and power structures of risk (table 3.2.2). This diversity in risk perspectives and understandings is a challenge in itself, and in Rosa's (2008) opinion a lack of clear definition in the risk governance framework becomes a threat to the interdisciplinary discussions of risk due to a lack of guidelines in forms of a scientific logic.

The purpose of the model

Holism is a two-sided coin; in its effort to capture the entire risk governance picture, the framework clearly falls short in delivering necessary simplifications. A risk governance framework needs the balance between sophistication and simplification (Löfstedt & von Asselt 2008), meaning that the framework should cover the systemic risk issues without ignoring important factors (Stirling 2007), yet are simple enough to model the risk system. Löfstedt & von Asselt (2008) expressed the need for further simplification within the risk governance framework as presented by the International Risk Governance Council (IRGC). This is a question of who will use the framework. Maybe the most valuable intention with the risk governance framework is the holistic picture it offers, providing leaders and governments with a mental picture of risk governance (North 2008). If the risk governance model creates more awareness, then resources needed to elaborate the framework might be available. A risk governance framework suited for

research aims such as creating evidence-based scientific knowledge needs a higher degree of both complexity and accuracy than a risk governance framework appointed to guide, for example, government leaders. For my research aims of exploring a global transport system I found the framework to have a degree of complexity that covered important features of the system.

The deliberative approach

Another challenge disputed by several authors (e.g., Löfstedt & von Asselt 2008, Rosa 2008) is the deliberative approach added to the policy making process in the risk governance framework. This communicative normative ideal, described comprehensively by Habermas (e.g., 2004, 1995) is still a normative ideal in need for more clarification through empirical studies: "*Many arguments in favour of analytic–deliberative processes and their theoretical foundations provide ample evidence for their potential contribution to improving risk evaluation and management. It is still an open question whether deliberation can deliver what it promises in theory. The empirical account is still open and incomplete*" (Aven & Renn forthcoming:208). Realizing the various and often substantially different risk perceptions amongst actors, groups, and units within a system it seems inconceivable that a common learning process could be realised. On the other hand, today's realisation of the variety within risk perceptions, and the lack of knowledge that features a whole range of risk issues might pull towards the ideal of deliberation. If we open up to a pluralistic process, the actors participating in the debate are equal in terms of valuable arguments concerning risk issues (Rosa 2008). Another concern is, then, how conclusions should be made. A valuable democratic process can prevent powerful vested interests from determining decision making (Tait 2008). Lack of clear guidelines within the risk governance framework on how to reach conclusions may result in what Rosa calls a manipulated speech community (2008) where power issues come to the fore and may lead to ignorance of important risk issues. If the openness and pluralism stated in the risk governance framework become too relativistic, the ideal of democracy might diminish in light of power structures. Another challenging

question related to the deliberative approach regards representativeness: Who is going to choose the actors to represent a unit, according to what criteria, and how do we account for what is relevant knowledge or not? What about economic resources for participation from relevant parties?

3.4 Complexity

Complexity refers to situations within a system where the interactions of components within the system make it difficult to predict possible outcomes. Due to interactions and interrelationships, the causal links become invisible and individual variations or adjustments at one part of the system might have unforeseeable effects on other parts of the system (Hollnagel e.g., 2009, 2008, Rasmussen 1997, Perrow 1999, Bertalanffy 1968).

Le Coze (2005) pointed to some of the characteristics by studying a system holistically -- in preference to a decomposition study, where one attempts to divide a system into analytical units. Decomposing a system may lead to loss of relevant information, especially due to interactions among elements. The number of variables and interdependencies makes it inconvenient to model relationships. A holistic study may offer the following advantages:

- Acquisition of insight into global interactions and interdependencies
- Knowledge about the relationships between the system and the changes, caused by studies of processes
- Understanding of complex interactions among humans, technology and organisational factors

Complexity becomes an issue when systems become extended or transformed. Caused by changes in the system, there are no longer any obvious connections between cause and effect. And the effects might show up long after the cause (Renn 2008). Senge (1990:364)

differentiated two sorts of complexity. 'Detailed complexity' is when a case has many variables; 'dynamic complexity' is when cause and effect are not close in time and space and when there is an obvious lack of connection between interventions and outcomes.

The term 'complexity' within safety science is often connected to the term 'system'; these have the hallmarks of tight couplings and interconnections (Perrow 1999). A complex system might be described as 'possessing' an elaborate set of interconnections and non-linear feedback loops, some of which are hidden or impossible to anticipate (Weick & Suthcliffe 2007:92). Perrow and Weick represent different views about the possibility of managing these systems. Where Perrow (2007) advises that society break these systems down into smaller entities and move such production out of rural areas, Weick and his followers (High Reliability Organisations and Resilience Engineering) might agree with this stand, but, globalisation is a fact and production systems are a part of the worldwide economy. The complex systems are therefore a reality which has to be taken into consideration.

According to Renn (2008), uncertainty is often a result of incomplete or inadequate reduction of complexity. Risk assessment often rests upon this uncertainty caused by the trouble with modelling cause-effect within today's complex systems. How could it be possible to partition this system into manageable entities in order to assess its risk level?

The concept of political and economic complexity (Høyland et al., 2008, Vaughan 1996) refers to factors at the macro level, where decisions are made. Decisions made at the top level of the system pertain to the whole system (Westrum 1996). Provisions or rules from different levels, held together with changes within these provisions create, complexity related to adjustment, compliance and interpretation. In a study of the Challenger accident, Vaughan (1996) revealed that political and economic relations were important explanations of the causes of the accident. Vaughan found that the managers operated in a world invented by political leaders that cut resources and that the NASA leaders responded to these cost cuts by increasing the flight rate and thereby increasing the workload. Turner and Pidgeon (1997)

pointed out that when an organisation's attention is concentrated on some issues, the decision makers may fail to consider important information about other issues.

According to Renn (2008), uncertainty in risk analysis is often a mix of aleatory and epistemic uncertainties; he further stated that it is essential to know the difference between them. If the uncertainty is aleatory, the randomness in outcome is a fact, and it is impossible to state a prediction that is more accurate. Conversely, if the uncertainty is epistemic, meaning that one lacks knowledge about a case, more data must be collected to arrive at a more precise starting point from which to begin the risk governance process.

3.5 Goal conflicts

During the period of this study, the cost pressures and efficiency have been a current issue within aviation (Høyland et al., 2008, Loqfquist 2008), a focus which is characteristic of the prevalent social and political climate. The cost effectiveness is easy to make objective by stating clear goals, followed by indicators to measure these goals (Gaba 2000). Examples of indicators are timeliness, regularity and economy (Tjørhom & Aase forthcoming). In situations where the operator has to handle goal conflicts, between, for example, regularity and safety, the means to handle such a conflict might create tensions (Pettersen & Aase 2008, Woods et al., 1994). Analysis of aircraft accidents has shown that, for example, acceptance of too long duration between de-icing and take-off contributed to the Dryden accident (1989) (Evans et al., 2006). Too narrow procedures and rules may contribute to conflicting situations for the operators and, in worst cases, contribute to wrong decisions that result in catastrophic accidents. The origin of such conflicting goals, between the situation per se and the designed rules, stems from inadequate contextual factors (Woods et al., 1994).

Within a changing environment, with efficiency trends it becomes prevalent to enforce and state clear safety goals (Tjørhom & Aase forthcoming, Aase et al., 2009, Grote 2008, 2004, Cook & Rasmussen

2005). These goals may be stated within a regulatory framework, thus becoming a part of the risk governance.

Within a risk governance framework, it became obvious that there are also goal conflicts within the elaboration of the core risk governance process. Stirling described such a goal conflict by addressing the inherent tension and power elements of governance (2008), pointing to different imperatives to governance. These imperatives are the normative, the substantive or the instrumental. Referring to Stirling, the normative reason for choosing governance is 'because it is correct', the substantive reason is selected to fulfil the objective of better ends (often related to the discussions of precautionary principle), and last, the instrumental is chosen to reach particular ends. So, even if the risk governance perspective is chosen, there might be an inherent tension and a potential danger that, for example reputation is the imperative. According to Power (2007, 2004), a risk framework is a disguised picture of trustworthiness. Giving such an instrumental reason for choosing governance might create tension towards the elaboration of rules. Efficiency might be prioritised before safety, even in the core risk governance process of prioritisation of safety goals.

The apparent visibility of the efficiency goals in contrast to the indistinctness of safety goals (Cook & Rasmussen 2005) calls for clarification of safety standards and procedures in order to keep this objective uppermost in the operator's mind. Grote (2008, 2004) stated that the safety within many organisations and systems has been viewed as a product of procedures and rules; in situations with uncertainties, there are calls for elaboration of flexible rule work.

3.6 Changes

Turner & Pidgeon (1997) claimed that focusing attention towards one area of activity within an organisation might negatively impact other activities the organisation is responsible for. Woo & Vicente (2003) indicated that increasing competition within socio-technical systems, such as commercial airplanes, forces the system to 'do more with less' (2003:253), and Hale & Baram (1998) declared: '*lessons learned in*

aerospace and defence industries reveal that the root of many accidents lies in poorly managed change' (1998:189).

Procedures and rules might be an appropriate way to manage safety within a stable system, but, in dynamic, fast-paced situations, within technological and organisational changes there are often lags in development of safety rules and regulation (Becker 2007, Rasmussen 1997), creating the discrepancy between prescribed work and real work (Bourrier 1998). As systems become more complex and interrelated, the regulatory styles have to open up to flexibility (Wilpert 2008). Both the technological change and the competitive environment foster short-term financial decisions ahead of long-term issues such as safety (Lofquist 2008, Jeffcott et al., 2006, Becker 2002, Rasmussen 1997). In order to keep the safety level high in changing situations, feedback mechanisms must be established (Rosness et al., 2004), safety information exchanged and learning fostered in the system interfaces (Wiig 2008) to develop the safety system to fit new situations. A complex system calls for open-minded discussions to capture the ambiguities to which the systems are subjected (Rosness et al., 2004), and to prevent a decrease in the safety boundaries (Rosness et al., 2004, Rasmussen 1997).

Studies (Lofquist 2008, Jeffcott et al., 2006, Rosness et al., 2005, NLR study 2003) show that systems subjected to structural changes might be vulnerable to important safety aspects, such as communication lines, flexibility, trust, and learning. Changes within organisational structures create degradation in the information flow (Rosness et al., 2004) and might be a reason for operational drift (Snook 2000). Likewise, the tension between centralisation and decentralisation of control (Jeffcott et al., 2006), calls for a flexible structure to anticipate any unwanted side effects of a decision. When organisational structures change, work groups may become dispersed or recreated and expertise lost (Pettersen 2006), which might impact the ability to function flexibly in circumstances calling for the requirement to anticipate decisions and operations (Jeffcott et al., 2006). An experience of commitment to safety production by management is of importance to trust issues and, thereby, may create tensions in the operational staff in decision

situations (Jeffcott et al., 2006). Furthermore, the important learning aspects of safety production might be threatened by a burdensome focus on procedures (sometimes conflicting) and the resulting blame when they are violated (Pidgeon & O'Leary 2000). A tendency to focus on blame fosters a non-reporting attitude, with the loss of possibilities to learn from incidents and accidents. Systems subjected to changes which decrease complexity and create more tight couplings (Perrow 1999) and intractability (Hollnagel 2009) are in need of data and evaluation of processes to learn and keep the safety production at a high level. Within aviation, the Dryden accident in 1989, the Bijlner accident in 1992, and the ValueJet accident in 1996 resulted in a shift in focus from a simple cause-effect explanation to a system focus, and, thereby, led to changes in safety legislation (NLR-CR-2003-316).

In 2008, the report from a Norwegian research project on changes within the aviation system, *'Every little bit helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector',* 2005-2007*'* (Høyland et al., 2008) concluded that among the cases that were studied, there was a range of characteristics that integrated and strengthened the crosswise safety work within the Norwegian aviation transport system. Such characteristics are a high degree of professionalism, awareness of safety, and safety responsibility within the work operations. Furthermore, procedures and new technologies, in combination with willingness to learn and strengthen competence, are highly focused. The challenges to the safety work in this change-intensive situation seem to be affiliated with the restructuring of the system, which created new interfaces between the actors (the reorganisation and relocalisation of the Aviation Authority, the separation of the maintenance unit for the airline companies, together with relocalisation of line maintenance), who might be vulnerable to the practice of safety work within the Norwegian aviation transport system. The study has shown that the relational premises are strongly influencing the possibilities to operate safely in a change-intensive situation. Thereby, the new interfaces seem to be the main challenge due to continuation of the safety focus across the aviation transport system (Høyland et al., 2008).

4 Methodology

This chapter introduces the methodological issues related to exploring the risk governance of a transport system. I present the background for my research, the research design, my method of data collection, and then explain how I ensured the quality of my findings.

4.1 The background for my research

I began this PhD study in light of my master's thesis, 'Safety Culture within Heavy Maintenance at Braathens Technical Service, Sola' (Tjørhom 2001). The knowledge I acquired during data collection, from observations, interviews and attendance at different congresses and dialogues, was my starting point. The conclusion of my thesis was that the employees within the unit of my study held a common awareness of safety. The study showed a safety culture denoted by Reason (1997) consisted of just, reporting, flexible and learning elements. Based on these results, I found the aviation field to be an interesting window into safety work in practice.

I embarked in this research at the request of an organisation focusing on safety issues, the Solaconference. The Solaconference is managed by employees and retired employees of the Norwegian aviation system. This organisation wanted to extend its work with annual safety conferences to encompass aviation safety research. The collaboration between the University of Stavanger and the aviation system started with workshops in which safety challenges and questions experienced within the aviation transport system were matched with challenges within risk and safety research. A research proposal to the Research Council of Norway was developed with input from a reference group within the Norwegian aviation transport system. That proposal suggested scrutinising whether or not the ongoing trends (deregulation, downsizing, merging, and relocalisation) in the society affected the risk management of the Norwegian aviation transport system. The overarching question was whether or not the traditional analytical risk

management tools used for safety management come up short in this new situation. In other words, is the prevailing risk management system in accordance with the ongoing changes to which the system is subjected? The proposal resulted in the collaborative project 'Every Little Bit helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector, 2005-2007' (Høyland et al., 2008). Four of us were affiliated with the University of Stavanger. We also collaborated with the Norske Veritas (DNV), and with Rogaland Research, now the International Research Institute of Stavanger (IRIS). During the project period, 2005-2008, this reference group, along with members of the aviation transport system in Norway, held and attended meetings. The purpose of these meetings was to present findings and search for further paths in the research in partnership with the actors from the empirical field.

The current PhD project was a part of this project. Within the research group and the reference group, I benefited from having research fellows assist me in elaborating the conceptual framework (Marshall & Rossman 2006). This collaboration improved my work and was helpful in refining my ideas and concepts. Nevertheless, my participation in the project also presented the challenge of distinguishing my own work from that of my colleagues.

4.2 Research design

Before choosing a research design for my study, it was important to define the scope of the research. The scientific position gives direction for every step in the research process (Winter 2000). A theoretical choice points to the worldview of the researcher. The choice of theory provides a lens through which one looks out upon the world, one that, as Blaikie (2000) said, '*highlights certain aspects while at the same time making other aspects less visible*' (2000:159). Every kind of scientific view puts some aspects in focus and leaves out others. As Gilbert said (1993), '*a shift in perspective changes the shape of the social world'* (1993:1).

4.2.1 Description or prescription of risk governance

As pointed out in chapter 1, the main research aims of this PhD-study have been to explore the risk governance system of civil aviation, with attention to the role of complexity, change and goal conflicts. To explore the aviation system with regard to these issues may point towards a pure descriptive approach of trying to explain how complexity, change and goal conflicts play a role in governing risk within aviation. A descriptive scientific ideal is often connected to a constructivist way of deriving data and knowledge about the outer world (Hansson 1999). The pure descriptive ideal, as opposed to the prescriptive normative ideal viewing the outer world as given objectivity, seeks contextual and full descriptions of the empirical field in order to grasp knowledge (e.g., Snook 2000, Vaughan 1996).

My PhD work has an explorative nature with the initial focus on the processes and structures constituting the aviation system's way of handling its safety work and managing its risks. At first, the study relied on a socio-technical system approach (Alamberti 2005, 2001, Leveson 2004, Rasmussen 1997) as a framework chosen by the research project in which this PhD work was a part of (Høyland et al., 2008). This framework created the selection of units to be studied in the Norwegian aviation case. In this phase of the PhD work, research topics were developed and chosen based on my interaction with the aviation system, and research questions and/or assumptions were based on collected data or previous studies. According to Yin (2003), and Miles & Huberman (1994) there is no contradiction between an explorative research design and the development of research questions and research assumptions. Qualitative analysis could identify causal mechanisms on a local level in a complex network of events and processes within a situation (Miles & Huberman 1994:147). Additionally, the format of journal articles also requires a structured presentation of research questions and/or assumptions, data material and analysis.

In the latter phase of my PhD work, I have used the theoretical framework of risk governance (Renn, 2008, Stirling e.g., 2008, 2004,

De Marchi 2003, Klinke & Renn 2002) to explore the civil aviation system, characterized in forms of the core risk governance model (figure 3.2) and the contextual risk governance model (figure 3.3). This might be interpreted as a shift from a more descriptive research approach to a normative approach using models to describe the aviation system. As such, every kind of model used to analyse data has the aspect of normativity embedded by directing the research in a predefined way, and thus the danger of trying to get the data to fit the model (Le Coze 2008). The risk governance framework has been chosen based on findings from the earlier phases of the PhD work stating the importance of the actor network, and the importance of consistent and integrated risk processes throughout the aviation system when the system is characterized by complexity, changes and goal conflicts. In my opinion, the risk governance model holds concepts and theories that reflect my research position, displaying an interdisciplinary approach to the establishment of risk policies, thereby having the ability to adapt to any particular system of risks. As such, the risk governance framework is in a middle position given the normative descriptive research continuum (Murphy 1994). The risk governance models imply an opening up of the risk processes to a wider pool of knowledge, giving them less normativity than a more centrally governed risk regulation framework. A bottom-up view on the risk decision making processes indicates a transition from a purely normative approach to more descriptive processes to risk policies including various risk perceptions (Bradbury (1989). However, the risk governance framework's focus on deliberate communication in line with an integrative risk communication (Löfstedt & Boholm 2009) is an ideal situation in need for empirical research in order to elaborate processes and structures that fulfill the goal of generating better outcomes of the deliberation (e.g., Mørth 2009).

