Organizational Psychology and Safety Culture in Air Traffic Control

Concerning Organizational Climate, Situational Leadership and Psychosocial Work Environment

Arvidsson, Marcus

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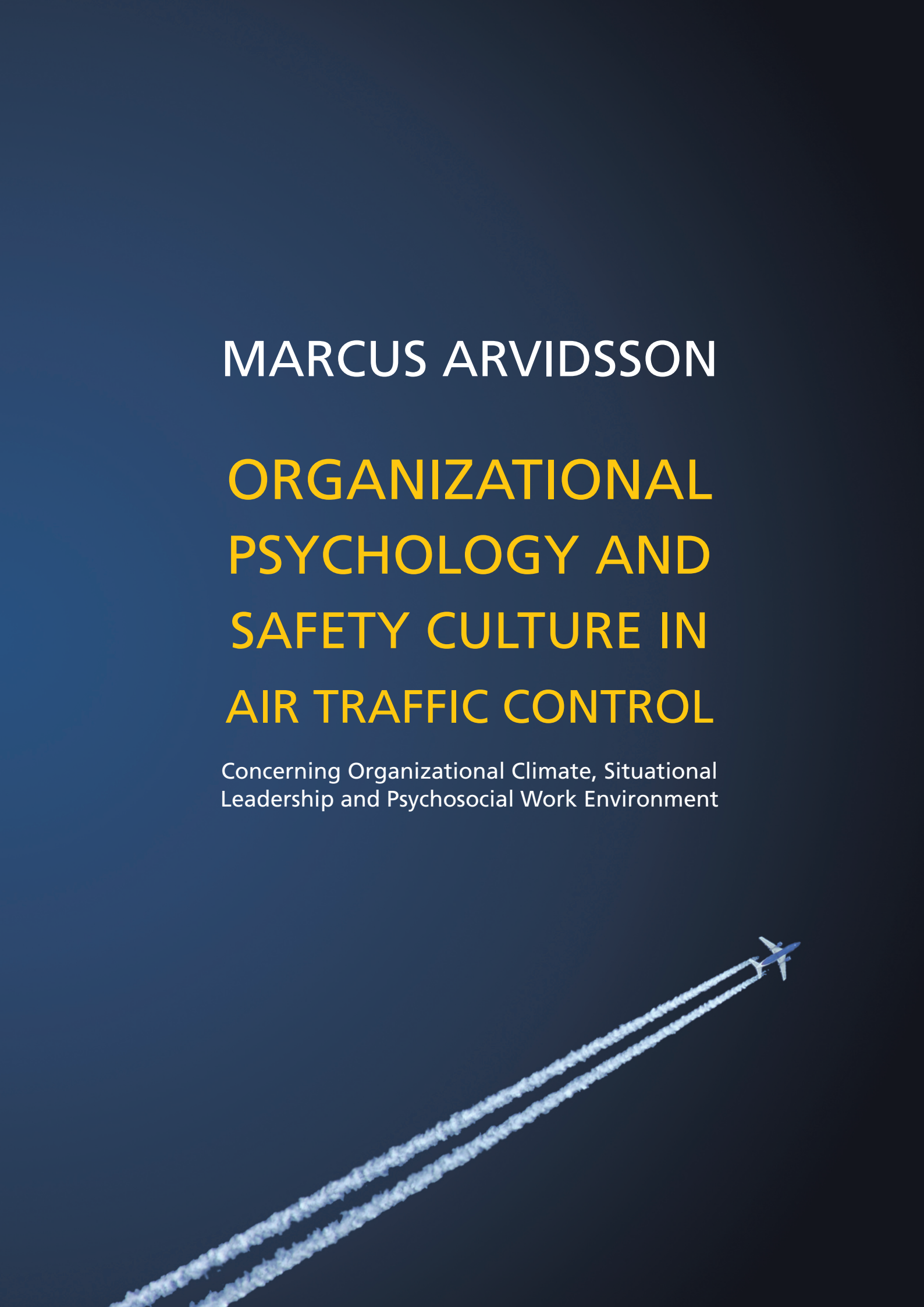

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Department of Psychology
Work & Organizational Psychology Division
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ABSTRACT

The air traffic control industry in Europe is under mounting pressure due to increasing air traffic and inefficient routines caused by a fragmented air space. In order to handle the demands the European Commission has launched a program entitled the Single European Sky initiative which seeks to promote a more efficient way of handling the air traffic over Europe. A reorganization of air traffic management will be introduced during this process and air traffic control centers in Europe will be merged. New technology will further be implemented and the air space will be rationalized. In this context the Swedish air traffic control provider is an interesting case since an adaptation to increasing air traffic and the Single European Sky initiative has already begun through the introduction of new organizational structures and new technology.