So far, the risk governance framework has mainly been applied as an analytical tool in case studies of risk challenges such as new technology (e.g. nanotechnology, gene technology) and environmental issues (see Renn & Walker 2008 for case examples) where risks are featured by a high degree of uncertainty, and that impact the community as a whole (Renn & Walker 2008). I found it interesting to see whether the risk

governance framework was also relevant for an industrial system encompassing all types of risks from those that are connoted as simple, to risks featured by uncertainty and in need for knowledge generation and value deliberation (Renn 2008, Aven & Renn forthcoming). Thus, the exploration of the risk governance system of civil aviation in this PhD study has combined a descriptive approach with few predefined analytical categories with a more normative approach using the risk governance framework with its belonging concepts. This has in my opinion given the PhD study a richer analysis within the areas of actor network, organizational capacity, and political and regulatory climate.

4.2.2 Choosing a design

The aims of my study were to explore the risk governance of the Norwegian aviation transport system, and to gain knowledge about the role of complexity, change and goal conflicts (see p.7). Whereas the overall project focused on the system, my goal was to explore its institutional levels and, thus, also to explore these actors' networking with external organisations and collaborators.

To study these themes, I chose an explorative research design in the tradition of interpretative social science. 'Exploration' means building '*rich descriptions of complex circumstances that are unexplored in the literature'* (Marshall & Rossman 2006:33), and exploratory studies give information about phenomena by revealing underlying structures (Marshall & Rossman 2006). In the case of changes to which the system is subjected, there is a need to investigate the relationships within the system and the impact this has on risk governance. There is also a need to discover important categories of meanings within the system. I intend to bring to light the patterns, meanings and categories of the actors at the upper level of the transport system. The interpretative approach focuses on data collection pursuant to life worlds, interactions, and social meanings or intersubjectivity as being beneficial to answer the research questions (Bonhnsack 2004, Flick et al., 2004, Denzin & Lincoln 2000). Using an interpretative approach, I was able to examine the theoretical interest of my data material and

thereby connect the collected data to a scientific relevant theory (Honer 2004).

Within an explorative design with an interpretative perspective (Kringen 2008, Corbin & Strauss 2008, Ragin 1994, Patton 1990), I have explored the system's ability to handle risk governance in complex change processes that circumvents previous structures. A study of 'opening up processes' of risk management through involving those with diverse knowledge and establishing a broader deliberate process within a system (Renn, 2008, 2005, Stirling 2008, 2004, Wynne 1996, 1992) shows a need for a broad range of data and calls for the interpretive explorative research design. Such an explorative design was valuable to collect data on different processes and structures within the system. The data collection methods included actors informing me about their experience of the risk management situation, acquiring information about the structures and statement from documents, and gaining access to information about the social meanings within the Norwegian aviation transport system by observation. Together these data gave me a broad range of information about the risk governance processes.

The exploration by interviews were based on predefined categories, sensitising concepts (Corbin & Strauss 2008, Ragin 1994), negotiated within a reference group consisting of actors in the system. The sensitising concepts were clarified and elaborated through interviews, text analysis and observations. This process was conducted analytically by matching the concepts derived from the data with related theoretical concepts, searching for patterns and then linking the data to those concepts. Research questions and assumptions to guide my four articles were based upon the outcome of this structuring process.

4.2.3 Research Strategy

The objective of this study is to explore a transport system within a risk governance framework. Due to the explorative nature of the research assumptions, I based my research design on a qualitative case study approach (Yin 2009, 2003, Blaikie 2005, Stake 2005, Seale et al., 2004,

Ragin 1994). Case studies are a strategy to gain profound insight into real-life phenomena within their context (Yin 2009, 2003), and, to gain insight into how the process is carried out. There are different approaches to case studies, depending on whether or not the researcher wants to compare cases. I chose an embedded single case design (Yin 2009, 2003, Blaikie 2000), so I studied different units within a single context and explored a single, embedded case. The embedded units were selected from different organisations constituting the institutional part of the aviation transport system with the objective of gaining rich data material from them concerning the risk governance of the system. A case study gave me the advantage of elaborating the richness of risk governance and extending the context. An exploratory study is distinct from a descriptive study according to the completeness in description (Yin 2003). Where the descriptive study presents a thorough representation of the case or cases, the exploratory study pinpoints some important issues and creates a foundation for further research. The Norwegian aviation is a comprehensive system difficult to capture and describe. I found an exploratory study of value to indicate important topics regarding risk and safety in socio-technical systems.

It might be difficult to draw a line between the case and its surroundings, but it still has to be unique among other theoretical constructs and empirical units (Stake 2005). The case was the Norwegian aviation risk governance system, an extensive case, where I had to narrow down the topics of interest in my research design to make the research manageable. As mentioned earlier, the selection of research topics was done in collaboration with the reference group consisting of actors with expertise in safety issues within the Norwegian aviation transport system. Provided with research topics that I developed into a semi-structured interview guide, I searched for in-depth information in the interviews and relied on multiple sources of textual and observational evidence, along with previous studies with the same theoretical propositions (e.g., Høyland et al., 2008, Pettersen 2008, Snook 2000, Vaughan 1996). Altogether, this richness in data material led to a profound comprehension of the research phenomena.

The units chosen were the Ministry of Transport and Communication Norway, the Civil Aviation Authority Norway and the Accident Investigation Board Norway, which I viewed as the critical embedded units (Flyvebjerg 2004, Yin 2003), that provided important information about the risk governance within the aviation transport system. My participation in the project 'Every Little Bit Helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector', 2005-2007', afforded me access to data from other parts of the transport system. The main method of data collection was interviews, and I also applied textual material and observational data through participation in different gatherings.

According to Yin (2009, 2003), the guiding questions in the study should define the case or cases. Given my purpose to explore a global transport system in relation to a risk governance framework focusing on complexity, goal conflicts and change (see research aim above), my guiding questions must elicit information on the research aims (see research questions on p.7-8).

4.3 Data collection and analysis

The data was collected in a qualitative tradition through interviews, textual analysis and observations. Qualitative research might be defined generically as *'a situated activity that locates the observer in the world'* (Denzin & Lincoln 2008:4). I was interested in capturing the world of my informants by an explorative approach, interpreting the data in a search for information about the informants' experience of risk governance issues, what kinds of structures and networks the informants experienced and were a part of, and how they experienced the interrelations within the aviation transport system. The documents gave me information about the formal structures, expressed goals and process work within the governance system. The observations were helpful in giving me insight into communications and social understanding and expressions of risk issues within the system.

Table 4.3 gives an overview of my case study, data sources and selection of actors within the units. The total data material comprises 46 interviews, about 22 accident reports, a selection of public reports, web pages with organisational information, participation in annual conferences arranged by Aviation Authority, AVINOR and Flight Operative Forum (a conference directed to flight operative personnel in management positions), the Solaconference, and dialogues when participating in seminars and working groups to arrange scientific conferences within the field of aviation.

Table 4.3 Units, data sources, themes and selection of data source

Unit	Data sources	Themes	Selection
EU	*Documentary analyses*	*Risk governance* *-regulatory framework* *-responsibility* *-participation*	• EASA, EU, JAA, ICAO etc. homepages. • European Governance. A White Paper (2001) • The White paper on Multilevel Governance: Relevance and Challenges of implementation (2009) • Different reports/papers from expert groups, discussions and hearings.
Ministry of Transport and Communication Norway	*Interviews*	*Safety policy* *Network* *Flexibility in competence* *Inspection activities* *Change processes*	11 employees (of 13), manager, middle manager and seven employees with juridical, economic and political science competence.
	Documentary analysis	*Safety policy* *Safety prioritisation*	• Strategy of Norwegian Aviation • The National Transport Plan, Report to the Parliament 16. (2008/2009) • The European decrees • Report to the Parliament 16 (2008-2009) • Report to the Parliament 17 (2002-2003) • Report to the Parliament 32 (2004-2005) • Report to the Parliament 35/2005 • The Norwegian act of Aviation 1993-06-11-101 • Current regulations within aviation • The Ministry EEA strategy
Civil Aviation Authority Norway	*Interviews*	*Change processes* *Job tasks* *Networking* *Responsibility* *Perception of safety* *Safety policy*	26 (of 160) within the analytical, operational, technical, juridical units and from different positions. 17 in Oslo, with two conducted by two researchers and nine in Bodø
	Documentary analysis		• Annual reports • Yearly allotment letters from the Ministry 2006-2009 • Evaluation report of relocation of Aviation Authority • Web site
Accident Investigation Board Norway	*Interviews*	*Investigation philosophy,* *Investigation practice,* *Accident model,* *Development over time,* *Awareness of complexity and change*	7 employees (of 13), the manager, two from the staff and four investigators interviewed in pairs.
	Documentary analysis		• 13 accident reports of fatal accidents in a time span from 1989-2001. • A random selection of 17 accident reports within the time span 1989-2006.

Next I will give a summary of the data collection and analysis phase, followed by an analysis of the studies' trustworthiness related to the data collection and analysis phases (Chapter 4.4).

Interviews

I conducted 11 interviews in May 2006 with the employees in the Ministry and 26 interviews in the Aviation Authority in August 2006 in Oslo and November 2006 in Bodø. In May 2007, I conducted the last seven interviews with the employees of the Accident Investigation Board Norway (Investigation Board). In conjunction with the interviews, I carried out four member check interviews (Lincoln & Guba 1985) to validate my information in May 2009. Each interview lasted about 60-90 minutes. The time span was chosen to allow for the possibility of deepening the research topics; more than an hour is particularly difficult to ask of the interviewees. The interviews were conducted in one-to-one situations, but two interviews in the Aviation Authority were performed by two researchers, seven of these interviews were conducted by a colleague, and two of the interviews in the Investigation Board were organised in pairs.

According to Kvale & Brinkmann (2009), '*the qualitative research interview attempts to understand the world from the subject's points of view, to unfold the meaning of their experience, to uncover their lived world prior to scientific explanations'* (2009:1). My interviews were qualitative, semi-structured interviews (Kvale & Brinkmann 2009, Hesse-Biber & Leavy 2006, Fontana & Frey 2005, Merton et al., 1990), presenting the informants with a predefined set of questions categorised according to the purpose of my exploration. The semi-structured interview guide allowed the interviewees to respond by telling their story (Kvale & Brinkmann 2009, Hesse-Biber & Leavy 2006). Guided by my intention to explore risk governance in a global transport system and gain knowledge about the role of complexity, change and goal conflicts within risk governance, I was interested in the informants' opinions, world views and experiences of safety in a transition phase and tried to shape the questions in a way that would capture their perspective. The thematic questions were in categories that should

capture the perceptions of safety related to the ongoing changes (see Table 3 and Enclosure 1). As preparation for the interviews, I e-mailed the informants a one-page information sheet on my project. The interviews were taped and transcribed verbatim (Kvale & Brinkmann 2009).

Each interview setting is an interactive one, where the meaning is created in the relationship between the interviewer and the interviewee, so it is important to ask if the result of the interview exists independently of that relationship (Denzin & Lincoln 2005). Due to bias in the data material, this challenge was handled by collaboration with research colleagues, in addition to extensive exploration of the data material.

The way that interviewers practice is important for the dependability of the research (Kvale & Brinkmann 2009, Morse et al., 2002). In order to gain knowledge of things we cannot directly observe, by '*making it possible to the person being interviewed to bring the interviewer into his or her world*' (Patton 1990:279), I had to be aware of the asymmetry in power between the interviewer and the interviewee (Kvale & Brinkmann 2009). I sought to make up for this by establishing a situation that felt reliable and relaxing to the interviewee (Fontana & Frey 2005). By reassuring the interviewee about the value of his or her knowledge, I conducted in-depth interviews (Lincoln & Guba 1985) by creating a relaxing atmosphere in which the interviewer and the interviewed are peers.

Documents

Written documents were valuable data sources for exploring the structural and some of the process activities within the Norwegian aviation transport system by providing information about the activities, intensions and ideas within my units. Written documents (Patton 1990) such as reports, hearings, white papers, decrees and laws were scrutinised in the search for information about processes and statements. I used the documents to 1) increase my knowledge about the field, to 2) provide a basis for defining my interview guide, and 3)

recognise the kinds of statements that were made. Patton pointed to the value of recognising the discrepancies between what is stated in a program and what 'does not happen' (1990:235). In this study, the documents were also been doing the opposite, to recognise the kind of safety statements made within the written documents.

The study has applied information from publicly available documents in order to explore the system and construct a base of information about structures, objectives, processes and written prioritisations within the aviation organisations, the affiliated employee organisations, and the government's statements and objectives. The main text sources have been public documents (see Table 4.3), organisational web sites and reports from accident analyses. The main part of the text has been available through Internet sources (Bernard 2006).

My documentary analysis was based on reading and rereading the textual materials to search for the features of the cultural world into which the documents are windows (Peräkylä 2005). During the analysis, I scrutinised the documents for the categories identified by the interviews: safety policy, safety goals, safety prioritisation, safety practices, network and structures.

A central part of the documentary analysis was the accident reports. Five accident reports were chosen for in-depth analysis to identify the prevailing investigation philosophy, accident model(s), causes, conclusions, and recommendations. Severity and time span were the main criteria for the selection of the accident reports. Accidents with a high level of severity were chosen with the expectation that the reports were based on extensive in-depth analyses that included all important issues that might have an impact on the course of events. By analysing these reports from the more serious accidents I could explore whether or not the accident investigations reflected the current complexity and change picture within the Norwegian aviation transport system. Furthermore, I chose 17 accident and incident reports from less serious events to sharpen my insight into how the Investigation Board reports events. Accidents over a 10-year time span were chosen with the expectation to observe a certain development in investigation

philosophy and accident model(s). Table 1 in Article 4 shows the accidents included in the main selection of investigation reports.

I also read and reread the reports and white papers within the EU in order to understand the safety work and structures of the work within that system. I also reviewed the documents of the Norwegian Parliament to capture the safety goals, safety prioritisations, responsibility and processes within the aviation safety. Together with the web sites that stated each organisation's work, all these textual materials constitute a part of the data within this thesis. The main documents relevant to this thesis are mentioned in Figure 3 and are shown in the reference list as web addresses.

Observations

Observation was a helpful tool for exploring the communications and expressions about safety issues within the Norwegian aviation transport system. The data collected by observations became a bridge between the actors' information about their safety experiences given in the interviews and the information about structures, goal and processes, collected by my documentary analysis. For me, observation was an instrument for completing the information collected by interviews and documents. As Patton (2002) expressed it, '*To understand fully the complexities of many situations, direct participation in and observation of the phenomenon of interest may be the best research method'* (21).

My ability to take part in meetings, gatherings and social settings allowed me to access a rich source of information. I was participating within the field as a member of the system when I was contributing with lectures and speeches as a researcher, or as non-member in the role as a student. Both of those roles gave me in-depth information about the aviation transport system. The experience of participating was of value to 'become an insider' (Blaikie 2000) and I was therefore better able to seize the social actors' expressed safety perception. When listening to and taking part in conversations, I was able to catch the actors in the system's interpretations of the safety concept. These observations helped me stay closer to the integrity of the phenomenon

and to utilise the same concepts as the social actors being studied (Blakie 2000:241). I chose the concepts of change, transition, safety and trade-offs between safety and production partly in the meetings prior to the project, as a means of translating the scientific issues into the framework of the informant.

Web pages

Related to exploring the EU system, an extensive part of the data was collected over the Internet. I searched web sites to collect information about the organisations' members, missions, goals and activities. The industry organisations, the institutional organisations, and the EU system were all explored by searches of their web sites.

Secondary data

In addition to my own data material, I accessed data collected by colleagues from other parts of the Norwegian aviation transport system. The main parts of this data were from interviews in AVINOR (Hauland et al., 2007), the Braathens Technical Service (Pettersen 2008), and questionnaire data from the entire Norwegian aviation transport system (Bjørnskau 2005). These secondary data were used in Article 4, 'The art of balance: Using upward resilience traits to deal with conflicting goals'.

Analysis

The analytical part of an exploratory case study is more like a constant, on-going process than a fixed step in a research design. The process has moved from the themes elaborated to guide my studies to theoretical considerations about these themes and then back again to the data collected in order to identify processes, variations, and patterns. The last analytical consideration was done by analysing the data according to the risk governance framework.

My analysis started out in search of identifying patterns within complex circumstances. I was seeking answers to 'how' and 'why' questions (Yin 2009, 2003), in order to understand how the actors in the aviation

transport system were acting upon risk issues, and why they were acting in the manner they did. These questions were explored in the data collection, categorised and connected to the theoretical framework. Over time, the nature of the exploration process changed and became more confirming, aiming at testing ideas, concepts and patterns (Miles & Huberman 1994, Patton 1990). Patton described such a process as '*moving back and forth between inductive, open- ended, and phenomenological encounters with programs to more hypothetical-deductive attempts to verify hypothesis or solidify ideas that emerged from those more open-ended experience…'* (1990:194).

The interviews, built up of themes founded on interactions with the reference group were audio-recorded (Rapely 2004), transcribed and categorised (Miles & Huberman 1994). The purpose of the interviews was to identify categories that illustrated the informants' experiences according to conditions within the governance model in a transition phase and to search for relationships between the categories in order to analyse them according to risk theories. I began with a mix of sociotechnical system theoretical views and the aims of the project ''Every little bit helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector, 2005-2007' and made the sensitising questions (Corbin & Strauss 2008, Ragin 1994) focus on structures, processes and actors within the system. This was done by a back-and-forth reflection of my own and by tying together the reference group's comprehension of valuable themes that will illustrate the change picture within the aviation transport system. The reference group came up with following themes: *change in the knowledge base, new interfaces and unclear distribution of responsibility*. These themes were further elaborated by results of the phase of asking sensitising questions (Corbin & Strauss 2008) to understand and elaborate the important topics in an interview guide that should reflect the role of complexity, change and goal conflicts. As a result of this reflection phase I added the following themes to the interview guide: *change processes, safety goals, safety practice, networking and structures of relationships*. With these themes, I began to ask theoretical questions (Corbin & Strauss 2008), questions that guided me to search for processes, variations and patterns within and between the established

themes in order to code the material. Coding (Schmidt 2004:255) *'means relating particular passages in the text of an interview to one category, in the version that best fit the textual passages'*. I was coding the data material by marking the text with colours in search of patterns and differences within the interviews' themes. The empirical categories were converted by this exploration into theoretical categories in a practical manner (Corbin & Strauss 2008) according to problems for discussion in articles, e.g., complexity, accident investigations and goal conflicts.

The textual analysis was conducted with the purpose of identifying an overall picture of the mandates of the different groups of actors within the aviation system. I was searching for information about participants, the organisation's main goal, and their role in the broader decision-making structure. In addition, documents and observational data were used to obtain a general knowledge of the aviation industry. Together, these data sources provide adequate information for addressing issues of expressed facts as opposed to the actors' own perceptions of risk governance, decision structure and the possibility of influencing decision-making processes. The current data material represents a valid description of risk governance system in Norway. Nevertheless, the data material represents perceptions and descriptions at a certain point in time and, given the change-intensiveness of the Norwegian aviation system, exploration of the system at another point in time might give different descriptions.

In the compilation phase of my thesis work, I explored for other patterns and processes by analysing my results in an overall theoretical framework. By theories on risk governance analysed my findings in search for an overarching structure for my data material. This analysis was done with the aim of putting my data into a new theoretical framework that was scant in the empirical data.

4.4 Research quality?

How does one document the truth in an interpretative and explorative case design? Winter says, *'Reality in a quality research is concerned with the negotiation of truths through a series of subjective accounts*' (2000:6). Pluralisation of life worlds (Flick 2004), requiring a multifaceted way of studying the empirical field, means that the researcher must take part in the life and experiences of the whole person or the person within a setting (Winter 2000). I have strived to take into consideration this required multifaceted way of study by my use of various forms of data material, while collaborating with colleagues in triangulating the data during the case study. The triangulation strategy has been a means to clarify meanings and patterns within the whole research process (Stake 2005). A fruitful aim has been to avoid misinterpretations and prejudicing the various data points and perceptions from research colleagues. In addition, the closeness to the empirical field during all the stages of the research process has been valuable in confirming and rejecting my observations and interpretations. To capture the truth is, during the whole process, to ensure that the work done is in line with the tradition within the type of research design, in search of *trustworthiness* (Lincoln & Guba 1985). Morse et al., (2002), called attention to the importance of making a distance between the constructive (during the process) and evaluative (research outcome) phases. The distinction between the process and the outcome are of particular interest in qualitative research, where the interactions between the field and the researcher make the research iterative, thereby making it easy to get lost in reformulations.

4.4.1 Trustworthiness

Lincoln & Guba (1985) asked, *'How can an inquirer persuade his or her audiences that the findings of an inquiry are worth paying attention to, worth taking account of?'* (1985:301) they also developed some criteria to achieve that purpose: credibility, transferability, dependability and conformability.

Credibility refers to the truth value within the study; this is a question of confidence in the truth content of the data to reassure that the study is credible (Lincoln & Guba 1985). Lincoln & Guba recommend several techniques to deal with credibility. As mentioned in my description of the data collection, I have utilised their recommendations about prolonged engagement in the field, triangulation, peer debriefing and member checks. The reference group and my affiliation with the field were beneficial to me with respect to prolonged engagement in the field. The attachment to the field means that I have continued to take part in conferences and meetings, to take phone calls to the actors, and continue the dialogue with the field even after the interviews were finished. The fact that the Internet sources are updated frequently was also valuable in keeping track of the field. Triangulation was taken into consideration in the design phase by a group of researchers discussing my project in the data collection phase, by coming to some interviews, and by using others' data. Peer debriefing was a part of the process where the project participation gave me access discussions of concepts, data, analyses and findings. The member check technique was used during my project as comments to my presentation of research design and research results on various seminars. Additionally, I requested and received feedback from the Accident Investigation Board due to the investigation article.

The criterion of *transferability* is satisfied if the findings are valuable in other contexts. According to Lincoln & Guba (1985), transferability claims thick contextual descriptions. Only a profound understanding of the case will make it possible for other researchers or practitioners to find value in it and judge if the findings are also applicable in their contexts. I have thus endeavoured to describe the context and the data collection in great depth to make this study accessible to others. Achieving transferability also depends upon purposeful sampling (Patton 1990), so I aimed for variation and richness in the sample among the informants, documents, reports and observations in order to elaborate a detailed and rich base of data.

Aspiring to capture the depth and the breadth of meanings within the chosen case unit, I selected interview informants with a preference for

ensuring diversity regarding their sections, professions and positions. This was especially of value within the Aviation Authority, which consists of 146 people. Within the other units, I covered seven out of nine of the Investigation Board, and nine out of 13 of the Aviation Authority. In addition to selecting by profession and position, I used the 'snowball' method (Patton 1990), picking some informants based on advice from key informants. I asked people from the reference group to inform me of 'who knows a lot about this topic'; some my informants also told me several times, unsolicited, 'you should talk to ….. she knows a lot about this topic'.

The accessibility of public documents and reports through web sites made it possible for me to explore written documents from several angles, at any time. I was also able to access different arenas within the Norwegian aviation transport system throughout my PhD thesis work.

The *dependability* criterion rests upon credibility. If the chosen inquiry design and strategy are proven to be appropriate, then the dependability criteria will be handled by further checking that this credible strategy has been followed during the entire study. Dependability is assured if the findings show stability over time. The techniques available for this are to analyse the data independently, using the same interview guide; to provide the same conditions with each group; and to prepare the transcripts immediately. In my study, the data was analysed by several researchers, because some of them also worked on the project 'Every little bit helps' and my supervisor co-wrote some of the articles. The same interview guide was used within the units of the case, but differed a bit between the units because the progression in the research allowed us to concretise and give more direction to the research.

Confirmability is the neutrality of the researcher and the importance of making explicit the bias that may occur within the study (Miles & Huberman 1994). This criterion was met by awareness about possible subjectivity, which can be avoided by an 'audit trail' (Akkerman, et al., 2008, Lincoln & Guba 1985), that is, by having a thorough examination of the study by an outsider to avoid subjective bias. Such an audit trail should be visible so that there are logical links from the data to the

findings by use of appropriate analytical methods, the proper use of categories and ensuring that there are quality interpretations (Lincoln & Guba 1985). I sought to meet the audit trail criteria in this thesis by providing a thorough description of my data collection, its processing and transformation into findings. The fact that two of the interviews were done with a colleague was also helpful for checking that my perceptions were in accordance with others'. The duality in interviewing by leaving seven of the interviews to a colleague was also a way to ascertain whether or not the informants' responses to other interviewers conformed to the responses I received. As a participant on a research group, I was able to check my assumptions in collaboration with both the research group and the reference group.

4.4.2 Methodological considerations

To explore risk governance within the Norwegian aviation transport system as a case, gave rise to methodological considerations such as operationalisation of concepts, selection of units, and choice of data collection methods.

The risk governance framework was adopted in the compilation phase of this PhD study, which means that the data collection had already been done. This use of theoretical concepts from risk governance framework in my data might then be considered a weakness since the data sometimes will lack the depth and breadth to explore the theoretical concepts fully. Nevertheless, I found the available data sufficient to explore the risk governance of the Norwegian aviation transport system.

The operationalisation of the concepts were done by an iteration process. The actors' reflection, together with the theoretical framework, constitute the foundations of the choice of operational concepts. By such a coupling of actors' experience and theoretical debate, the concepts to be used in my study become apparent. In order to narrow down the scope of the study I made the choice of complexity, change and goal conflicts, as main topics.

Collaboration with other researchers in the research project of which this PhD study was a part became a means to overcome the challenge by selection of units, considering the institutional level as my main analytical level. The units of my case were then chosen to be the institutional actors of the Norwegian aviation transport system, and, interviews were used as the main source of data, to provide information on the actors' own experience with risk governance. Additional data was collected from documents, web pages, and observations. Data from other parts of the system than the institutional, also gave supplementary data, given my objective of exploring the aviation transport system.

A main methodological disadvantage in my PhD study is the collection of data from the EU level part of the governance system, using merely written documentation in the forms of web pages, reports, rules and regulation, and a few interviews with some of the Norwegian actors participating in the global governance process. Further interviews and observation within the EU risk governance arenas would clearly have expanded my empirical knowledge of the aviation case. Instead, my study relies upon a selection of documents available and the interviews with some of the Norwegian actors which have participated in the EU governance processes.

Another challenge of exploring a complex system such as aviation was to decide when data saturation had been accomplished. In this process, the member check interviews were valuable.

One of the main advantages of my case study was access to an abundance of data through extensive participation in aviation seminars and activities, member check interviews, and from the availability of information through documents, reports and home pages.

5 Summary of results

This PhD thesis explores the risk governance processes related to the globalisation of civil aviation and inquires into the role of complexity, change and goal conflicts in such processes.

5.1 Main results

I explored the institutional level of a global transport system through four articles. By using interviews, documents, and observations I tried to explore the complexity, changes, and goal conflicts of the system related to risk governance. Table 5.1 shows the research questions and the findings in each of the articles.

Within each of the articles, the research questions appear as more detailed than in the table, e.g., Research Question 2 is developed into two research assumptions in Article 2: 1) In order for the Ministry of Transportation and Communication to fulfill its responsibility for the totality of the aviation transport system, this requires resources, network, and an overall safety policy making explicit how to prioritise between conflicting goals, and 2) In order for the Civil Aviation Authority to handle simultaneous changes such as transition from national to European legislation, geographic relocation, and the effects of deregulation, this requires flexibility in competence, networks, increased inspection activity, and an overall safety policy.

The articles	Research question	Findings	Units
1. Risk governance within aviation	1. How is risk governance conducted within the global aviation system?	-Actors from all over the system are represented and organised in a structural framework in the governance process. -Transition to EU risk governance has influenced the elaboration of the regulatory framework both in form and process	Main units: Ministry, Aviation Authority. Additionally, exploration of the EU system
2. Safety and changes in the Norwegian aviation transport system - What is the role of the legislator and the regulator?	2. How do the national legislator and the regulator conduct their roles in change intensive settings?	- The resources and network activities within the legislator and regulator seem scant to capturing and making explicit an overall safety policy. - Both the legislator and the regulator show awareness of ongoing changes by a willingness to expand safety knowledge. They show a strong individual safety consciousness, are flexible and open minded and eager to expand their networking activities.	Ministry, Aviation Authority
3. 'The role of complexity in accident investigation practices.'	3. Is the framework for conducting accident investigations in accordance with the current complexity and change picture within the aviation system?	- The accident investigation framework is in transition to focus organisational and system factors, but it still lacks a common framework to investigate by a systemic approach.	Investigation Board
4. 'The art of balance: Using upward resilience traits to deal with conflicting goals.'	4. How are trade-offs between safety and efficiency handled within the Norwegian aviation transport system?	-A lack of prioritisation exists between safety and production from the government, which creates a situation where the goal conflicts are transferred to operators. The operators are highly committed to safety and give it prioritisation if required.	Ministry, Aviation Authority, AVINOR, Braathens Technical Service, the entire Norwegian aviation transport system.

Table 5.1 Articles with belonging research questions, findings and case units

5.2 Article I

'Risk governance within aviation'

The study explored the structure, actors and relationships within risk governance of the Norwegian civil aviation and its relation to the global aviation transport system via the European Union (EU) and the International Civil Aviation Organisation (ICAO). The article is based on data from interviews with actors at the institutional level of the Norwegian aviation system and from textual data from documents and web sites concerning the supranational aviation organisations.

The study showed that Norwegian aviation actors participate in an extensive number of relationships within the global aviation system, such as intergovernmental organisations (ECAC, Eurocontrol, ICAO and, JAA[7]), legislative actors (national, laws and EASA), and industry associations of airline companies, air traffic controllers, pilots and technicians (e.g., IATA, NEAP, IFALPA, IAOPA, IFATCTA, EBAA[8]).

The study also showed that the actors' experiences of the structures, in the form of decision processes and rules formulation, and the knowledge processes, in the form of information flow and integration

[7] ECAC: European Civil Aviation Conference, Eurocontrol: The European Organisation for the Safety of Air Navigation, ICAO: International Civil Aviation Organisation, JAA: Joint aviation Authority, EASA: European Aviation Safety Agency

[8] IATA: International Air Transport Association, NEAP: North European ANS Providers, IFALPA: International Federation of Air Line Pilots Association, IAOPA: International Council of Aircraft Owner and Pilot Associations, IFATCA: International Federation of Air Traffic Controllers Associations, EBAA: European Business Operation Associations.

of contextual knowledge, are in accordance with the requirements of the risk governance processes. There are collaborations within the regulatory framework based on the principles of confidence in the system, experience of competence, and a feeling of contributing during the different stages of risk governance. The contextual expert knowledge seems to be highly integrated in the governance framework, the industry actors seem to use their contacts by lobbying, and the industry and governmental actors are present together in working meetings. In addition, although the process is viewed as legitimate and follows the definition of a bottom-up framework, there seems to be a distinction between industry actors and governmental actors in terms of their experience of the knowledge processes and structures. The legislators and the actors from the management level of the regulator are more satisfied than the industry actors are with the transition to EU governance. Governmental actors experience decision-making processes as accessible as a result of the transition to an EU framework, while industry associations worry about an extended distance to the governance process.

This study also highlights the change in Norway's institutional role due to the expected extension of the EU's role as the aviation safety legislator. Regulation (EC) No 216/2008 establishes common legislative regulatory framework within the European Union. This transition from a common understanding based on the ICAO and JAA agreements to an integrated regulatory approach might have an impact on Norwegian participation in the risk governance process within aviation. Norway is part of the EASA safety agency, but as a non-member of the EU, Norway is neither part of the EU Commission nor of the EU Parliament. The EASA is an executive agency, while the Commission and Parliament make the final decisions about safety regulation. As a non-member of the EU but as a member of the European Economic Agreement (EEA), an eventual decision by the Norwegian Parliament to ratify the legislation (EC) No 216/2008 may negatively affect the Norwegian participation in the European Governance model since Norway is not represented on the EU Commission or in the Parliament. This non-participation in the EU seems to deprive Norway of access to the decision-making process

within the EU Parliament and the Commission. A diminished participation could lead to a regulatory framework that fails to consider important Norwegian safety concerns.

The transition towards an EU risk governance framework of the Norwegian aviation transport system might then create goal conflicts within the operational parts of the system. Due to the complexity that characterises the system, the outcomes of prescribed regulations become hard to determine. Unforeseen consequences of interactions might emerge and a transition to a detailed regulatory framework is a counteraction in a situation that calls for attention to emerging risks.

As such, the globalisation of risk governance within aviation poses both possibilities and challenges for the Norwegian aviation system: possibilities in the form of formal structures for participation and preparation of rules, and challenges in the form of integration and implementation of contextual knowledge within the EU regulatory framework.

5.3 Article II

‘Safety and changes in the Norwegian aviation transport system – What is the role of the legislator and the regulator?’

The article focuses on the impact of the political and regulatory levels on core risk governance processes in change-intensive settings. The data material consists of 38 interviews, document analyses and observations conducted in the Norwegian Ministry of Transport and Communication (Ministry) and in the Civil Aviation Authority Norway (Aviation Authority).

The study documented that, within the two units explored, no explicit operational safety policy exists beyond a twofold objective for aviation to be safe and community-serving. The absence of directing safety goals created frustration among the employees in the Ministry and the

Aviation Authority. We found that to compensate for this, a strong, individual safety consciousness among all informants acted as a buffer against possible negative effects and that there was a broad informal network within the national aviation system with multiple contact points (Høyland et al., 2008, Pettersen 2008, 2006, SL/REP 35/2005, Tjørhom 2001). Employees are open-minded, eager to learn and to improve their competence in safety issues. With regards to handling the change intensity in the aviation system, we did not identify any increases in resources or frequency in inspection activities or any moves towards a risk-based inspection safety policy.

The network of international organisations and the EASA seems to be well developed and focused on by the Ministry and parts of the Aviation Authority. Nevertheless, there seems to be a discrepancy between the Ministry and the Aviation Authority regarding their experience with communication and relationships in an appropriate network, as well as between the two organisations. Whereas the Ministry reported frequent contact with the Aviation Authority, employees in the Aviation Authority experienced a lack of formal networking.

In the article, we claim that for legislators to follow up their responsibility for the totality of the aviation transport system requires resources, network, and an overarching safety policy that is explicit about how to prioritise conflicting goals. The results documented that the resources and network activities within the legislator seem scant for capturing and making explicit an overall safety policy. An operational safety policy will make it possible for the rest of the transport system to prepare concrete safety objectives and to develop limits for how to prioritise conflicting goals.

Our second assertion is that for the regulator to handle simultaneous changes, such as the transition from national to European legislation, geographic relocations, and the effects of deregulation, flexibility is required in competence, networks, increased inspection activity, and a safety policy that is explicit about how to prioritise conflicting goals. The results document a work force that is responsible, flexible and

eager to adopt new work practices to match the current changes. The process of restructuring and the relocation of their head office have set back the development of new inspection methods.

This article then shows that the actors within the aviation system are aware of the lag in regulatory framework given the intensiveness of change. The actors demand elaboration of knowledge about the new risk situation. This finding displays a perception of the complexity and uncertainty related to risk management by the employees at the institutional level of the system.

The implications of the study are that there are strong demands to establish a structure for information handling, along with the need for a distinct safety goal structure within the national aviation transport system.

5.4 Article III

'The role of complexity in accident investigation practice'

How risk is governed depends upon how risk is understood, and how risk is understood is often based on how accidents are understood. In this article, we studied how knowledge and experience about risk are developed, using accident investigations as the main knowledge base. The objective of this study was to explore whether or not the investigation philosophy and/or practices in the Norwegian aviation transport system reflect the increasing complexity and change intensity of the system, encompassing both core risk governance elements and contextual elements.

The study is based on seven semi-structured interviews of informants in the Accident Investigation Board Norway (Investigation Board) and analysis of accident reports, including five reports from serious accidents in 1989-2001 and a random selection of 17 accident reports as supplementary data material.