As psycho-organizational aspects can be identified as affecting safety outcomes in high risk organizations with highly reliable operations, the overall aim of the research presented in this thesis was to study different psycho-organizational aspects in Swedish air traffic control during times of change. The studies on which this thesis is based focused on: *innovative organizational climate,* examining the innovative preparedness and capacity to cope with changes in a highly regulated organizational environment; *situational leadership,* examining leadership characteristics in a high risk organization with a well developed safety culture; *psychosocial work environment*, examining critical psychosocial environmental factors in a high risk organization with demanding work operations; and *safety culture,* examining perceptions of safety culture as well as the relationships between safety culture aspects and organizational climate dimensions.

All in all, five studies were conducted of which four were empirical. The empirical studies were all conducted at two air traffic control centers and an administrative air traffic services (ANS) unit which was part of the LFV Group Swedish Airports and Air Navigation Services. The three study locations employed 635 air traffic controllers and other staff members. The organizational climate was measured with the *Creative Climate Questionnaire* (CCQ) (Ekvall, 1990), the situational leadership with the *Leader Effectiveness and Adaptability Description* (LEAD) (Hersey & Blanchard, 1988; Holmkvist, 2000), the psychosocial work environment with the *Copenhagen Psychosocial Questionnaire* (COPSOQ) (Kristensen, Hannerz, Høgh & Borg, 2005), and the safety culture with the safety culture assessment questionnaire developed by Ek (2006).

Study I concluded that the existing empirical research concerning relationships between organizational climate, leadership and safety culture or safety climate is limited. Previous research supports the assumption that safety culture is related to other psycho-organizational aspects, but the knowledge base is still too limited to be conclusive. The ambiguity in defining and operationalizing the concepts is an additional weakness in the field.

It was further assumed that the innovative organizational climate would be under-developed in air traffic control due to the strict regulatory framework which is present in this environment. The results from Study II revealed, however, that the innovative organizational climate was quite positive in spite of the rule governed work. Differences in the assessment of the innovative organizational climate could be identified according to work characteristics and work tasks but not according to organizational position.

Study III concluded that the situational leadership characteristics differed according to situation. The leadership behavior was more relationship-oriented in *Success* and *Group situations* compared with *Hardship* and *Individual situations*. The leadership adaptability – the leader's ability to adjust leadership style according to the situation – was superior in *Success* and *Individual situations* than in *Hardship* and *Group situations*. Operational conditions, leadership structures and working tasks were, on the other hand, not associated with leadership behavior.

Three aspects of the psychosocial work environment were identified as difficult in air traffic control in Study IV. In an otherwise positive assessment, *Sensorial demands*, *Freedom* and *Feedback* were challenging aspects. These aspects seemed to be characteristic for operative air traffic control work since the operative personnel assessed them to be statistically significantly less positive than did the administrative personnel. Organizational position was also found to be influential in the assessment of psychosocial work environmental factors since the management group made more positive assessments on a number of dimensions. The effect of differences in operational conditions was, however, limited.

The safety culture was positively assessed in the Swedish air traffic control context according to Study V. The administrative ANS unit had generally somewhat lower scores than the two operative air traffic control centers. Overall, *Communication, Justness* and *Flexibility* received slightly lower scores than the rest of the safety culture aspects. The results further demonstrated that the two organizational climate dimensions, *Support for ideas* and *Conflicts*, were positively and most frequently related to the various safety culture as-

pects at the two air traffic control centers. However, few relationships were found between the safety culture and organizational climate concepts at the administrative ANS unit.

Because of the limited knowledge concerning the influence of organizational aspects on safety and their possible relationships with safety culture and safety climate, more research in this area is desired, especially in the field of air traffic control. Due to differences in national conditions and culture as well as local variations, studies similar to those conducted in Sweden are also needed in other European countries in order to make the transition to the Single European Sky as smooth, safe and efficient as possible.

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Lund, August 2006

Marcus Arvidsson

PUBLICATIONS

List of papers included in the thesis with a description of the authors' contributions

The thesis is based on the following five papers, which will be referred to by their Roman numerals in the text:

I Arvidsson, M.
The influence of organizational climate and leadership on safety culture and safety climate from an air traffic management perspective – a review.

Submitted to *Safety Science*

II Arvidsson, M., Johansson, C.R., Ek, Å., & Akselsson, R. (2006).
Organizational climate in air traffic control: Innovative preparedness for implementation of new technology and organizational development in a rule governed organization. Applied Ergonomics, 37, 119-129.

Arvidsson and Johansson formulated the objectives and design of the study. Arvidsson and Ek planned and administered the questionnaire survey. Arvidsson carried out the data analysis and wrote the paper. All authors reflected on the results presented in drafts of the article.

III Arvidsson, M., Johansson, C.R., Ek, Å., & Akselsson, R.
Situational leadership in air traffic control.

Submitted to the *Journal of Air Transportation*

Arvidsson and Johansson formulated the objectives and design of the study. Arvidsson and Ek planned and administered the questionnaire survey. Arvidsson carried out the data analysis and wrote the paper. All authors reflected on the results presented in drafts of the article.