Our study has documented that a normative framework exists in the Investigation Board for conducting investigations, one that is rooted in international and national regulations and laws. The normative framework has not resulted in the development of a set of operative, common working practices for sound investigation, except for an assessment of alternative methodological approaches in the start-up meeting. On the contrary, informants advocate that an 'open mind' perspective with no fixed accident models or investigation procedures is best suited to avoid biases and preferences. Every investigation is perceived as unique, and each accident's characteristics determine the way an investigation should be conducted.

The Investigation Board's investigation philosophy developed as a result of a general development in accident theories, resulting in, for instance, the 1994 ICAO resolution stating that investigation practices should, to a greater extent, emphasise underlying factors such as organisational and management issues. Other reasons for the development of the investigation philosophy and/or investigation practices are the Investigation Board's processes of networking and collaborations with other countries and its own improvement measures. Even though the informants display some awareness of the changes and complexity in the current aviation transport system, they do not relate development in investigation practices to these characteristics. Rather, they connect the development over time to individual preferences and previous external (international transportation accidents) and internal (Namsos 1996) investigation reports.

This article also documents that the employees within the aviation system are aware of the new situation, and that they experience of need for new tools to investigate accidents. The changes and complexity imply a demand for elaborating the methods of investigation in order to reveal new accidents and incidents explanations.

5.5 Article IV

'The art of balance: Using upward resilience traits to deal with conflicting goals'

The management of prioritising conflicting goals is prevalent in risk governance. It is impossible to cover all potential conflicts in the rules and regulations, thus the different actors within the aviation transport system must adapt and develop their own priorities. This study described some of the processes involved in balancing conflicting goals in a change-intensive environment. As the analytical framework, we used the concepts of 'downward' and 'upward' resilience. Downward resilience refers to the macro level directions and solutions that prepare organisations for resilience through a clear goal structure, infrastructure, and procedures for safely handling the goal conflicts. Upward resilience means that decisions made at the micro level reflect commitment to safety in the face of goal conflicts. In a situation where a system is subjected to changes, complexity and ambiguity might alter the resilience traits caused by the loss of oversight at both the macro and micro levels of the system.

In this article, the Norwegian aviation transport system is viewed as one system in its capacity to handle risk prioritisation. The institutional and management levels are viewed as the top level of the system, and different operators at different levels are viewed as actors in the sharp end of the system. Altogether, the different levels should form a base for organisational capacity in dealing with conflicting goals.

The study was based on data from several research studies in Norwegian aviation (Aase et al., 2009, Tjørhom & Aase, 2009, 2007, Høyland & Aase, 2009, Høyland et al., 2008, Pettersen & Aase, 2008, Pettersen, 2008, Hauland et al., 2007, Pettersen, 2006, Bjørnskau, 2005) that covered empirical data from different levels of the transport system. The study gave an account of three units: the legislation/regulation case (38 interviews); the air traffic controller (ATC) airport operation case (126 interviews at five airports and qualitative free text data from a questionnaire survey with 231

respondents); and the maintenance case (participant observation, 15 interviews, informal discussions and free text data from a questionnaire study with 283 respondents).

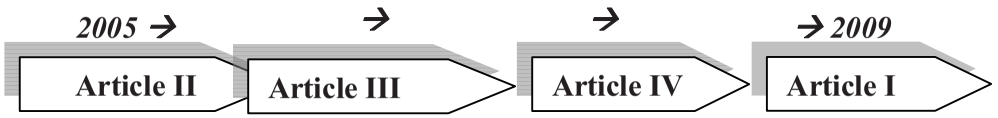
The results showed a deficit in the structural framework of the Norwegian aviation transport system due to the lack of guiding safety goals. The Ministry is responsible for the framework condition for aviation safety, and its goal is twofold: to contribute to increased safety and to serve the community. The political situation and prioritisation might colour the importance of each of these goals. The unwillingness to develop distinct goal rules for safety creates insufficient organisational capacity within the Norwegian aviation transport system. The result shows that, in situations with goal conflicts, the regional policy (community-serving) often takes precedence over safety issues. The unwillingness to state clear safety policies and to elaborate safety goals creates a deficit in the downward resilience, which again creates pressure on the operational levels of the system.

The study further showed that the assets and skills at the operational level are prevalent in the different upward resilience traits. The actors at the micro-level reported goal-conflicts due to the lack of clear and elaborated safety goals; they also experienced economic issues taking precedence over safety. The operators referred to a lack of commitment to safety from managers, pressure to work overtime, and a lack of time to resolve safety issues. Nevertheless, the decisions made at the operational level show knowledge, competence and flexibility to handle trade-off situations where safety is at stake. Sacrificing decisions (Woods 2006), meaning that one prioritises safety and sacrifices efficiency, are seen as an important issue in bottom-up risk governance.

This study documents the necessity of consistent risk governance within the micro, meso and macro levels of the aviation system. Risk governance of a system requires coherence through the different layers in the model (Figure 3.3). All elements from political and regulatory context, through organisational capacity and into the core risk governance processes has to exercise a coherent focus to the prevalent risk situation of the aviation transport system.

5.6 The relationship between articles and thesis summary

When explaining the relationship between the risk governance framework presented in the thesis summary (part I) and the articles (part II), it is useful to present the timeline of the different articles (figure 5.6) in relation to the theoretical influence and concepts used.



Theoretical influence	Socio technical system approach	Accident and investigation theories	Resilience engineering	Risk Governance
Theorists	Rasmussen, Leveson, Alamberti, Reason, Gherardi & Nicolini,	Snook, Vaughan, Leveson, Hollnagel, Le Coze, Rasmussen	Hollnagel, Woods, Gaba, Grote, Vaughan, Snook, Rasmussen	Renn, Hood Rothstein, Hale, Hopkins, Power, Baldwin, Cave, Hutter, Grote, Wynne, Wilpert,
Main concepts	Safety, changes, interactions, prioritisations	Accident investigation, complexity, changes	Safety, goal conflict, resilience	Risk, governance, regulation,actors, complexity
Contributions to risk governance	- Core risk governance - Organisational capacity - Actor network - Political and regulatory climate	- Organisational capacity	- Core risk governance - Actor network - Organisational capacity - Political and regulatory climate	- Core risk governance - Actor network - Organisational capacity, - Political and regulatory climate

Fig. 5.6 The relationship between articles and thesis summary

Figure 5.6. Article timeline, theoretical influence and contributions to risk governance

As figure 5.6 depicts, the first phases of the PhD work (articles II, III and IV) were influenced by theoretical frameworks such as the socio-technical system approach, accident and investigation theories, and resilience engineering. The main concepts used were safety, changes, interactions, complexity, and goal conflicts. The latter phases of the PhD work (article I and thesis summary) were influenced by a risk governance framework using the concepts of risk, governance, regulation, actor network, organizational capacity and complexity.

The main concepts used in articles II, III and IV were explored by developing themes for data collection based on the theoretical influences as shown in figure 5.6 in addition to an iterative process with the larger research group in ''Every Little Bit helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector' (2005-2007)', and the reference group consisting of actors from all levels of the Norwegian aviation transport system. The main themes in data collection for all four articles were safety policies, interpretations of safety management criteria, the practicing of safety management and risk management, the actors' commitment to safety, competence and capability available, perceptions of specific changes in the aviation system, and types of interactions and/or network activities amongst the actors.

As noted in figure 5.6, there is a shift from using safety as the main concept in the first phases of the PhD work to using risk as the main concept in article I and the thesis summary. The data collection and analysis were done by using the safety concept as defined by Gherardi & Nicolini: "*the final outcome of a common collective construction process which involve people, technologies, textual and symbolic forms assembled within a system of social relations"* (2002:192). The choice of safety as a main concept rather than risk in my PhD project was a choice taken within the research group ''Every Little Bit Helps? Risk Challenges and Parallel Change Processes within the Norwegian Transportation Sector' (2005-2007)'. Using risk governance as a

theoretical framework in the latter phases of my PhD work made it natural to use risk as a main concept. I found this shift unproblematic since my comprehension of safety was based on safety as a process, involving the various actors and technology in an interrelated system (Gherardi & Nicolini 2002). Within the risk governance framework, risk is conceived as outcome, uncertainty and a formula to combine these elements in order to mitigate the risks (Renn 2008). In hindsight, it might have been favourable to deliberately use both the safety concept and the risk concept in the main data collection activities. The actors within the aviation system might differ in their perceptions of the two concepts and may have offered me different answers when reflecting on risk rather than safety. The risk concept might have induced perceptions concerning uncertainties and the management of new and unknown risks, while the safety concept might induce the informants' thoughts on procedures and compliance with safety systems. Nevertheless, I asked the informants to reflect upon safety not only as a fixed product but also as a process depending on relationships, competence, resources, and structures.

As figure 5.6 shows, article II is based upon a socio technical system approach, searching for safety prioritization, safety practices and the relationships between the actors in the aviation system. These issues fit well with the core risk governance process according to risk assessment, policy making and management of risks within a system. The actor network at the institutional level was also explored within this article, together with the political and regulatory climate by focusing on prioritizations and resources within the regulation process of a change intensive transport system. The two research assumptions stated in the article were based on the contextual knowledge of the aviation system and the socio technical system framework, and were presented in order to give the results and analyse a structure. As figure 5.6 shows, article III is based on accident and investigation theories and focuses on whether the frameworks and methods for accident investigation capture the complexity that characterises the aviation transport system. The concepts used and the results within the article fit well with the risk governance concept of organizational capacity. Especially skills, resources and flexibility needed to capture trends and

emergent features appearing within complex systems are highlighted in the article. Two open-ended "how" questions were used in the article in order to structure the data presentation and analysis.

As figure 5.6 shows, article IV is based upon resilience engineering theories as a framework to analyze the processes of balancing safety and efficiency within the Norwegian aviation transport system. The main concepts used in the analysis were safety, goal conflict and resilience, and together with the results, this fits with the risk governance framework concerning risk assessment, risk management, actor network, organizational capacity, and social and political climate.

In article I and the thesis summary, the risk governance framework was used to picture the regulatory actor framework of the entire Norwegian aviation transport system. Based on my data material and my analysis, I wanted a framework that could describe the management of aviation safety in a more general manner than focusing on parts of the system or parts of the existing safety theories. The risk governance framework's focus on actors both horizontal (amongst the various level) and vertical (within each level) (Renn 2008) was decisive for my choice of framework in the latter phases of the PhD work and was easily adaptable to my former work and aims of exploring the processes and structures of safety within Norwegian civil aviation. Another framework that could have been used is the risk perception theories (Boholm 1998, Daniels & Walker 1996, Fishoff 1995, Slovic 1992,) focusing on strategies for mutual learning and relationships amongst the aviation actors. Even though risk governance can depict the Norwegian aviation risk and safety system in a conceptual manner, the framework is still complicated to use to model and analyse empirical data (Lofstedt & van Asselt 2008, Renn & Jager 2008, Rosa 2008). The comprehensive integration of various theoretical perspectives in an overall framework will always be challenging to transform to operational empirical concepts, and in this PhD work the risk governance framework has been used as a conceptual framework giving rise to important discussions concerning actors, processes and structures and the necessity of knowledge and resources available to assess and manage risk.

6 Discussion

The main aim of this thesis has been to explore the Norwegian aviation transport system in light of a risk governance framework and thereby to gain insight into the complexity, changes and goal conflicts to which the system has been subjected during the period of my data collection, 2005-2008.

The risk governance of Norwegian civil aviation is organised within a transnational framework. The aviation transport system is global and therefore in need of a common risk governance system to capture all of the challenges with regard to operating across national borders. As elaborated in this thesis, the origin of this transport system's regulatory framework was founded on transnational common agreements for harmonising and securing the standards in operating air traffic. Due to the transition from common national agreements to a juridical-binding regulatory framework, it is of interest to explore the system concepts within the risk governance framework and to discuss whether or not this framework allows for the integration of ongoing changes and evaluation of their influence on risk management.

The findings in my PhD thesis show that within the core risk governance of which Norwegian aviation transport system is part, an appropriate process seems to be occurring to implement contextual knowledge. The actors are involved by their competence, and are aware of the risk that might result from the ongoing changes. They clearly express a need for more knowledge and networking. There is a deficit in the organisational capacity to arrange for resources in the form of knowledge about safety issues in change-intensive situations. Another deficit is the lack of structures, for example, in networking. The most alarming deficit is found within the political framework, due to the state's failure to formulate an overall safety goal to guide risk governance in emergent situations.

The discussion is organised in accordance with the risk governance model presented in Figure 3.3 in Chapter 3, adjusted in line with the

main results of my research studies within the Norwegian aviation transport system: (1) core risk governance processes and actor network, (2) organisational capacity, and (3) political and regulatory climate.

The reasons for the adjustments within the model are that no core risk governance process (risk-assessment, appraisal, management, evaluation, and communication) will function optimally unless the contextual level of the actor network is generated, so the actor network should be integrated in the core risk governance in the figure and, the link between the two is therefore shown in the figure as a stippled line. I view these the core risk governance process and actor network as two sides of the same coin. Likewise, the social and economic climate and political and regulatory climate are intervened due to the impact on the core risk governance process. The couplings of the two are also illustrated by the stippled line. 'Political and regulatory climate' is the heading of the contextual level within the discussion.

The discussion starts with a presentation of the remodelled contextual risk governance model. Added to this model are boxes that indicate the main findings related to deficits and surpluses within the risk governance framework of which the Norwegian civil aviation is a part.

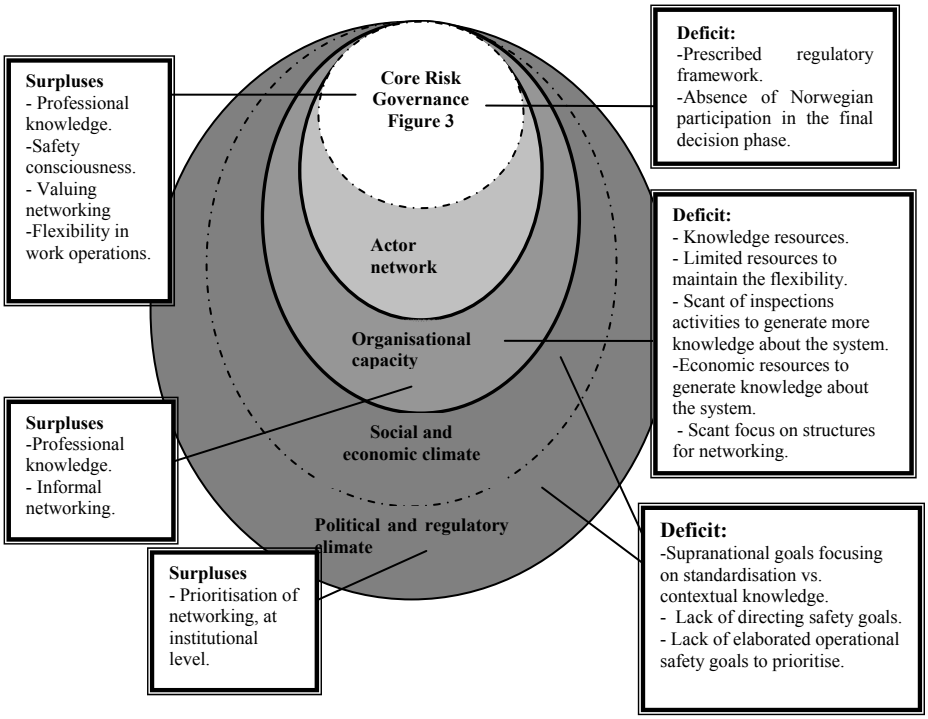


Figure 6.1 A remodelled contextual risk governance model.

The risk governance framework values a transparent model of risk assessment and risk management as a means to avoid the blurring of science and politics (Renn 2008, Jasanoff 2004, Liberatore & Funtowicz 2003, Webler & Tuler 1999, Weingart 1999, Funtowicz & Ravetz 1992, Otway 1992, Wynne 1992) and to implement all necessary contextual knowledge, assuring equality and argumentation for all types of claims through a mutual understanding and learning process (Renn 2009, 2008, Stirling 2009, a,b., 2008, 2007, Webler & Tuler 1999, Pidgeon 1998, Habermas 2004, 1995). I am interested in discussing whether such a transparent model has been implemented in the core risk governance processes of which the Norwegian aviation transport system is part.

6.1 Core risk governance process and actor involvement

The involvement of actors is consistent with the arguments of opening up the process to stakeholders (Stirling 2008, 2007, Wynne 1996, 1992) in a fair manner, encouraging participants to bring their knowledge competence into the discussions (Renn 2008, 1995). Such involvement is in need of an understanding of the relevant actors who are the best-informed and most willing to overcome prejudices (Pidgeon 1998). Hajer & Wagnenaar (2003) stated that the '*demands of business highlight interdependencies and relationships among tasks and prompt development of inter-organisational networks'* (2003:6). The deregulation, merging and transition to the EASA regulatory framework make the whole aviation system much more interconnected and in need of networking. Within these networks, the actors might experience solidarity in their need of a joint commitment to establish force behind arguments and to gain knowledge about the complex system (Hajer & Wagenaar 2003).

The Norwegian aviation transport system is highly influenced by the actors' and stakeholders' knowledge and values. The government and the industry have brought representatives into the arena in the processes of risk appraisal, evaluation, and decision making for the regulatory framework. The arena covers meetings, hearings, discussion forums and lobbying that structure the dialogue of the risk assessment process. This process of negotiating common agreements in order to meet the substantive criteria of better ends (Stirling 2008) has been a hallmark of the Norwegian aviation transport system from the beginning of the post-war period (Tjørhom forthcoming). It seems as though the negotiating process for the regulatory framework has been expanded with more actors due to their own demands for participating within the elaboration of the regulatory framework. The stakeholders of established organisations have gained entry to the arenas where risk decisions are taken. The closing process of the regulatory framework is made within each state that has committed to the common agreements to the rules framework, in accordance with their respective legal frameworks.

My studies have documented that, as it has been subjected to an increasing degree of complexity, the Norwegian transport system needs an open process to implement stakeholders' knowledge during all stages of the risk governance process. With regard to the deliberative imperatives of debating all relevant issues during an exchange of observations and viewpoints, followed by balancing this information in further discussions (Renn 2008, 2004, Habermas 2004, 1995, Daniels & Walker 1996), it seems well documented in this thesis that the deliberative process is concentrated in the risk appraisal and risk assessment stages, where the exchange of observations about risk issues is taking place. Nevertheless, my research did not explore the core risk governance regarding the final decisions and, for that reason, I offer no analytical explanation of whether the deliberative imperative has been fully implemented in the core risk governance process. But the data clearly show a deliberative process by the implementation of contextual knowledge to foster mutual learning. The studies further showed that the process with deliberative elements had started even before the establishment of the EU, but that the transition to an EASA framework created more formal structures that might make the exchange of observations and viewpoints more transparent.

This study has documented both positive and negative implications to the core risk governance process (Tjørhom forthcoming) of replacing the former international common agreements with a regulatory framework within the EU framework. Due to the new framework, a more formalised style seems to suit some actors well, while others experience this formalisation as a challenge. The actors from the Ministry, Investigation Board and most of the employees in management positions within the Aviation Authority are mainly familiar with a bureaucratic style and are thus comfortable with EASA as a framework for the decision-making process. Other actors from the Aviation Authority and from the industry are less comfortable with the new framework. These actors experience the new framework for risk governance as cumbersome, making statements such as, '*there is a long*

way from Norway to Cologne[9]'(Tjørhom forthcoming). There could be many interpretations for this experience of inconvenience with the formalised structure. The more formalised structure creates a more profound prioritisation of risk management, something that might be challenging to the industry given the prevalent focus on cost effectiveness. Another explanation could be that the industry is more pleased with a consensual risk governance structure where the decisions are taken in more closed circles and thereby reluctant to the transitions toward more corporatist or meditiative decision making styles (Renn 2008) where the openness and transparency within the process are more dominant.

In addition to the increased formalisation, the new regulatory framework is described by the actors as more prescriptive, consisting of more detailed rules. This description is most prevalent with actors from the industry and with some of the inspectors in the Aviation Authority. It seems that the rush for harmonisation and standardisation conflicts with the elaboration a pragmatic and functional regulatory framework that covers emergent risks. The prescriptive EASA regulatory framework is worth questioning in a context of changes that create complexity within the system. The intensive change within the aviation safety system creates a lag in the ability to develop safety rules (Rasmussen 1997), caused by the need for more knowledge and for the establishment of feedback mechanisms (Rosness et al., 2004). My studies show that lack of appropriate safety rulemaking creates a tension between focusing on safety or production (Tjørhom & Aase forthcoming). Additionally, one might expect that prescriptive rules in the future will show the same deficit, lack of possibility to prioritise safety in emergent situations that calls for requisite imagination (Westrum 2006, 1996).

Another issue that is of interest is the Norwegian government's role within the EU. The transition to the development of the regulatory

[9] The EU agency, EASA, is based in Cologne, Germany.

framework in the EU might create some challenges for the Norwegian aviation system, since Norway as a state is omitted from the closing part of the core risk governance processes (Tjørhom forthcoming). The fact that Norway is not in this stage of the process might be considered a threat to having a transparent core risk model, as described in the literature (Renn 2008). Even though the Norwegian government has participated in the assessment, appraisal, and evaluation phase of the elaboration of the regulatory framework, the experience of being left out of the final closing process might have implications for the risk governance framework.

Also important to question is whether processes for both input legitimacy and output legitimacy are present within core risk governance of aviation. My findings indicate input legitimacy through actors' involvement in a structural and processual manner that legitimates a transparent, deliberative process. My results further show that important contextual knowledge are captured through involvement of stakeholders with interests in the outcome of the risk decision making process. Nevertheless, the industry' resistance towards the new structure is worth noting, in order to ascertain whether this finding shows a deficit with other actors as well, and whether this deficit might be improved by structural or processual changes to the core risk governance processes. Another issue concerning the input legitimacy is the role of the non-members states of EU. Since non members are excluded from the EU Commission, and EU Parliament where the final regulatory decisions are taken, one should be vigilant to the discussion of input legitimacy. Even though these non members participate and bring their knowledge to the governance process, they do not participate in the final phase of risk governance.

When it comes to output legitimacy within the Norwegian core risk governance process, my studies show that the transition to an EU governance framework has demanded both human and economic capital. The transition phase has required employees to follow new and old regulations simultaneously. This has become an additional burden to the concurrent relocalisation of the Aviation Authority. Both the regime of double regulations and the contemporary relocalisation

process compromised the effectiveness of the risk governance processes. Most likely the eventual output gains in forms of effectiveness will become visible when the transition phase is completed.

6.2 Organisational capacity

The system's organisational capacity clearly influences its dealings with the core risk governance process. The organisations within the civil aviation transport system must display the capacity to handle a core risk governance process (Renn 2008). Required questions to ask include: are there assets and resources to deliver the necessary contextual knowledge into the core risk governance process; and, is the implementation process of the regulatory framework appropriate for handling the intensive change?

To make use of the assets and resources, there is a need for skills, together with a demand for a structure that ensures that the assets, resources and skills are used in an efficient, legitimate, integrating and socially-acceptable manner (Renn 2004). The economic resources should include the budget to secure adequate knowledge and to utilise the knowledge collaboratively.

The results of this PhD project have documented that the Norwegian civil aviation transport system possesses many of the required assets to develop a sufficient core risk governance model. The entire system comprises actors who have the professional knowledge to recognise the necessity of integrating knowledge to execute the risk work. The informal networks within the organisations, together with the seminars and meetings where the actors from the entire system are gathered, are highly valued by the aviation sector (Tjørhom & Aase forthcoming, Tjørhom forthcoming, Tjørhom & Aase 2007.). This thesis has also documented the actors' receptiveness and their willingness to acquire new knowledge in order to improve their competence, with a focus on the knowledge needed to manage the core risk governance process appropriately (Tjørhom & Aase 2010, Tjørhom & Aase 2007).

Nevertheless, the ongoing changes within the aviation system have evidently affected the knowledge resources. Deregulation, the relocation of the Aviation Authority, the competitive situation and the transition towards the EU regulatory framework, have all affected the knowledge resources Some of the interfaces within the aviation transport system have been transformed (Høyland et al. 2008). Knowledge according to area of technical expertise has been dispersed (Pettersen 2008, 2006), the Aviation Authority's expertise has been altered by a 80% turnover in the workforce as a result of the relocation process (Eriksen et al., 2009), the collaborating inspection procedures between technicians and operational personnel have been terminated (Tjørhom & Aase 2007), and some of members of the Aviation Authority are demanding more collaboration inside their organisation, e.g., with the Ministry (Tjørhom & Aase 2007). The actors are arguing for an increased focus on knowledge improvement by increasing the networking across the system. The risk governance structure clearly highlights the importance of knowledge resources. The alterations in the knowledge base, combined with the alteration in the production system indicate a deficit of knowledge resources. Changed interaction and discontinuation of former communication (e.g., within work groups) besides to the demand for increased knowledge of risk issues caused by the change intensiveness, indicate a possible lack of knowledge resources to handle the change intensiveness and complexity of the system.

One way to broaden the knowledge base is to use accident and incident investigations as feedback mechanisms in the industry. In recent decades, the Investigation Board unit has extended its investigative methods from technical and human factors into finding explanations of accidents by using accident models with a more systemic focus. Nevertheless, the analytical tools used to gain knowledge about possible systemic interdependencies are still immature. The learning potentials by using more holistic investigation approaches is thus less utilised than what could be expected.

In the Aviation Authority case, it appears that the ongoing changes call for an expansion of the resource pool in order to monitor the industry.

Studies show that increased supervisory activities are needed in a deregulation phase in order to monitor companies, especially those that have been newly established (Rosness et al., 2005). Since the intensity of changes has created new interfaces and possibly new paths to accidents, there are demands for monitoring trends that might threaten safety. Our studies showed neither an increase in inspection activities nor an increased focus on monitoring trends (Tjørhom & Aase 2007). Even though the Ministry recommended that the Aviation Authority adopt a risk-based framework in order to collect information on ongoing trends, the Aviation Authority did not have the resources to adjust its work activities. Furthermore, our findings showed that the government has been reluctant to reallocate economic resources to supervise the industry in a period when new companies are entering the market; it is also hesitant to develop a supervisory methodology that matches the intensive change within the system. Within the Aviation Authority, resources have been focused on the relocation process and the transition towards an EU regulatory framework. The Aviation Authority has, therefore, not reprioritised its resources to develop risk-based supervision and analytical work.

The organisation's capacity to implement the new EU regulatory framework seems problematic due to the nature of the rules. The EASA places a great emphasis on prescribed rules. Due to the transition to the EASA framework, the rules have become stricter (Tjørhom forthcoming, Stockmann & Wiener 2008). A shift towards a sharper focus within the regulatory framework seems to be a contradiction in a system that is subject to change and that has scant knowledge about safety work in this new production situation. Too much attention to implementation of a detailed regulatory framework might create a system in which actors lack the resources to monitor emergent risk and goal conflict situations (Tjørhom & Aase forthcoming). In unforeseen situations, the actors then lack the resources to be flexible (Wilpert 2008) and to use the requisite imagination, understood as the ability to anticipate the possible negative course of events (Westrum 2006), typically seen as the ability to create worst-case scenarios. A detailed regulatory framework might be overwhelming and, thereby, deprive the actors of the cognitive space to anticipate such a course of events.

Given the complexity that is the hallmark of the aviation transport system, possible interconnections and feedback loops become invisible (Weick & Suthcliffe 2007) and when an emergency arises there is clearly a need for effective handling of possible negative effects.

The findings that show that the actors within the system expressed a willingness to learn, are competent, and are aware of changes and the operational vulnerabilities resulting from these circumstances (Tjørhom & Aase forthcoming, Tjørhom forthcoming, Tjørhom & Aase 2007), are surpluses in the risk governance model due to an organisational capacity to handle a core risk governance processes. A prioritisation of resources to extend knowledge, prepare for flexibility and knowledge feed-back by strengthening the actor networks can all compensate for the deficits within organisational capacity.

6.3 Political and regulatory climate

The context for the core risk governance process has been constituted by Norwegian politicians in a legal framework. These politicians are the representatives of the Norwegian people. By assuming responsibility for the aviation transport system, these elected actors organise the regulatory framework by making decisions about the process, structure, and style of the regulations. These decisions create the framework for all core risk governance processes (IRGC 2009, Renn 2008). The political framework constitutes the basis of risk governance by the politicians' determination of the kind of rules considered appropriate (prescriptive/goal-based) to take action in the case of of possible negative adverse effects of an activity (Grote 2008, 2004, Wilpert 2008, Kirwan et al., 2002).

The results of this PhD project show a deficit in the political and regulatory climate because of the lack of clear safety goals within aviation. The Norwegian government seems reluctant to formulate and elaborate guiding safety goals; instead, the Ministry expresses a twofold goal of safety and service to the community (Tjørhom & Aase forthcoming, Tjørhom & Aase 2007. b). The government has

traditionally left it to the aviation transport system to elaborate the regulatory framework for aviation safety, by delegation in yearly allotment letters. These delegations of the regulatory framework are in accordance with a contextual framework, where the rules, standards and procedures are elaborated by the actors with expertise in the field. This form of delegation is in line with a risk governance framework, and as such the knowledge resources are appropriately utilised. Nevertheless, the lack of clear safety goals weakens the structure of the regulatory framework and the ability to use the actors' flexibility in work situations. In the absence of clear guidance for safety work from the political actors and the Ministry, the operators in the Norwegian aviation transport system experience a tension between safety and production in circumstances with goal conflicts (Tjørhom & Aase forthcoming.). This tension between safety and production is a common result of a social and economic climate fostering production pressure. The economic climate seems to be demanding in a situation subject to deregulation (Hovden 2002). The aviation industry is expected to focus on cost-effectiveness, which is easier to measure than safety (Gaba 2000). Such a cost pressure climate calls for the government to be aware of the possible threats towards shift in focus (Turner & Pidgeon 1997).

My PhD research shows that the lack of clear safety goals creates frustrations for the actors and their risk management practices (Tjørhom & Aase forthcoming.). The lack of an explicit safety policy and the safety objectives create a tension in situations where, for example, regional policy and safety policy are in conflict (Tjørhom & Aase forthcoming.) or when economic and safety issues must be weighed against each other (Tjørhom & Aase forthcoming, Loquist 2008). Examples of such circumstances are when the managers act forcefully to require the operators to prioritise production over safety; for example, in situations where weather conditions might affect safety or when cost pressures create tension between safety and production. In such situations, the operators experience the outcomes of a production prioritisation uncertainly, creating a threat to safety in the operation.

The decision to shift the regulatory framework towards a unified juridical EU framework is a result of a political process occurring outside the Norwegian state, caused by Norway's non-membership in the EU. Results show that the previous common agreement regulatory framework's (by ICAO and JAA) translation to Norwegian rules might progress slowly. The transition from common agreements to implementation to Norwegian acts of law is often fragmentary and handled by the actors in the system in a top-down manner. It takes a long time from the time the recommendations are agreed upon until they are fully implemented in the Norwegian acts of aviation. The transition to an EASA framework with merely a prescriptive regulatory framework that has juridical force is clearly a change in the political and regulatory climate, a change that Norway is required to make. In one way, this alteration from common agreements to juridical laws is positive, due to the sanctioning force within the EU that can speed up the implementation of the new regulatory framework. This increase in dispatch due to the regulatory framework is extremely important in a change-intensive climate, where the safety regulatory framework must be in accordance with the modification of the production system. The question is whether or not this rulemaking climate fosters a core risk governance process that can accommodate changes and complexities. In a start-up phase of a new framework to elaborate rules, it might be difficult to get the actors to reflect on common goals (Morgan & Yeung 2007). As discussed above, the regulatory framework is, to some degree, a prescriptive framework and thereby reflects reactive risk management in a system distinguished by changes and complexity. Based on the number of states constituting the EU, along with the fact that these states -- after the enlargement in 2004 and 2007 -- are rather heterogeneous, it is worth asking if the EASA should take the last step into full safety regulatory of each member state and the affiliated states (Smith & Fishbacher 2009). It might seem like a rush to agreements to implement the framework, even though the rules create challenges for the different states. The thesis also finds that it is very demanding to get permission for an exemption from the regulatory framework (Tjørhom forthcoming). These facts point to a slowdown in the process to install the EASA as the main elaborator of the regulatory framework.

Given these circumstances and the lack of resources with which to develop knowledge about safety issues related to change processes, the Norwegian aviation transport system is clearly in need of focused attention on safety by the political part of the risk governance system. A system that neglects to state clear safety goals will become vulnerable to safety issues when the industry pays attention to its main goal of surviving in a competitive industry. A good governance framework based on the normative principle of deliberative processes and structures might become a buffer to degradation in the safety work practices, but until such processes and structures are fully developed, the deficit within the political framework must be addressed.

6.4 Utilisation of a risk governance framework in this thesis

By using the risk governance model as a framework to explore risk regulation within the Norwegian aviation transport system, I have been able to view the system holistically and simultaneously to separate elements of importance to risk governance. The model is a helpful tool for separating the different elements needed to handle the core risk governance process. The model also explores interconnections, interdependencies and complexities. The risk governance model illustrates both how the actors are connected within the single layers and how the layers, constituted by these connected actors, depend on each other. As a framework, the risk governance model is similar to other systemic models for analysing risk management within systems. Leveson's (2004) STAMP model is a safety control structured program for analysing a comprehensive system and its operations. Rasmussens' (1997) model of the socio-technical system involved in risk management illustrates the levels of politicians, managers, safety officers and work planners that are involved in the safety management process. Hood et al., (2001), present the theoretical framework of regulatory regimes in order to capture both the context and content of policy making and to clarify the importance of network regulatory systems.

The risk governance model differs from the other models by consisting of new terminology that better captures the fluidity within a global context. Introducing the word 'governance' instead of 'government' might give rise to new cognitive commitments about how to manage systems (Hajer & Wagenaar 2003). According to Hajer and Wagenaar, this vocabulary might give both practitioners and theorists a new framework for rethinking governing, politics and administration. Released from tacit cognitive patterns, the actors within a system might become amenable to focusing on institutional designs that capture the change processes to which the Norwegian civil aviation system is subjected. The risk governance model might then turn attention to the networking and processes required to encompass the entire risk management process. Such a focus aims at rethinking the old patterns of hierarchy, where some levels are often valued as more important than others. The risk governance model illustrates that risk knowledge and the requisite resources are spread throughout the aviation system. I would contend that both the theoretical foundation and the way of illustrating risk governance contribute positively to a better analytical framework, given decision making in a global world. The model might then be a fruitful tool for analysing how we constitute the decision processes (Hajer & Wagenaar 2003) and what kind of policy outcomes are warranted when the structures and processes are changed in more fluid situations in which relationships are changed. Nevertheless, the deliberative focus within EU risk governance is just dawning. The focus on efficiency, as manifested in the rush for standardisation and harmonisation is clearly an obstacle to the development of a deliberate governance process. If the normative theory of risk governance is going to become an empirical reality, the focus on input elements in the governance process is just as important as the outcome. Risk governance of the aviation transport system has to develop the contextual elements to arrange for the necessary knowledge base and structure within the core risk governance process. By focusing on the structure and requisite knowledge, the risk governance of Norwegian aviation transport system might become a valuable process capable of taking into consideration the elements of complexity, change and goal conflicts.

7 Conclusions

This thesis has explored risk governance within the Norwegian aviation transport system, which, during the last two decades, has been subjected to several changes that added complexity to the system. Deregulation has changed business structures to handle competition. The aviation transport system has likewise been subjected to a transition from a national framework for safety rules to a supranational framework, as the EU assumes the leadership for elaborating the regulatory framework. There is the added continuous introduction of new technology, which also creates new circumstances for the actors within the aviation transport system. In sum, all of these changes are creating a situation wherein the prevailing system must be explored in order to scrutinise whether the risk governance system is keeping pace with the ongoing changes. It might be a challenge to the safety work if production is extensively altered. This thesis has examined risk governance due to the current situation characterised by change, complexity and goal conflicts.