IV Arvidsson, M., Johansson, C.R., Ek, Å., & Akselsson, R.
Psychosocial work environment in air traffic control: Assessments with respect to ATM characteristics, task and organizational position.

Submitted to the *International Journal of Aviation Psychology*

Arvidsson and Johansson formulated the objectives and design of the study. Arvidsson and Ek planned and administered the questionnaire survey. Arvidsson carried out the data analysis and wrote the paper. All authors reflected on the results presented in drafts of the article.

V Ek, Å., Akselsson, R., Arvidsson, M., & Johansson, C.R. *Safety culture in Swedish air traffic control.*

Accepted for publication in *Safety Science*

Ek formulated the objectives and design of the study. Arvidsson and Ek planned and administered the questionnaire survey. Ek carried out the data analysis and wrote the paper. All authors reflected on the results presented in drafts of the article.

Other publications by Arvidsson published in proceedings and presented at international conferences

Arvidsson, M., Johansson, C. R., Ek, Å., Akselsson, R., & Josefsson, B. (2002). Aspects of Organizational Psychology and Innovation in Air Traffic Control. In C. Weikert (Ed.), *Human Factors and Safety in Aviation* (pp. 14-21). Lund, Sweden: Swedish Centre for Aviation R&D.

Ek, Å., Arvidsson, M., Akselsson, R., Johansson, C. R., & Josefsson, B. (2002). Study of safety culture at two air traffic control centres. In C. Weikert (Ed.), *Human Factors and Safety in Aviation* (pp. 55-56). Lund, Sweden: Swedish Centre for Aviation R&D.

Arvidsson, M., Johansson, C. R., Ek, Å., & Akselsson, R. (2002). Organizational climate in air traffic control. In C. Weikert, E. Torkelsson., & J. Pryce (Eds.), *Occupational Health Psychology: Empowerment, Participation & Health at Work* (pp. 24-27), Nottingham: I-WHO Publications.

Ek, Å., Arvidsson, M., Akselsson, R., & Johansson, C. R. (2002). Safety culture in the Swedish air navigation services. In C. Weikert, E. Torkelsson, & J. Pryce (Eds.), *Occupational Health Psychology: Empowerment, Participation & Health at Work* (pp. 58-61), Nottingham: I-WHO Publications.

Ek, Å., Arvidsson, M., Akselsson, R., Johansson, C. R., & Josefsson, B. (2003). Safety Culture in Air Traffic Management: Air Traffic Control. *Proceedings of the 5th USA/Europe ATM 2003 R&D Seminar, Budapest, Hungary,* June 23-27.

Arvidsson, M., Johansson, C. R., Ek, Å., & Akselsson, R. (2003). Team Climate and Safety Culture in Air Traffic Control. *Proceedings of the XVth Triennial Congress of the International Ergonomics Association, Seoul, Korea, 5,* 368-371.

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Arvidsson, M., Johansson, C. R., Ek, Å., & Akselsson, R. (2004). Organizational climate and psychosocial work environment in air traffic control. In J. Houdmont & S. McIntyre (Eds.), *Occupational Health Psychology: Key Papers of the European Academy of Occupational Health Psychology* (pp. 44-50). Avioso S. Pedro: Publismai.

Ek, Å., Arvidsson, M., Akselsson, R., Johansson, C. R., & Josefsson, B. (2005). Organizational Issues and Safety Culture in ATM Part 1 – Stability Analysis. *Proceedings of the 6th USA/Europe Seminar on Air Traffic Management Research and Development, Baltimore, USA*, June, 27-30.

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APPENDED PAPERS

I. The influence of organizational climate and leadership on safety culture and safety climate from an air traffic management perspective – a review

II. Organizational climate in air traffic control: Innovative preparedness for implementation of new technology and organizational development in a rule governed organization

III. Situational leadership in air traffic control

IV. Psychosocial work environment in air traffic control: Assessments with respect to ATM characteristics, task and organizational position

V. Safety culture in Swedish air traffic control

CHAPTER **ONE**

1 INTRODUCTION

1.1. Environmental conditions and basic needs of research

The air traffic management (ATM) industry in Europe is under considerable stress due to the constantly increasing number of air traffic movements. The capacity for handling air traffic has already reached the limit. The European Commission and the European Organization for the Safety of Air Navigation, Eurocontrol, predict that air traffic will be twice the present amount by 2020 (Van Houtte, 2004). The primary reason for the inefficiency is the fragmented organization of the European air space. Air Navigation Service Providers (ANSP) in Europe are largely organized on the basis of national boundaries while air transport operates in a single European market. Thus the service provided sometimes involves cumbersome procedures that must be in place due to the fragmented airspace.

To approach a harmonization and a more rational organization of the European airspace, the approximately 60 air traffic control centers (ATCC) in Europe have to be reduced and the operations have to be more efficient while still ensuring high safety standards. In order to meet these challenges and prepare for the future, the Single European Sky (SES) initiative was launched by the European Commission (EC, 2004). Air traffic control centers will be merged in this transition and the upper air space will be reorganized into functional air space blocks which will be designed according to air traffic flows rather than to national boundaries. To realize this prospect there is a need for change in organizational structures, as well as improvements and harmonization in technology. One of the major consequences of a fusion of air traffic control will be the merger of workforces and hence organizational issues and safety culture are brought into focus.

In Sweden, the adaptation to increasing demands on efficiency, technical development and harmonization with international standards and the SES initiative has already been initiated. The Swedish ANSP is undergoing major changes concerning establishment of commercialized spheres, air space restructuring, new leadership structures, new work organizations and work

practices, i.e. transition to a more computerized air traffic control system, Eurocat 2000E.

The extensive organizational and technical changes in the Swedish ATM industry and in the rest of Europe can affect the safety work and introduce changes in the existing safety culture and driving forces for safety. This in turn, could have effects on air safety. Changes in organizational settings such as downsizing have previously contributed to serious damage to the existing safety culture with severe consequences in other industries (Baram, 1998; Erlandsson, 2001).

The process of developing a safety culture within ATM and of determining the relationship to safety management involves many challenges. Important questions need to be answered in terms of what constitutes a safety culture in the ATM context and which organizational aspects influence the safety culture. The theoretical assumption is that the safety culture does not exist as an isolated element alongside other organizational aspects. Instead, it is present within different parts of the organization with no boundaries between levels and organizational areas. The safety culture is therefore likely to be affected by different, existing organizational aspects. This assumption is supported by safety research where a shift of focus in recent years has become apparent. Today there is an increasing awareness that organizational, managerial and human factors rather than merely technical failures are prime causes of accidents in high risk environments (Flin, Mearns, O'Connor & Bryden, 2000). Thus organizational factors are now regarded as important aspects in preventing incidents and accidents in contrast to earlier more individualistic and technical approaches. Most of the research in this area is still, however, too narrow and safety culture is often studied without reference to other organizational aspects. Sorenssen (2002) refers to Apostolakis and Wo (1995) who claim that it would be unwise to separate safety culture from the general organizational culture since both aspects are closely interrelated through working tasks and other organizational aspects. Reason (1997) further claims that the overall quality of both production and safety is dependent upon the same underlying organizational processes and thus safety is not a separate issue in an organizational context.

Even though air traffic control has been a popular research arena and thus has a strong research tradition – especially in the field of behavioral research in terms of human-computer interaction, man-machine interface, mental workload, stress, etc. – work concerning organizational aspects in relation to safety is remarkably limited (e.g. Flin et al., 2000; Guldenmund,

2000; Smallman, 2001; Wiegmann, Zhang, Von Thaden, Sharma & Gibbons, 2004).

The thesis aims to overcome this limitation. It presents research results from studies that examine innovative organizational climate, psychosocial work environment, and situational leadership together with safety culture in a high risk air traffic control setting in time of change.

1.2. HUFA - Human Factors in Air Navigation Services

Collaboration between the LFV Group Swedish Airports and Air Navigation Services and Lund University was initiated in 1998 which resulted in a significant number of master theses concerning various psychological, organizational and human-factor aspects in Swedish air traffic control. A need for further research was identified since new technology was about to be implemented with significant changes in working tasks and methods, and an organizational restructuring from a hierarchical to a team based organization was ongoing. In 2002 a more extensive project was launched entitled "Human Factors in Air Navigation Services" (HUFA). Utilizing a longitudinal approach, the aim of the project was to study and monitor organizational climate, psychosocial work environment, leadership effectiveness and safety culture, during the course of organizational and technical change in the Swedish ATM.

The organizational aspects were studied during the course of three measurements conducted at two air traffic control centers (ATCCs) and at the air navigation services (ANS) unit which is part of the LFV head office. Due to several delays in the implementation of the new air traffic control system, the initial research design was adjusted along the path. The final framework consisted of two measurements conducted before the introduction of the new air traffic control system and one about six months after the implementation. Due to the delays, the studies in this thesis focus on the first pre-implementation measurement.

An important tool for improvement was identified in the form of an interactive action research based, ongoing dialogue with the ATCCs and the ANS unit concerning the findings during the studies. This dialogue provided the opportunity for the staff to further discuss issues raised by the results on a local basis.

The understanding of organizational factors and their involvement in safety is established in Swedish air traffic control. In order to promote a reporting

culture where operators feel safe to report anomalies and incidents, the development of an open, just and trustful culture has been on the agenda for some years. The driving force is learning from mistakes since each anomaly can provide valuable information and help prevent similar events in the future.

1.3. Overall aims and research questions

The thesis aims to present the knowledge generated through research on psycho-organizational aspects and safety culture in a high risk organizational setting with highly reliable operations.

The research is part of a larger research project that aims to contribute a more extensive understanding of the way in which psycho-organizational factors and safety are affected by significant changes in technology and organization, and how different psycho-organizational aspects relate to and interact with the safety culture.