7.1 Answering the research questions

As stated in the introductory chapter, the following research questions guided my four studies on risk governance:

1. How is risk governance conducted within the global aviation system?

This study clearly shows that the Norwegian aviation transport system is part of the supranational risk governance. Actors from all over the transport system are grouped within organisations and are, thereby, represented within the risk governance. The previous regulatory framework featured by common supranational agreements has been further developed by the Norwegian actors. The previous framework also showed traits of governance processes by actors participating in decision making and elaboration of the regulatory framework. The

transition to the EU framework is documented within the study to present both the possibilities and the challenges to the risk governance framework – possibilities in the form of formal structures for participation and challenges in the form of integration and implementation of all the contextual knowledge - within such an extensive framework.

The study also points to the fact that the EU regulatory framework is more prescriptive than the former common agreements framework (developed within ICAO) and aims at harmonisation in a prescriptive framework that might undermine the contextual knowledge. The study concluded by questioning the transition to a comprehensive EU safety regulatory framework in light of Norwegian non-membership in the EU, thereby excluding Norway from participation in the final decision part of risk governance.

2. What is the role of the national legislator and the regulator within the risk governance system?

This study demonstrates a lack of response and of resources by the legislator (the Ministry) to follow up its responsibility for the totality of aviation safety. Given the intensive changes, the Ministry should take charge by setting overarching safety goals and allocating the requisite resources. The study showed that there was no explicit safety policy and no increase in resources in order to elaborate new tools for measuring risk.

The study shows that the regulator (Aviation Authority) lacks the directing goals from the Ministry and that the increased supervision we assumed by the Aviation Authority is lacking. The study also documents that inspectors within the Aviation Authority found that the networking seems too weak to manage the intensive change to which the system is being subjected.

The study concludes that the strong sense of responsibility and self-organised networking within the legislator and the regulator seems to be a buffer against possible negative side effects from the current

changes, and although the informality with which this takes place seems to strengthen the safety conditions, it also induces a certain vulnerability due to the dependency on individuals.

3. Is the framework for conducting accident investigations in accordance with the current complexity and change picture within the aviation system?

This study documents the existence of a normative framework due to conducting accident investigations within the Investigation Board. Nevertheless, this framework has not been developed into a set of common work practices, which this study revealed as unique in the practice of writing investigation reports. This uniqueness was from actors viewing it as important to have open-minded perspectives and advocating a response that avoided prejudice and bias. Furthermore, the study demonstrates a development in investigation practices by revealing an increased awareness and attention to organisational and institutional factors within aviation accident investigation. This development of a reconstruction accident practice was shown to be inspired by different sources (enthusiasm on the part of the Investigation Board, networking, and science). Nevertheless, the study emphasises the need for a common investigation framework that covers the organisational and institutional factors.

4. How are trade-offs between safety and efficiency (goal conflicts) handled within the Norwegian aviation transport system?

The study shows that the daily operation and management of risks within aviation are handled in a resilient manner. There is a strong commitment to safety at the operational level of the Norwegian aviation transport system. In cases with trade-offs between safety and efficiency, the operators work thoroughly and prioritise safety. The challenge within the transport system is the lack of clear safety goals from the Ministry. This absence of clear guidance to balance safety and efficiency might make the aviation transport system vulnerable in situations with high cost pressures. The study shows examples of such

situations, where the operators report lack of support, lack of time allowed to prioritise safety, and pressure to be efficient at the expense of safety. Such a lack of a guiding safety prioritisation might make the system vulnerable over time. The operators lack an overall picture of the system as such and are therefore in need of guidelines to make the requisite safety prioritisations.

7.2 Research contribution

This thesis expands the knowledge of risk governance within a global transport system. My exploration of the Norwegian aviation transport system in this work contributes to the development of the risk governance framework as an analytical tool to explore a risk governance system. Given several recent risk management studies that focus on the system perspective to understand and manage safety (Leveson 2004, Rasmussen 1997) and by valuing the interfaces and interdependencies (Snook 2000, Vaughan 1996) and drawing attention to the complexities (Hollnagel e.g. 2009, 2008, LeCoze 2008, 2005), this thesis functions as a theoretical continuation of such research.

Few empirical studies have been conducted to explore a industrial system using a risk governance framework. The main application of risk governance framework has been done on issues regarding environmental or new technology issues (e.g Renn & Walker 2008). This exploratory study will expand the knowledge of governance processes within a global transport system, and thus present some implications for the regulatory framework in a system marked by change, complexity and goal-conflicts.

7.3 Further research needs

Given the circumstances characterised by complexity and the associated uncertainties, I see two follow-up research needs of special interest:

- To study decision making within the parts of the governance framework, especially within the core risk governance process and by exploration of the normal operations.

One of the more prominent research aims is to explore and elaborate upon the deliberate decision-making process. Dealing with complex, uncertain and ambiguous outcomes is tricky; even though everyone might agree upon the goal - safety- there are still many challenges to overcome to determine how safe is safe enough. What knowledge must be implemented within the decision processes, and what is the most appropriate way to structure the knowledge?

- To establish comparative studies by which to explore the governmental prioritisation within every complex system that is subjected to ongoing changes, where cost effectiveness is a topic.

A comparative study of risk governance would be fruitful. Railway and sea transport should be empirical objects to explore pursuant to risk governance. Of interest in the comparison will be to trace similarities and differences arising from structures and knowledge processes.

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Part II

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Tjørhom, B., & Aase, K. (2007). Safety and changes in the Norwegian aviation transport system– What is the role of the legislator and the regulator? In: Aven, T & Vinnem, J.E (Eds.) *Risk, Reliability and Societal Safety*, Vol. 3, pp. 2143-2149. Taylor & Francis, London.

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Safety and changes in the Norwegian aviation transport system – What is the role of the legislator and the regulator?

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ABSTRACT: The aim of this paper is to study how political priorities at the legislative level, how enforcing practices at the regulatory level, and how changes at these levels might have an impact on safety in the aviation transport system. We will explore the political part of the aviation system: the Ministry of Transport and Communications, and the executive part of the system, the Civil Aviation Authority. Besides describing and seeking to understand the role of the legislator and the regulator, we also search for their interactions with the other parts of the aviation transport system. An understanding of the political, legislative, and regulative levels of the aviation transport system is necessary for understanding the work and priorities of maintaining safety at the lower levels of the system. The data in the paper is based on 38 qualitative interviews, and participant observation at different levels of the aviation transport system.

1 INTRODUCTION

This paper is about safety and changes in the Norwegian aviation transport system, and the possible relation between the two. As in most commercial and even public sectors, the civil aviation transport system has been subject to fundamental changes the last decade. In industries that go through upheavals, a study of how different stakeholders and organizations act and respond to changes, and how they maintain safety under such circumstances is interesting. The aim of the study is to get an understanding of the role of the legislator (Ministry of Transportation and Communication) and the regulator (Civil Aviation Authority) in a change intensive system, and how they work with safety. An understanding of the political, legislative, and regulative levels of the aviation transport system is necessary for understanding the work and priorities of maintaining safety at the lower levels of the system (Alamberti 2005, Leveson 2004, Moray 2000, Rasmussen 1997).

2 CONTEXT

At the surface, the voluminous system of legislation, regulations and formal procedures within the aviation industry make it seems like there is little or few questions left for the employees' own judgment. As documented in Pettersen (2006), there is more to operational problem solving in aviation than a predescribed set of procedures. In light of current changes both nationally and internationally, the legislative and regulatory body is also in a transition stage. Such legal and regulative transitions are comprehensive and timeconsuming, creating possible maneuvering problems and periodically double sets of rules to comprehend to.

2.1 *A change-intensive aviation system*

The Norwegian civil aviation system is subject to general societal trends such as increased air traffic, a technological pace that calls for continuous upgrade on technical competence, and a globalization of markets. At a company level, airlines, air traffic control providers, ground services, and aircraft maintenance organizations are being restructured, merged, downsized, sold, and bought to "fit" the competitive global marketplace (Pettersen & Aase 2006). The aviation industry is regulated by supranational rules. In Europe, there has been a shift from standards regulated by common understanding to a EU regulative prescribed by law. The European Aviation Safety Authority, EASA, replaces former national regulations within the aviation industry and also the joint Aviation Regulations (JAR). EASA is a framework of rules and directives to be filled by decisions and resolutions made by the constitutional EU member states. Norway, as a non-member of EU has a license to participate and comment in different agencies, without the right to vote. So far, the EASA regulations concerning technical issues have come in force, while the EASA regulations concerning operational issues is still in process.

In addition to the changes induced by societal trends and regulations, the Norwegian aviation system has been subject to several specific changes during the last decade. The deregulation of the marked from 1994 to 1998 permitted new participants to operate within the Norwegian aircraft system. The deregulation had an impact on the competition within the aviation industry, and also called for a change in the regulation regime. One of the implications was that detail supervision was replaced by system supervision. Another implication was a splitting up of technical and operational inspection activities.
Until 2000, the Norwegian Air Traffic and Airport Management handled the operation of airports and safety management. This agency was then divided in Avinor, the Accident Investigation Board, and the Civil Aviation Authority. Avinor is responsible for handling airport operations, the Accident Investigation Board for accident investigation, and the Civil Aviation Authority for supervision of the aviation transport system. The Civil Aviation Authority was until 2005 located in the capital, but as a consequence of a regional policy decision in 2002–2003 (Royal Proposition 17 2002/2003) it was relocated to the north of Norway. The decision was made by the Norwegian parliament in June 2003, and the first employees were situated at the new headquarter autumn 2004.

2.2 *The legislator*

The Ministry of Transport and Communications has a superior responsibility for managing the Norwegian aviation transport system. The administrative work is delegated to the Air, Post and Tele department, holding a separate aviation unit. The manager of the Air, Post and Tele department reports to the Secretary General, which again reports to the political direction. A separate aviation unit in the Ministry was established in 1992. Until then, the aviation responsibility was spread out "*on the entire house*". The aviation unit is governed by the National Transport Plan (Report to the Norwegian Parliament 46 99/2000), and are responsible for four broad categories of tasks: (1) Administration of framework conditions, laws, and regulations; (2) Aviation safety work in general; (3) Department of government for the Civil Aviation Authority, and the Accident Investigation Board; (4) International collaboration and negotiation.

The employees of the aviation unit have backgrounds and competences within political science, economics and law, with work tasks linked to their competence. The unit's safety work is linked together with other work tasks. Safety is described to be a bit everywhere. Or as one employee said: "*I work indirectly with safety since I am responsible for competitive tendering*." Or as a colleague said: "*My role in this is a bit distant. With regards to safety questions, I do not have a direct role. But it is all mixed in because when there is a new EU directive influencing safety, someone has to handle it. It might be my responsibility*."

2.3 *The regulator*

The Civil Aviation Authority gets a yearly allotment letter from the Ministry of Transport and Communication, containing the premises for their duties. Their main activity is to contribute to increased aviation safety. The Civil Aviation Authority prescribes rules and regulations (in collaboration with EU), performs entrance control, and carries out inspections. The Civil Aviation Authority's core operations are divided into five: operative inspections, technical inspection, airport safety and security, jurisdiction, and administration. In addition there are staff support services such as information management, community contact, quality, and safety.

Because of the relocation process in the Civil Aviation Authority there are at present two organizations. The technical inspection department is mainly in place at the new headquarters, while parts of the operative inspection department is still located in the capital. Due to a loss of employees related to the relocation process, the Civil Aviation Authority experienced recruitment problems, and was forced to abandon their demand related to "background within civil aviation". Today, the technical inspection department consists of personnel with a broader technical and/or management background.

3 THEORETICAL PERSPECTIVE

Our theoretical framework is based on a sociotechnical systems approach (Alamberti 2005, Leveson 2004, Moray 2000, Rasmussen 1997). By that we reject traditional cause-effect accident models. Rasmussen argues that: "*The usual approach to modelling socio-technical system is by decomposition into elements that are modelled separately*" (1997: 186). He further explains that this decomposition may have some unintended effects because we loose the interrelation between system levels that might influence work processes and safety conditions. As a consequence, all participants in the aviation transport system, from legislator to operator, or at least all parts of the system, should be viewed as linked together. Safety is then an interactive, dynamic process that takes place in the entire aviation transport system. Moray (2000) displays similar thoughts. Changes in the nature of work need to be followed by changes in the theoretical framework for risk. There is a need for a system approach, specially taken into account the national characteristics, economic and political constraints by the industry.

Alamberti (2005) claims that the main challenge in working with safety is to capture the structures and work operations in the concrete work systems more than adopting successful safety tools. He further refers to several success criteria regarding increased safety level: (1) the need to limit the discretion of workers, (2) the need for a system level arbitration, (3) the need to simplify professional rules. First, limiting the discretion of workers means that without limits there will be an attitude towards production as the main goal in the organization. Research studies document that operators in lack of risk limitations will challenge their maximum performance. Second, system level arbitration means that it is a problem that people in safe systems are held responsible for incidents and accidents. Instead of catching scapegoats, multiple causes should be searched for at all levels of the industrial system. An operator conducting an erroneous work task may for example stem from a lack of regulation. Third, simplifying professional rules means that there might be too many rules because of new rules added to the old ones without an overall discussion of the rules. At the end, rules that are meant to improve safety end up making the system more complex.

The legislator and the regulator restrict the acts of the operators in the socio-technical system (Kirwan et al. 2002). In a system perspective, the legislative and regulative process is complicated when dealing with an entire industrial sector. In this perspective, the legislators and regulators become "*agents of social control*" (Reason 1997: 173). But the regulation may also influence behaviour in an enabling and facilitating manner (Baldwin & Cave 1999). The regulation process is constrained by the inter-organizational relation existing between the regulatory body and the regulated body (Vaughan 1996). This relationship is in turn a relation between to autonomous parts and may find place in different ways, like for instance collaborating or fighting.

During the past two decades we have seen a shift from a regulation regime focusing on a detailed "nuts and bolts" level towards a regime of self-regulation through internal control (Reason 1997). In a self regulation regime the role of the regulator become more of a system controller. To control the organizations as a whole, instead of controlling technical details requires another type of

competence. System supervision calls for a careful understanding of what to discover and how to focus the monitoring to catch the risks in the system, and to prevent the regulated organizations from covering their own weaknesses and faults.

A change-intensive nature of a socio-technical system may have several effects on the regulation of the system due to the level of uncertainty. Grote (2004) describes the consequences of uncertainty as follows: "*With higher levels of uncertainties any attempt to design the uncertainties out of the system will fail and therefore the system has to be enabled to cope with uncertainties locally. This understanding lies at the heart of the socio-technical design principle of handling variance at their source*" (Emery 1959 in Grote 2004). By this we understand that in times with many and simultaneously changes it might be difficult to design and upgrade the rules according to continuous changes. Amalberti (1999 in Grote 2004) claims that if rules get developed incrementally there is a tendency that they become inadequate when situations get abnormal. He further argues for strong but flexible guidance in abnormal states (Amalberti 2005) because guidance from higher levels in the system is needed in times with turbulence.

4 METHODOLOGY

Based on the contextual description of the aviation system, and based on our theoretical framework, the following research assumptions have been developed:

1. In order for the Ministry ofTransportation to follow up their responsibility for the totality of the aviation transport system, this requires resources, network, and an overall safety policy making explicit how to prioritize between conflicting goals.
2. 2. In order for the Civil Aviation Authority to handle simultaneous changes such as transition from national to European legislation, geographic relocation, and effects of deregulation, this requires flexibility in competence, network, increased inspection activity, and an overall safety policy making explicit how to prioritize between conflicting goals.

Due to the explorative nature of the research assumptions, we have chosen a research design based on a qualitative case study approach (Blaikie 2005, Seale et al. 2004, Yin 1994, 2004). Two case studies have been conducted, one within the legislator and one within the regulator using qualitative interviews as the main data collection method supported by participant observation through attendance at regional and national meetings and seminars within different parts of the aviation system. In addition, a network with participants representing different levels of the aviation system was established to develop current problem areas and test results.

The data material consists of 38 qualitative interviews with employees in the Ministry of Transport and Communications and in the Civil Aviation Authority, and observational data at different levels of the aviation transport system. The informants at both system levels represented different levels of experience and different work areas such as jurisdictional, technical, operational, and administrative issues. A total of 11 interviews were conducted in the Aviation unit (consisting of 13 employees) within the Ministry during a three-day visit. In addition, the manager of the Air-, Post and Tele unit was interviewed. A total of 26 interviews were conducted in the Aviation Authority (consisting of 145 employees), 17 of them during a two-day visit at their former head office, and 9 of them during a two-day visit at their new head office. Each interview lasted for about one hour, and a semistructured interview guide was used to organize the interviews. Themes in the interview guide were currentwork tasks and responsibilities, safety philosophy, safety related work tasks, current changes at each system level, and interactions with other system levels.

All interviews were transcribed in detail, and memos, summaries and field-notes were written based on the observational data. All data were analyzed according to a categorization strategy (Miles & Huberman, 1994) using safety policy, network, competence, inspection activities, and changes as the main categories. In addition, documents and observational data were used to get a general knowledge of the aviation industry. The selection of quotes used in the paper is made based on the purpose of representing trends and depth in the data material.

The current data material in our opinion represents a valid description of the safety work practices at the two system levels due to the substantial number of interviews. Nevertheless, the data material represents perceptions and descriptions at a certain point of time, and given the change-intensiveness of the Norwegian aviation system it may represent a threat to validity.

5 FINDINGS

5.1 *Safety policy?*

Employees in both the Ministry and the Civil Aviation Authority have difficulties in reporting a concrete and common safety policy. Answers were vague, and the informants had trouble expressing a policy, and expressions were not consistent within the organization: "*There is no safety policy communicated*", "*We work according to ICAO's objectives*", "*The National Transportation plan guides ourwork*", "*Our objectives are stated in the annual plan*", "*We follow the rules*" or "*Our goal is to be community serving and contribute to an increased safety level within aviation*". Most of the informants express a frustration by not having a common and committed safety policy. In their annual report from 2005, the Civil Aviation Authority states that their vision is to be "*An active initiator for safe and community serving aviation services*". Our results document that the vision to a limited degree has been communicated and made operational in the organization, neither is there an expressed policy from the Ministry that gives a unified direction in safety questions.

If there is no overall committed safety policy how then do these two instances handle their safety responsibility? Several informants refer to an individual safety responsibility embedded in each and every member of the transport system: "*Yes, we all*

have an individual safety policy" or "*most people act on safety in a responsible manner*". They further elaborate on how they make their work tasks attend to safety: "*My view is that our main objective is to promote aviation safety. First of all to make sure that the companies stick to present safety level, which we consider as reasonably high, but also to work for an even higher level*".