The overall aims of the research presented in the thesis are:

I. Outline the empirical knowledge regarding relationships between organizational climate, leadership and safety that is provided in the literature.

   In order to understand the complexity of psycho-organizational factors and their relation to safety there is a need to broaden the view to include more than just safety culture or safety climate in the analysis. First of all it is necessary to identify what is already done and what knowledge is missing.

II. Investigate the innovative organizational climate and the preparedness and capacity to cope with changes in a highly regulated organizational environment.

   High risk organizations concerned with reliable operations have natural obstacles in developing an innovative organizational climate and a preparedness to change due to strong regulations. While operating in a changing environment, however, adaptation will become necessary.

III. Investigate leadership characteristics in a high risk organization with a well developed safety culture.

Leadership has been identified as a strong influential factor concerning attitudes and safety related behaviors in high risk contexts. The nature of the leadership practices in a well developed safety culture can provide knowledge about safety practices.

IV. Identify critical psychosocial environmental factors in a high risk organization with demanding work operations.

High demands in the work environment can be stressful and have consequences on work performance which can be critical in a high risk environment. Change and development add to the mental workload and can contribute to further stress in the work situation.

V. Investigate perceptions of safety culture in a high risk organizational setting.

Safety culture has been identified as a critical aspect in positive safety practices in high risk organizations with highly reliable work operations.

VI. Investigate relationships between safety culture aspects and organizational climate dimensions.

In the process of improving and developing a safety culture, it is vital to gain more knowledge of what aspects or factors in the organizational climate that shape or affect the safety culture.

CHAPTER **TWO**

2 AIR TRAFFIC CONTROL

The primary task of air traffic control is to maintain the regulated separation between aircraft in order to prevent collisions in the airspace and to uphold well organized and efficient air traffic flows. The air space is organized into bordering sectors each controlled by one, two or in exceptional cases more air traffic controllers. The activity is founded on international rules and common agreements between nations around the globe.

The air traffic controllers give the pilots permissions, instructions, directions and have the air traffic under continuous surveillance. The work is conducted by means of computer screens, providing radar information presenting the current air traffic situation in the controller's specific sector of air. Information is given by the system concerning flight number, altitude, speed, direction, etc. Information about incoming flights, weather conditions, etc., is also provided by the system. As standard procedure, two air traffic controllers work together within one sector as executive and planner (see Figure 1.) Today, changes in altitude or speed are directly entered in the system which was not the case in the old system where planning and altering were written down on paper strips.

Even though the technical developments have resulted in various aids that help the air traffic controller to conduct the work in a safe and efficient way, the work is still demanding with a high mental workload in terms of perception, attention, information processing, problem solving and decision making. All controllers are, in addition, aware of the great responsibility involved in the work.

Since the air space is under constant surveillance, the work is conducted in shifts around the clock. The operative work is organized in teams with necessary qualifications for specific sectors, handling either the arrival and departure flight traffic or the en route traffic. Each shift is supervised by a watch supervisor who performs briefings and debriefings and has the overall responsibility for the work.

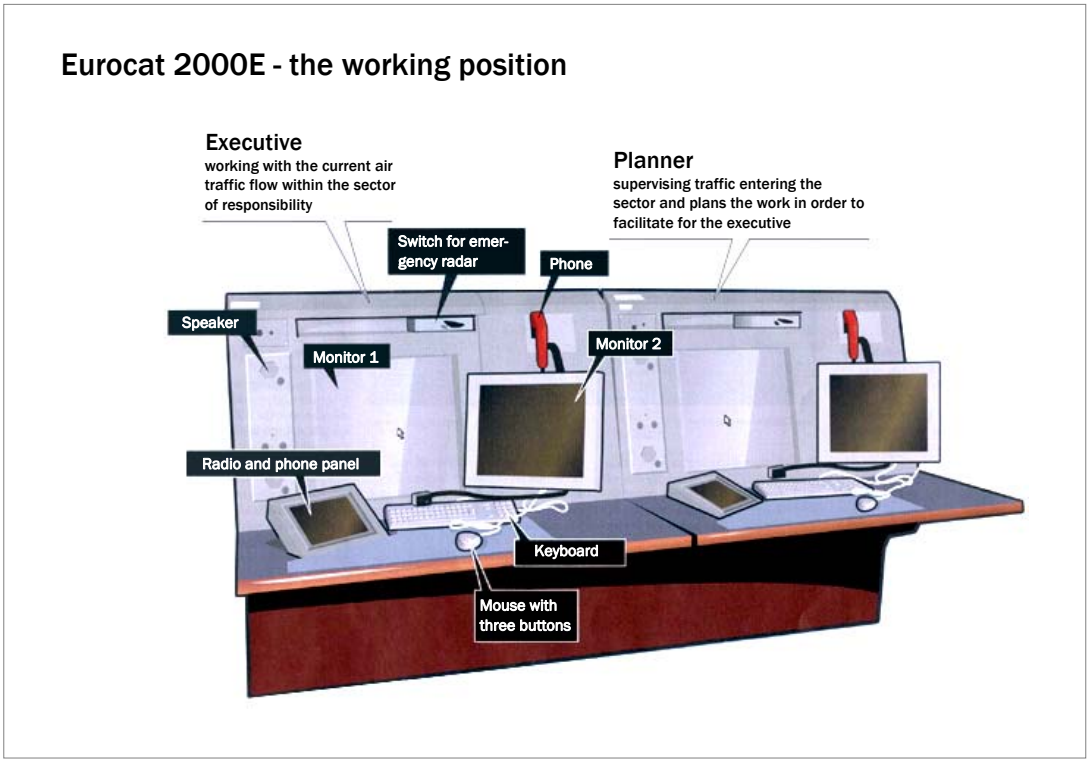

Figure 1. Eurocat 2000E working position. © Svenska Grafikbyrån

Today air traffic control is a highly complex interaction between specially trained personnel, advanced technology and carefully tested working methods. However in the beginning of commercial aviation, around 1920, aircrews lacked ground-based navigation aids. To avoid getting lost or colliding with other aircraft or the ground, pilots relied on direct observation, their own deductions and simple instruments (Williams, 1990). During The Second World War air operations in poor visibility and at night were required which led to elementary air traffic control based on procedures similar to some of those still followed beyond radar coverage. The safe and efficient management of air traffic was established as the objective of air traffic control. Safety was paramount. The founding of the International Civil Aviation Organization (ICAO), the regulatory body for the specification and implementation of common air traffic control procedures and practices led to the formulation of internationally agreed standard practices. A sensible balance between national sovereignty and the international regulation of air traffic became apparent, taking in account national differences in geography, traffic demands and the political and financial priorities (Hopkin, 1995).

Initially the greatest demand for commercial flights was between main centers of population and the most direct routes were naturally preferred. Many of these routes were eventually marked by ground-based beacons emitting signals that could be sensed by aircraft flying along the route. Separate and approximately parallel routes were allocated to aircrafts flying in opposite direction. Aircraft were also separated in altitude with different flight levels for different types of aircraft and for traffic flying in different directions. When the arrival of radar improved the quality of this information, the minimum separation between aircraft could safely be reduced so that the controller could handle more air traffic within a given airspace.

As the number of aircraft and the demands for air traffic control services increased so did the workload of the controller. The concept of sector was applied to the region of airspace defined by geographical and height boundaries within which the controller was responsible for providing the air traffic service. For a time, further increases in demand could be accommodated by reducing the size of the sectors. However, the handover of responsibility for the control of each aircraft as it left one sector and entered the next imposed a communication workload for both the controllers and the pilot. At some point the further partitioning of sectors becomes counterproductive as a response to increased traffic demands because of the extra coordination and liaison tasks introduced by sectorization (Hopkin, 1995). The fragmentation further makes the optimization of traffic flows difficult, which is one of the obstacles the Single European Sky initiative is supposed to overcome.

Developments in navigation, in communication, in computer technology and software, in system planning and strategic control techniques and human-machine interface design have mainly been the response to increased air traffic in order to amplify capacity and maintain safety in air traffic control. Thus, traditionally, much emphasis concerning research in this field has been directed towards technical or individual aspects rather than towards organizational issues. Since air traffic is still rapidly growing, so are the demands on air traffic services. As more and more people become involved in the operations of handling air traffic, increasing demands on coordination and organization between people and procedures will be identified. To cope with increasing demands and maintain safety and efficiency, greater attention needs to be given to the psycho-organizational aspects.

CHAPTER **THREE**

3 THEORETICAL FRAMEWORK

The thesis focuses on four different psycho-organizational aspects which separately and in interplay can have an impact on safety outcomes in high risk organizational settings with highly reliable operations. This section provides an overview of the aspects included in terms of *organizational climate*, *situational leadership*, *psychosocial work environment* and *safety culture* and their relation to safety and importance in air traffic control.

3.1. Organizational climate

Encyclopædia Britannica Online (2003) refers to climate as "conditions of the atmosphere at a particular location over a long period of time." In contrast to weather, which is considered as quite unstable, the climate describes certain more stable conditions in a specific region. This meteorological term has been transferred to the social science area and has become a concept describing certain psychological conditions in a specific social context (Ekvall, 1990). The concept of climate in a psychosocial sense goes back as far as to Gestalt psychology where it was introduced as a term in the field of social psychology (Lewin, Lippit & White, 1939). Gestalt psychology emphasizes the notion of the whole, implying that individual elements of perception are formed into wholes representing more than the simple sum of the specifics of the individual elements. Organizational climate is a gestalt based on perceived patterns in the specific experiences and behaviors of people in organizations (Schneider, Bowen, Ehrhart & Holcomble, 2000).