This individual or local safety responsibility is a consequence of a lack of safety standards from the political part of the aviation system. The politicians leave the standard setting to the executive officer in the Ministry of Transport and Communication, which again leave it to the Civil Aviation Authority. If an employee then handles a safety question in an inexpedient way, it will be corrected from the cabinet ministers office. In lack of an appropriate safety policy, employees use their own discretion because they have an in-depth knowledge of the aviation system.

5.2 *Network*

Employees in the Ministry of Transportation reported an extensive and frequent interaction with EU, the Civil Aviation Authority, a common Scandinavian collaboration and regulation association, and with contact persons in the aviation companies. The network within EU is to prepare for the new extensive EASA regulation frame, and with regards to the blacklist (operators that are not satisfying ICAO's minimum demands). The contact with the Civil Aviation Authority is two ways. The Ministry delivers rules for the Civil Aviation Authority to follow, but are dependent on feedback on technical and juridical question. The feedback is seen as a necessity for the Ministry because of their lack of technical competence. To get insight into technical issues employees in the Ministry contact technical or operational personnel by telephone, letters or by inviting them to meetings or work groups.

Employees of the Civil Aviation Authority describe their relationship with the Ministry as less colored by collaboration than the employees in the Ministry. By the interviews we reveal the shape of the relationship. Reasons for this is that the juridical section in the Civil Aviation Authority handles the majority of enquiries from the Ministry regarding handling and follow-up on regulations. Technical personnel give their feedback on technical questions to their own juridical personnel and are not in direct contact with the Ministry. The assistant director of the technical and operational section has weekly and monthly contact with the Ministry of Transportation, and participates at the tertiary meeting arranged by the Ministry. Inspectors in the Civil Aviation Authority have little or no perception of the responsibility or the work tasks of the Ministry. An exception is when they might get involved in thematic ad-hoc work groups for special reasons, but most informants have problems with remembering any contact or collaboration with the Ministry.

The processes of restructuring and relocating of their head office mark the employees of the Civil Aviation Authority. A number of experienced employees have terminated their work contracts, and the remaining are unfamiliar with the new organizational setting. This influences the network relations in the organization. Even though employees seem to have a small threshold for contacting colleagues with questions, they also report about limited contact: "*As a colleague of mine says: This is a bunch of one-man businesses! I am not happy with this. We have little or no formal meetings with time for discussion*". The informal nature of the network relations is a consequence of the level of aviation experience amongst the employees of the Civil Aviation Authority. Even if they are recently employed in the Civil Aviation Authority, they hold long experience within the aviation industry in some way or another. This means that they know the people in the aviation system and talk to them informally: "*This is the way it has always been, we speak to each other but nothing is formalized. We have tried to put pressure on getting a formal quality assurance system*".

5.3 *Flexibility in competence*

Both in the Ministry of Transportation and in the Civil Aviation Authority there is a strong will among the employees to increase their competence by learning from experience related to incidents and accidents:

"*When it comes to safety, you never get fully qualified*". At the same time they seek better systems for organizing this work: "*We speak to each other about safety but it is quite sporadic and takes place when we lack answers to our safety questions*". The informants refer to a lack of arenas for communicating about safety, and systems or procedures for bringing tacit knowledge forward.

The relocation of the head quarters of the Civil Aviation Authority has resulted in a new competence composition in the organization.A number of employees have resisted moving to the new office, resulting in an extensive recruitment process. The combination of newly hired employees and a lack of experience transfer from the "old" ones have resulted in an alteration in competence. Some of the informants refer to a change in technical competence as a consequence of the relocation process. Others claim that the newly hired personnel's competence is not that different from the former. Several of the newcomers are recruited from the National Air Defense, meaning that they have both technical and management experience. The challenge for these employees is to transfer their knowledge from the National Defense regulations to the regulations within Civil Aviation. The timing for this transfer seems to be suitable because of the change in regulation regime from JAA directions and national regulations to EASA regulation. The new inspectors can then use the new regulations directly, thus achieving new knowledge that meet the needs of the technical organizations in the airline companies not holding this competence yet. The new inspectors report about a feeling of good timing for their new employment.

In addition, the restructuring of the Civil Aviation Authority gives the organization an opportunity to reconstruct the technical department from consisting of inspectors each responsible for an assigned set of companies, to a pool of inspectors responsible for surveillance and inspections of all airline companies. This restructuring means less vulnerability due to less dependence on the individual inspector.

5.4 *Inspection activities*

In 2005, the Accident Investigation Board concluded in a report (Royal Proposition 35/2005) carried out on assignment from the Ministry of Transportation, that the Civil Aviation Authority should prepare for more system-orientated and risk-based supervision activities. This would increase the opportunity to capture possible negative effects on safety from different change initiatives within the airline companies.

Our interviews document insecurity among the employees regarding risk-based inspection. The Civil Aviation Authority has started a process to direct their inspections towards a risk-based approach. The problem is that it is difficult to define and implement the concept of risk-based supervision. Employees are frustrated because they do not know how to perform risk-based supervision activities. The informants reflect a will to develop the supervision towards a risk-based approach, but are frustrated because of a lack of knowledge: "*Risk-based supervision is just a word*", "*We have not been able to discover what it (risk-based supervision) is, we have had seminars resulting in a decision to stop calling it risk-based supervision*" or "*We ought to have somebody monitoring what's the problem. Many people mean that's risk-based supervision*". In the employees' opinion they perform risk-based supervision when they search for new risks and try to choose the essential between many risks. The problem lies in the fact that this process involves an extensive body of unconscious knowledge. The relocation process in the Civil Aviation Authority has further negatively affected the development of a risk-based supervision approach. The work started before the relocation decision was taken, and the relocation process moved the focus from developing risk-based inspection as a new inspection tool to organizational changes.

System-oriented supervision activities have been developed over the years in the Civil Aviation Authority, and informants report about a shift in focus from components and details in the technical system to the system as such. Inspectors try to capture circumstances related to organizational issues and search for underlying causal relation: "*…much of the interaction with the airline company is based on confidence, so we are not…we do not intend to carry out millimeter control*". The inspectors view their role as a combination of control instance and advisor: "*I ask questions with two purposes: To get an answer and to stimulate reflection. That is how I acquire a lot of knowledge on what they (supervision object) think and what they believe, assume, suppose, and also how they live*". The informants further point to rumours as an information channel for focus in the inspection activities: "*It is much about rumours. We have a lot of contacts in the industry. It is direct relations between people working within technical services in the airline companies and people in the Civil Aviation Authority. They provide our inspectors with a lot of inside information. In addition, we have to be aware of conditions to watch up for*" or "*We have our contacts within the industry. We can read their pulse, and in my view we have a sufficient overview*".

The changes of regulation (from JAA to EASA) and the change of competence within the Civil Aviation Authority have separated inspections within technical and operational providers that were formerly united. Earlier, the JAA regulative was common for these two sectors and thereby it was natural to perform common inspections. The informal agreement on common inspections was also abandoned with the alternations in the workforce competence.

6 DISCUSSION

Our results have documented that within the two studied organizations, no explicit operational safety policy exists. What we find to compensate for this lack of superior guidance is a strong individual safety consciousness within all informants in both the Ministry of Transportation and in the Civil Aviation Authority. In addition, there is a broad informal network within the entire aviation system with several contact points. Employees are open-minded, want to learn, and improve their competence in safety issues. With regards to handling the change intensity in the aviation system, we did not identify an increase in resources or frequency of inspection activities, neither a clear move towards a risk-based inspection philosophy.

What do these findings mean for regulating and controlling the safety level within the aviation system? Out findings have indicated that the sum of external and internal forces of change has made the control of the aviation system more unpredictable, especially due to the pace and simultaneousness of the changes. The changes make it difficult to understand the "big picture" of the aviation system, and thus a challenge to regulate and inspect (Rasmussen, 1997; Snook, 2000). Local responses to forced-upon changes can be unpredictable, missing the overall focus, resulting in coordination problems. The lack of an overall operational safety policy might reinforce this comprehension.

Even if there is a sense of overall safety understanding in the Ministry of Transportation and the Civil Aviation Authority, this understanding lacks the operational dimension, giving directions to the work processes in the aviation system. The official safety policy of the Civil Aviation Authority, "*…safe and community serving…*" might further become confusing due to its two concurring elements, safety and community serving. Situations may occur where these two considerations will be in conflict with each other. When an operational description of the vision lacks, it seems difficult to find the right balance between the possible commercial elements of community serving and safe aviation operations. As Rasmussen says, "*Commercial success in a competitive environment implies exploitation of the benefit from operating at the fringes of the usual, accepted practice*" (1997: 189). When conflicting goals is concurrent with possible interaction effects of decisions made by participants at other system levels, this might set the stage for unknown and unwanted incidents.

The individual safety consciousness throughout the workforce within the two studied organizations in the aviation system seem to act as a buffer against some of the precarious change effects, together with a strong sense of responsibility, and a will to search for the best safety solutions. The transparent network within the aviation also makes it possible to develop and share these solutions. In addition, employees regard their own role as important by expressing a feeling of being fallible, and are in constant search for new knowledge. This means that employees perform comprehensive searches for solutions to different safety question and are not afraid of admitting their own uncertainty and consult colleagues across the aviation system to test their solutions. All the above-

mentioned elements are considered important elements of safe work practices (Gherardi & Nicolini 2000; Pettersen & Aase 2006), and constitute flexibility in competence that acts as a valuable prerequisite in handling several and simultaneous changes.

To some extent, a certain degree of inflexibility was identified in the Civil Aviation Authority when it comes to technical competence, displaying a conflict between the former and the new organization. Employees of the former organization express a rigid understanding of what kind of technical competence that matches the inspection tasks. It has been a complicated and time consuming process to redefine the demands for the technical competence related to the inspector position. Even if there has been no increase in the frequency of inspection activities as a result of the current changes in the aviation industry, the Civil Aviation Authority are searching for solutions to the recommended risk based supervision philosophy. So far, this supervision approach is not a reality, lacking an operative understanding and belonging routines. As a result of the transition from JAA procedures to the EASA regulative, common inspection activities covering both technical and operational work areas are reduced to a minimum. The new EASA regulative, together with the deregulation of the industry, the splitting of organizations, and the relocation of the Civil Aviation Authority may have the consequences that rules and procedures tend to get more fragmented (Amalberti 2005).

7 CONCLUSIONS

In our first research assumption, we claimed that for the legislator (Ministry of Transportation) to follow up their responsibility for the totality of the aviation transport system, it requires resources, network, and an overall safety policy making explicit how to prioritize between conflicting goals. Today, the resources and network activities with the legislator seem too scant for capturing and making explicit an overall safety policy. An operational safety policy will make it possible for the rest of the transport system to prepare concrete safety objectives and develop limits for how to prioritize between conflicting goals.

In our second research assumption, we claim that for the regulator (Civil Aviation Authority) to handle simultaneous changes such as transition from national to European legislation, geographic re-localization, and effects of deregulation, this requires flexibility in competence, network, increased inspection activity, and an overall safety policy making explicit how to prioritize between conflicting goals. What we find is a work force that is responsible, flexible and has a hunger for elaborating newwork practices to match the current changes.The process of restructuring and relocation of their head office have set the development of new inspection methods back. The strong sense of responsibility and selforganized networking within the legislator and the regulator seems to be a buffer against possible negative side effects from the current changes, and the degree of informality in which this takes place seems to strengthen the safety conditions, but also induces a certain vulnerability due to the dependency of individuals.

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Article III

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Article IV

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The art of balance: Using upward resilience traits to deal with conflicting goals

Berit Berg Tjørhom & Karina Aase

Abstract. This chapter describes some of the processes involved in balancing conflicting goals (e.g., between safety and operation) in a change-intensive environment by using examples from civil aviation transport. The ability to handle multiple goals involves the use of both downward and upward resilience traits to address potential conflicts. By downward resilience, we mean that macro level directions and solutions prepare for resilience through clear goal structures, infrastructure, and procedures that handle the trade-offs between safety and efficiency. Upward resilience means that decisions made at the micro level in a system reflect a commitment to safety in case of goal conflicts. Changes, caused either by external or internal drivers, may alter these resilience traits by introducing loss of oversight. Changes made at the macro level of the system might have unintended consequences on the micro level, and vice versa. The chapter is based on studies conducted in the Norwegian civil aviation transport system.

1. Introduction

Even though a range of incentives exists in our society to ensure that commercial aviation operates safely (e.g., public opinion, passenger lists, lawsuits), the importance of highlighting the balance between safety and production goals is still prevalent (Perrow, 1999). In a change-intensive environment with coexisting and conflicting pressures from macro and micro-level actors, managers may set their priority on cost optimization without having good aviation safety indicators to

warn them about the erosion of safety margins (Rasmussen 1997, Woods 2005, Woods 2006a, 2006b).

During the last decade, the civil aviation transport system has been exposed to several externally and internally motivated changes. Such changes may come in the form of new EU legislation and regulations, deregulation of the market, new business structures (e.g., mergers, restructurings, relocations), and new technologies. An increased focus on efficiency and cost reduction has been observed, thus resulting in questions about whether this pressure has negative effects on the prioritisation of safety (Høyland & Aase, 2009, Aase et al., 2009). Historically, conflicting goals have been shown to be part of the causal explanations of several serious aviation accidents in Norway. Analysis of accident investigation reports has revealed that in the Skagerak accident (1989, 55 fatalities), pressure to uphold the flight program due to a critical company economy was part of the accident picture. In the Namsos accident (1993, six fatalities), the investigation board recommended that the airline company's board of directors and top management clarify their principles for safety priority versus regularity, timeliness, and economy (Tjørhom & Aase, 2009).

In this chapter, we want to explore how the processes of balancing conflicting goals are handled in today's aviation system and whether the balance between safety and production in a system becomes more complicated when changes, caused by either external or internal drivers, represent major elements of the context in which the system operates. The chapter uses empirical examples based on qualitative studies at different levels of the Norwegian aviation system (legislation, regulation, air traffic control, airport operation, and airline maintenance). The main topics of the studies have been safety, management commitment to safety, change, and safety prioritisation (Aase et al., 2009, Tjørhom & Aase, 2009, 2007, Høyland & Aase, 2009, Høyland et al., 2008, Pettersen & Aase, 2008, Pettersen, 2008, Hauland et al., 2007, Pettersen, 2006, Bjørnskau, 2005).

2. The art of balance

According to Reason (1990), '*All organisations have to allocate resources to two distinct goals: production and safety*.' In his opinion, these goals are agreeable in the long term, but from a short-term perspective, given a lack of resources, it appears as though production takes precedence over safety. Hollnagel describes the process of balancing safety and efficiency by using the efficiency-thoroughness trade-off (ETTO) principle (2009, 2004, 2002). In this perspective, people adjust their work according to current conditions. It is never possible to be completely thorough, or fully efficient in view of scant resources, such as time, workforce, and money. According to Hollnagel, every work situation calls for trade-offs between thoroughness and efficiency. The trade-off tendency or favouritism of either efficiency or safety is dependent upon the dominant concern within an organisation or a system. It follows from the ETTO principle that it is never possible to maximise both efficiency and safety.

The problems with tradeoffs involving safety, resilience or thoroughness are reinforced by the difficulties associated with measuring safety. Gaba (2000) points to the fact that signals of safety are weaker than signals of production, and further refers to the asymmetry regarding measuring of these two goals. Where economic performance has a history of measurement for anticipation, safety often comes up short due to lack of leading indicators (see also chapter 4 in this book), thus creating difficulties in stating the relationship between resources and gains regarding safety. The picture becomes even more blurred as a result of the focus placed on 'best practice' (Hubbard, 2009) during the last decade. By collecting examples from successful organisations, one seeks to adapt to best practice standards for operation. These standards might address both safety and operation, but as Woods (2006a) pinpoints, what if there are too many goals implemented within an organisation? What if the different 'good' solutions compete and thereby create tension, and even worse, make the system less resilient?

To ensure that a system is able to handle the balance of fundamental tradeoffs such as safety versus production (efficiency -thoroughness, optimality - brittleness, acute - cronic goals), one must create knowledge of the state of the art regarding safety and the ability to handle uncertainties. Where are the system's borders with regard to safety? The interactions of tradeoffs create a need to consider sacrifice judgments or decisions where acute goals are sacrificed to put more emphasis/ resources on achieving cronic goals like safety (Woods 2006a, 2006b). Sacrifice judgments involve the process of temporarily sacrificing acute production or efficiency related goals, or relaxing the pressure to achieve these goals, in order to reduce the risks of approaching too near safety boundaries (Woods 2006a, p. 32). Sacrifice judgments may occur when an approach to an airport are broken off during weather that increases the risks of wind shear, or when a take-off is delayed due to maintenance technicians' suspicion of airplane-related technical faults (Pettersen 2008). In other contexts, safety might get sacrificed at the expense of effectiveness due to double binds created by poor accountability and brittle strategies that exacerbate goal conflicts. An aviation example is when an aircraft is de-iced and then enters the queue for takeoff. The effectiveness of the de-icing agent degrades with time. Delays in the queue may raise the risk of ice accumulation. There have been several airplane crashes where, in hindsight, crews accepted delays of too great a duration and ice contributed to a failed takeoff (Woods et al., 1994).

2.1 Downward and upward resilience

Woods (2006a) uses the phrase *cross-scale interactions* to describe the interrelations within a system. Decisions made at the strategic, or macro level of the system, might impact decisions made at the operational level or micro level, and vice versa. Woods (2006a) further operationalises cross-scale interactions by using the concepts of downward and upward resilience to describe the interrelated processes of value to resilience within a system, such as the civil aviation transport system, where decisions made at one level might have implications for system functions elsewhere in the system. Downward resilience includes macro level directions and solutions preparing for

resilience through clear goal structures, infrastructure, and procedures to handle tradeoffs. Upwards resilience includes decisions made at the micro level reflecting a commitment to safety in cases of goal conflicts (sacrifice judgments).