According to Ekvall (1987), two theoretical approaches to the concept of organizational climate can be identified: one realistic and objectivistic and one subjectivistic and phenomenological. According to the objectivistic view, climate exists as a reality in the organization and can be observed and studied in various ways. Climate is defined by typical behaviors, attitudes and feelings. It is an attribute of the organization, an objectively existing

part of the organizational reality that is independent of the perceptions of the organization's members.

In the subjectivistic approach, the organizational climate is regarded as the perceptual and cognitive structuring of the organizational situation common to the members. Individuals encounter a continual flow of events, routine actions and processes in the organization and they try to interpret them in order to make the environment comprehensible. In this way the members of the organization create a cognitive map which helps them to explain and attach meaning to their experiences. Interaction between members of the organization implies an exchange of experiences and perceptions which modifies the cognitive maps. In this process a common view of perceiving and interpreting the organizational environment arises between the members. The organizational climate consists of the shared perceptions that evolve in the course of time and events.

The central issue is thus whether climate is a "shared perception" or a "shared set of conditions" (Denison, 1996). Nevertheless, both approaches consider the climate as an overall attribute. The climate concept is not concerned with adjustment to the individual task or relations with a particular colleague but with the total psychosocial work environment (Ekvall, 1987).

Ekvall (1996) defines organizational climate as a conglomerate of the attitudes, feelings and behaviors which characterize life in an organization. The organizational climate exists independently of the perceptions and understandings of the members of the organization and climate is conceived as an organizational reality in an "objectivistic" sense (Ekvall, 1996). At the individual level of analysis the concept is called psychological climate. At this level, climate refers to the intrapersonal perception of the pattern of behavior, attitudes and feelings experienced by the individual. When aggregated, the concept is called organizational climate. These are the objectively shared perceptions that characterize life in the organization (Isaksen, Lauer, Ekvall & Britz, 2000).

The individual in the organization is regarded as an observer and potential reporter of the prevailing climate rather than as a creator or carrier of the climate in the cognitive sense (Ekvall, 1987). Every individual organizational member perceives the climate and can describe it on the basis of his or her own perceptions. The climate of an organization can therefore be studied by way of these perceptions. But this is not the same as saying that the climate is the perceptions. The climate can just as well be studied by

way of external assessors (Ekvall, Arvonen & Waldenström-Lindblad, 1983).

According to Ekvall (1990) the organizational climate can be seen as an intervening variable between the processes of in-put and out-put within the organization (see Figure 2). Invested resources are expected to create certain effects throughout different organizational processes such as profit, innovations, quality, good service, job satisfaction, etc. The climate has an impact on these organizational processes and on the outcome as well. The climate itself does not accomplish anything but it strengthens or weakens the effects created by the available resources. If the outcomes are good, effects on attitudes, feelings and behaviors will be different than it would be if the outcomes were poor.

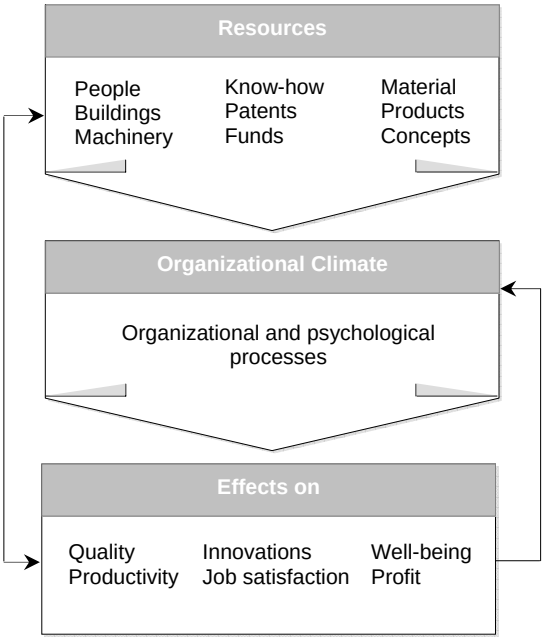

Figure 2. Organizational climate as an intervening variable (Ekvall, 1996).

The organizational climate is shaped by the interaction between the organization and its members. The day-to-day contact and confrontation with the organization, its structures and processes creates the attitudes, feelings and behaviors that constitute the organizational climate. The individuals within the organization, their personalities, attitudes, knowledge, experiences, etc., have a central impact on the kind of climate that evolves. The organization offers the opportunities, as well as the boundaries for the possible interactions and the climate that develops. In addition, the management is consid-

ered to have a great influence in shaping the climate. Other factors such as the size of the organization, the physical environment, the financial situation, etc., can also have an impact on the organizational climate (Ekvall, 1990).