Downward resilience is of importance because the context and structures of a system either foster resilience or induce pressure towards resilient operations. For instance will the ability of macro level actors or "distant supervisors" to communicate intent about goals, plans, and procedures act as a downward resilience trait influencing how people at the micro level adapt to these governing tools. Local micro level actors may use the distant macro level supervisors' or authorities' statements of intent behind goals, plans, and procedures in cases of unexpected events or changes (Shattuck & Woods 1997, Woods & Shattuck 2000). The absence of a clear goal structure, communication of intent behind the goals, and a lack of willingness to implement adequate technology might create poor conditions for resilient operations and sacrifice judgments for frontline personnel. Safety goals should act as yardsticks meaning that deviations from the goals could appear as warning signals for operators and managers when operations exceed safety margins. Frontline operators may not be fully able to understand the consequences of a chosen deviation from prescribed rules because their actions or tradeoffs are made in a specific contextual frame of reference - from their point of view in the organization (Dekker, 2006). Repeated deviations from the prescribed design may, over time, become a new rule, which means that the design and the real operations become unequal (Snook, 2000, Vaughan, 1996, 2006). An accumulation of such deviations makes the system opaque, and it becomes difficult to know if the decisions made regarding tradeoffs are really sacrifice judgments.

Upward resilience is of importance because local micro level actors might create resilience in a system using their experience, flexibility, and professionalism to handle the gap between rules and procedures, and the actions required to adapt to new circumstances (McDonald 2006, Pettersen & Aase 2008, Morel et al., 2008). These actions of the micro level actors might be reflected in decisions made at the macro level as new strategic goals, elaboration of new procedures, or implementation of new technology. The opposite, creating a threat to

upward resilience is when operators and decision makers in the front line get stuck in a single problem frame and miss or mis-interpret new information that should force re-evaluation and revision of the situation (Klein et al., 2005, Patterson & Woods 2001). Research appears to indicate an emerging understanding of the gap between design, procedures, and rules, and the work that is really going on in the frontline (Snook, 2000, McDonald, 2006, Pettersen, 2006, Pettersen & Aase, 2008). This gap can be described by hidden grey zones potentially inherent in design, procedures, and rules that call for new ways to handle the operations (Pettersen & Aase, 2008). When situations appear that call for such flexibility, the operators and manager make sacrifice judgments (McDonald, 2006). These judgments are frequently based on experience, and depend on the professionalism amongst frontline operators. Professionalism means that within a system, there exists an ability to use experience and knowledge in addition or even instead of written procedures. In a study of professional sea-fishing skippers, Morel et al., (2008) found that they used multiple expert strategies to reduce risk without giving up on their fishing activity. They relied on a high level of adaptability, linked to an exposure to frequent and considerable risk. Such professionalism or craftsmanship serves as a buffer in situations of trade-offs between safety and production goals (Høyland & Aase 2009, Morel et al., 2008).

As we have seen, the ability to balance multiple goals involves using both upward and downward resilience traits, and most important the interactions between them and across system levels. Changes caused by either external or internal drivers may alter these resilience traits by introducing loss of oversight or emerging risks. Let us now turn to some examples from real practice.

3. Traces of balancing within the Norwegian aviation transport system

During the last decade, the Norwegian aviation transport system has been influenced by numerous and extensive changes. These changes, along with the interconnectedness of the transport system, might impact the ability to handle multiple goals within the system. The complexity within the system is greater than ever, meaning that the risks associated

with these interdependencies might be extensive and it could be useful to discuss them using the concepts of downward and upward resilience.

3.1 Methodology

To illustrate the issues of balancing, we will in the following use examples from different research studies undertaken within Norwegian civil aviation (Aase et al., 2009, Tjørhom & Aase, 2009, 2007, Høyland & Aase, 2009, Høyland et al., 2008, Pettersen & Aase, 2008, Pettersen, 2008, Hauland et al., 2007, Pettersen, 2006, Bjørnskau, 2005). The studies cover empirical data (collected over a period of four years, 2004 - 2007) from three cases that represent different levels of the aviation system:

- *The legislation/regulation case* consists of 26 interviews with inspectors, advisors and managers in the Norwegian Civil Aviation Authority (NCAA) and 12 interviews with employees in the Ministry of Transport and Communications. The objective of the study was to describe safety policies, perceptions of safety, safety practices and changes.
- *The air traffic control (ATC)/airport operation case* contains a study of five airports with 126 informants (interviews), aimed at diagnosing the safety culture as a means for improvement. The case also includes qualitative free text data concerning changes and safety aspects from a questionnaire survey, with 231 respondents (managers, planners, engineers, air traffic controllers) from ATC and airport operation.
- *The maintenance case* was carried out as an exploratory study of a line maintenance department, with participant observation, 15 interviews and a number of informal discussions. The goal was to gain insight into how safety is created and maintained through work practices at an individual/group level. The case also includes free text data from a questionnaire survey, with 283 respondents within maintenance (managers, planners, engineers, aviation technicians).

Using data from the different case studies in this study was done by searching the empirical material and the previous research publications for issues covering the topic of goal conflicts and for empirical examples on processes of balancing safety and production.

3.2 Downward resilience?

There has been a transition towards deregulation of the aviation transport market, which has influenced the economic situation within the aviation business. Due to economic pressure, the structure of the companies has changed. Companies have been downsized, bought, and merged. Further, within the safety regulation framework, there has been a transition from national regulation towards a standardised EU framework for safety rules. The Ministry of Transport and Communications states the following:

> *"The Ministry is responsible for the framework conditions within aviation transport in Norway."*

This general and overall statement is handled by the Ministry's subordinate agency, the Norwegian Civil Aviation Authority (NCAA), which is assigned responsibility for ensuring that civil aviation in Norway is operated safely and efficiently. This responsibility is made explicit in the NCAA's vision:

> *"NCAA should be an active initiator for safe and community-serving aviation services."*

The background for this vision influenced by the current Ministry is the knowledge that civil aviation plays a more important role in the transport pattern in Norway than it does in most European countries, and that civil aviation makes an important contribution to maintaining settlement and employment throughout Norway. The result is a network of 46 state airports across the entire country (approximately 4.8 million inhabitants). The objective of being both 'safe' and 'community-serving' seems to contain potential goal conflicts according to an informant from NCAA:

> *"Our goal is to be both community serving and contribute to an increased safety level within aviation. I do not agree with such double-edged goal, in my opinion our job should be to say NO to anything that may harm safety! But there are lots of difficult decisions regarding exemptions from rules and regulations that we have to deal with."*

The Norwegian Aviation Act of 1993 is a so-called delegation act, which leaves to other institutional bodies the responsibility to elaborate on the details found in the body of rules. There are no clear statements from the Ministry on how potential conflicts should be handled by the NCAA in their activities related to supervising and ensuring compliance with regulations and conditions. The challenge of conflicting goals inherent in the statements of the Ministry and the NCAA might be even more prevalent because the political system in Norway is transitory, consisting of many small political parties that form coalitions. In practise, this transitory nature means a new political environment emerges every fourth year. Employees in the Ministry express the following about changes in government:

> *"The department changes colour, quite a lot of the attitudes change. But from day to day, the jobs we do are the same."*
>
> *"New government? Then we have to fling ourselves into the new government's declaration."*
>
> *"It often happens during preparation of different cases or elucidations that we become aware of the fact that what we prepare is against political decisions. It is important for us to act tidy on these issues."*

Changes in political climate might generate a change in the goals and statements of the Ministry of Transport and Communications, and consequently, the NCAA, i.e., if a political party is especially focused on regional policy, the implication could be that when this party assumes power in the government, it might abandon existing plans for closing down some of the short take-off and landing (STOL) airports in Norway that do not satisfy the demands for airports within the EU or follow the international body of rules.

Because the NCAA still holds the technical competence to license the operation of STOL airports, it becomes their task to decide whether exemptions from existing regulations must be granted in order to operate these STOL airports. In the absence of an overall defined trade-off, the decision to exempt or not becomes a struggle between

professional considerations and current political composition. This struggle indicates a vulnerability regarding the commitment to safety (or not) among the employees in the NCAA. It also returns to the role of the Ministry of Transportation to demonstrate a commitment to safety. As one NCAA employee said:

> *"We are the government's instrument for both a safe and community-serving aviation. Viewing resilience as an interrelated system, it becomes important to know the Ministry's opinion about commitment to safety."*

This lack of clear guidance from the Ministry on how to prioritise conflicting goals is what Grote (2004, 2008) denotes as a deficiency in rules management. She suggests 'rules management as a source for loose coupling in high-risk systems' (2008, p. 91). Rules can function as glue within organisations, which makes the working operations consistent even when workers must adapt to unfamiliar events. If rules should be resources rather than determinants for action, we must distinguish between different specification levels of rules. We can differentiate rules for goals, processes, and actions (Hale & Swuste, 1998). These three types of rules could be viewed as following an axis, where goal rules are the most strategic of the three and action rules are the most detailed.

The lack of distinct goal rules worked out by the Ministry of Transport and Communications has created an inherent tension between the double-edged objective of both 'safe' and 'community-serving.' None of the stated visions by the Ministry or the NCAA can serve as goal rules that give the organisation a common direction for making trade-offs between safety and production. Indeed, the visions of both organisations lack the dimension of giving direction for determining trade-offs between safety and efficiency. Decision makers then lack the directions that give them the power to make sacrifice judgements (Woods 2006a). Without any clear or well-defined overall goal rules for safety from the macro level of the Norwegian aviation system, it is difficult to claim that the system has an inherent downward resilience.

3.3 Upward resilience?

Within ATC/airport and operation, goal conflicts have been identified as being related to prioritisation between efficient traffic handling and safety. Differences between airports exist, in which some handle the possible conflicts by choosing safe work practices, some by addressing the conflict upwards in the hierarchical system, and some by providing the necessary resources for safe operations. The experience of other airports indicates that efficient traffic handling gets prioritised over safe operations, thus resulting in procedure violations (Høyland & Aase 2008, Høyland et al., 2008). The examples show that when the operators experience a commitment to safety by their managers, they dare to make sacrifice decisions, as they do at the airports where they feel that commitment. The opposite is true at airports where the operators experience a lack of commitment from their management, and thereby tend to give efficiency precedence over safety. At the airports where economic pressure gets precedence towards safety, the employees expressed the situation as:

> *"It is not possible to get support for safety by the managers."*
>
> *"We feel pressure towards too much overtime work."*
>
> *"Operative personnel might lack of time to [resolve] safety issues caused by continual pressure towards administrative work task[s]."*

Within aviation maintenance, the technicians report that formal descriptions of work are part of their knowledge base. In addition to the written procedures, they must elaborate on their problem-solving procedures. These procedures are used when situations call for flexibility. The standard operating procedures are static tools that need to be justified to keep the system resilient. Such problem-solving procedures are 'embedded in the heads and hands of the practitioners' (Pettersen 2006, 2008). The technicians report about intuitive feelings that guide their judgements, based on years of experience, which offer them a comprehensive view of their part of production in an appropriately safe manner. According to the technicians, their freedom to choose safety over efficiency has changed. They experience conflicting goals related to keeping the aircraft safe from technical

faults while simultaneously getting the aircraft operational within the time limit of its planned schedule. They report that when they experience conflicts regarding making (in their view) good trade-offs, they often resolve those conflicts by creating time spaces ('delays due to technical reasons') to ensure the airplane becomes technically airworthy (Pettersen & Aase 2008). In the trade-off between punctuality and safety, the operating technicians were committed to making sacrifice judgements.

Due to the current change intensity of the Norwegian civil aviation system, many technicians have experienced increased demands for productivity. When they were asked about their perception of how the current changes affect safety, the following statements were frequent:

> *"Economy gets precedence over safety."*
>
> *"There is an odd mixture of safety and profit."*
>
> *"Generally increased demands for improved efficiency."*
>
> *"The trust in central management is considerably weakened caused by their one-sided focus on economy."*

Their perception of an increased focus on production is a challenge when it comes to their commitment to safe work practices. According to Woods (2006a), the frames for making sacrifice judgements have then been altered. Lacking a framework for sacrificing judgements based on clear and common goal rules that create downward resilience, the technicians must make their own action rules (Grote 2008), as exemplified by 'delays due to technical reasons' rooted in their technical competence.

4. Conclusion

In the Norwegian aviation transport system, different studies have shown that there is a lack of commitment to downward resilience at the macro level, due primarily to the tension inherent in the double-edged objective of being both safe and community-serving. The prioritisation of regional policy (community-serving) and an unwillingness to develop distinct goal rules for balancing safe and community-serving

air transport, place downwards pressure on the aviation system. Despite deficiencies in the downward resilience, upward resilience traits at the micro level of the aviation system seem to counterbalance the picture by characteristics such as a clear commitment to safety, sacrificing decisions, and establishing resource buffers to handle safety in critical situations. The critical issue regarding resilience in the Norwegian aviation transport system seems to be the awareness towards vulnerability caused by the system's dependency on upward resilience.

These findings have implications for different levels of the aviation transport system. We propose following actions to strengthen downward resilience:

1. Development of clear safety goal rules at the governmental level.
   - Downward resilience is threatened by the unwillingness to state clear goal rules at the strategic level. After years of changes within the aviation transport system, employees need clear statements that give them a framework to remain flexible and committed to safety despite economic pressure.
   - The goal rules should be based on worst-case scenarios using input from the entire aviation transport system. The institutional level of the system must be responsible for collecting information regarding trends that threaten resilience.
2. Development of guidelines and requirements for addressing cross-scale interactions.
   - The training tools should include participants from different levels and professions.

We propose following to strengthen upward resilience:

3. Foster perpetual awareness among operators.
   - Without a constant unease about the way to handle an operation, one might become lost in routine and fail to notice variations. Even a seemingly insignificant variance in operation must be taken as a potential leading indicator regarding threats against resilience.

4. Extend operators' collaboration with other parts of the system.
   - A strong focus on professional values might have some downsides (McDonald, 2006). Within a profession, self-confidence may evolve to the level of overconfidence. In a trade-off situation, this may result in over-reliance on the individual's judgement - at the expense of cautious prudence. Technicians and airport operators might rely too heavily on experience and knowledge, thus taking unnecessary chances without fully embracing the body of rules. Interrelations necessitate an exchange of knowledge across professions.

The tension between downward and upward resilience in the aviation system that we have studied is balanced by a strong professionalism throughout the system, which functions as a buffer and makes safety goals prevalent over production goals. To uphold this art of balancing, in our opinion, it is crucial to develop strong but flexible goal rules at the macro level to demonstrate a commitment to safety and that micro level actors find trustworthy. At points of intensified production pressure and higher organizational tempo, extra investments in sources of resilience are required to keep production/safety trade-offs from sliding out-of-balance. In other words, safety investments are most important when least affordable (Woods 2006b).

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APPENDIX

Interview guide, the Ministry of Transportation and Communications

(Air, Post and Tele Department- Aviation unit)

General understanding of work practices

- Number of employees?
- Types of competencies?
- Organisation of work tasks
    - Functional task distribution?
    - Work teams?

Areas of responsibility

What do you perceive as your work tasks?

- Frame work conditions in the civil aviation transport system.
- Legal framework and regulation of safety
- General direction of the Civil Aviation Authority and the Accident Investigation Board
- Aviation safety work

Changes in frame work conditions

- Do you perceive any changes in the frame work conditions of aviation?
- What types of changes are critical in your or your and your departments work tasks?

The components of change

- What has changed in the aviation industry?
- What are the consequences for your daily work practices?
- Have specific measures been implemented to address the changes?
- What role do you have in the change processes?
- What are the consequences of changes for your department?

- Do you perceive the changes as affecting the interactions within the civil aviation transport system?

Interview guide Civil Aviation Authority (CAA)

General information

- Competencies and background
- Work task`s

Safety philosophy

- Do you have a safety policy that directs your supervision work?
    - What is the content of this philosophy

Areas of responsibility

- What do you perceive as the aviation authority's areas of responsibility?
- What role does supervision play in the aviation system?
- How do you carry out the supervision?
    - Do you work according to a risk based supervision approach?
    - Do you carry out impact studies concerning change/downsizing, reorganisations, and political decisions?

Learning and safety

- How do you transfer the knowledge gained by supervision?

Changes in frame conditions

- Do you perceive any changes in the framework conditions of aviation
- What are the consequences of deregulation of aviation? Positive negative effects?
- What types of changes are critical in your and your departments work tasks?

The components of change

- What has changed in the aviation industry?

- What are the consequences for your daily work practices?
- Have specific measures been implemented to address the changes?
- Do you perceive the changes as affecting the interactions within your organisation, or within the civil aviation transport system?
- How has the relocalisation of the CAA affected the organisation? Work environment, organisational issues, conflicts, collaboration, communication?

Collaboration/ networking

- How do you perceive the relationship and collaboration with the other actors in the aviation system (Ministry, airline companies, etc.?
    - Degree of formalisation?
    - Informal relations?

Interview guide, the Investigation Board (AIBN)

Safety philosophy/ investigation philosophy

- Do you have a defined safety philosophy that you are working according to?
- What is the content of this philosophy?
- Is there a common overall safety philosophy in the aviation transport system?
    - If so, what is the content of this philosophy?
- Do you have a particular philosophy within the investigation board?
    - If so, what is the content of this philosophy?
- Are you using a particular accident model in your investigations?

Investigation practice

- How do you conduct a typical investigation within the aviation transport system?
- How do you compose the work team? How do you divide the work operations? How do you perform as a team?
- What kind of questions are you asking?
    - Do you use checklists?
- Latent causality, how do identify such conditions within your investigation practices?

Changes

- Changes within the aviation transport system? Important to safety/less important to safety?
- Change in investigation philosophy/practice?
- Connection between changes and risk level? Examples?

SL REP 35/2005 ”Safety in the Norwegian aviation during the process of change”

- Main findings according to the report?
- The process of producing the report.
- System approach? How to define the aviation transport system?
    - How to influence the aviation transport system, e.g. how to implement risk management initiatives?

Collaboration/Networking

- Who are the investigation boards most important collaborators?
    - Within the Norwegian aviation transport system?
    - Internationally?
    - Others? Research/external/other investigation boards?
    - Relationship to the Ministry of Transport and Communications and the Civil Aviation authority?

Investigation reports

- How to ensure quality?
- Do the reports reflects the investigation philosophy?
- Time perspective and implementation?
- How do you describe and emphasis latent factors in casual effect relationships in the reports?
- Reports that document elements of change in the explanation of incidents/accidents? Examples?