3.1.1. Innovative organizational climate

Organizational climate consists of various aspects which imply that several different climates can be distinguished within an organization, e.g. a "service climate" (Schneider et al., 2000), a "safety climate" (e.g. Zohar, 1980; Flin et al., 2000) or an "innovative climate" (Ekvall, 1996). The innovative organizational climate can be described as an important factor for stimulating change and innovation within an organization (Ekvall, 1994). The key driver of the organization's ability to change is innovation (Ahmed, 1998). The climate for innovation promotes the generation, consideration and use of new products, services, and ways of working. An innovative organizational climate supports the development, assimilation and utilization of new and different approaches and concepts.

According to Saleh and Wang (1993) an innovative organizational climate benefits from (1) an open, endorsing climate, (2) a climate where collegiality is the basis of relationship, and (3) a reward system to reinforce such a climate to achieve innovation. Openness in exchanging information has two positive implications for innovation. The first is the technical value of increasing the availability of information, and the second is the psychological value of promoting trust. Trust helps in developing a climate in which employees are not afraid to challenge the status quo or to take risks even though they may fail. In a collegial climate, authority and power are shared equally among colleagues, which is different from the leader-subordinate authority relationship of the classical approach. Decisions in a collegial climate are perceived to be the major seat of company power. A well planned reward system is also an effective tool to reinforce the expected behaviors and to shape the development of the desired climate.

High risk organizations like air traffic control or nuclear power plants, governed by rules, instructions and regulations usually have difficulty in getting a positive innovative climate to evolve. Due to detailed instructions describing working methods and procedures, the space allowing and stimulating creativity or innovativeness is limited. Little room is given for new ideas or thoughts. According to Ekvall (1994) standardized routines and regulations have a negative impact on creativity and seem to prevent an innovative climate from developing. Hedberg and Sjöstrand (1979) further discuss forces within an organization that prevents the organizational members from ob-

serving and becoming aware of the needs and requirements of change. They refer to the term "organizational inertia" which is caused by strict instructions and manuals used in defining and describing work methods and procedures. An orientation towards control of flexibility in the organization can further affect the outcome when implementing new technology according to Zammuto & O'Connor (1992). The control dimension is associated with mechanisms of coordination and control, such as rules and policy procedures. Flexibility is associated with commitment-based mechanisms of coordination and control such as training and socialization. According to Zammuto & O'Connor (1992) organizations with control-orientation are more likely to fail in the implementation of new technology compared with flexible organizations.

The rules and regulations in air traffic control are certainly motivated. For safety reasons, the air traffic controllers are not allowed to take actions that would challenge the safety standards. Innovativeness in the area of air traffic control and other high risk, highly reliable organizational settings should therefore not imply freely experimental behavior in daily operations. Still the ability to change will be crucial when adapting to future conditions in terms of increased air traffic volumes and harmonization or air traffic procedures.

3.1.2. Organizational climate versus organizational culture

During the 1980s the term "organizational climate" was gradually replaced by the term "organizational culture" in the field of organizational research (Guldenmund, 2000). There has been an ongoing debate ever since about differences between the concepts and whether or not it is useful to separate them.

One of the most cited definitions of organizational culture is that of Schein's (1985). According to this definition, organizational culture is "a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (Schein, 1992, p. 12). Values become norms and the norms tell the members of the organization about the correct attitudes and actions.

From Schein's (1992) point of view the culture can be analyzed at several levels. The term "level" refers to the degree to which the cultural phenomenon is visible to the observer. The surface level is referred to as arti-

facts which include all the phenomena that one sees, hears and feels when one encounters a new group with an unfamiliar culture. This level also includes the visible behavior of the group and the organizational processes through which such behavior becomes routine. The next level is represented by espoused values including strategies, goals and philosophies. Values on this level will predict much of the behavior that can be observed at the artifactual level. However, if those values are not based on prior learning they might just reflect what Argyris and Schön (1996) have referred to as "espoused theory of action", which does not predict the individuals' actual behavior but rather their expressions of action strategies. Basic underlying assumptions represent the deepest level and are defined as the essence of culture. At this level, unconscious, taken-for-granted beliefs, perceptions, thoughts and feelings are included which together make up the ultimate source of values and action. Basic assumptions are so taken for granted that members of a group will find behavior based on any other premise inconceivable. Though the essence of an organizational culture is shared, taken-for-granted basic assumptions, the culture will be manifested at the levels of observable artifacts and shared espoused values, norms and rules of behavior.

Schein (1992) conceives organizational climate as preceding culture. Organizational climate is a reflection and manifestation of the cultural assumptions. Climate is replaced by culture and culture then expresses a broader and more profound meaning.

Ekvall (1983) distinguishes organizational climate from organizational culture. He divides an organization's social system into: (1) organizational culture, i.e. beliefs and values about people, work, organization; (2) social structure, i.e. the informal organization; (3) organizational climate; i.e. common characteristics of behavior and expression of feelings by organizational members; and (4) work relations, i.e. the nature of the relationship between management and employees. Ekvall argues that all four segments are mutually related but distinguishable.

If organizational climate is to be included in an organizational culture model it should, according to Ekvall (1996), be regarded as a manifestation of organizational culture on what Schein (1992) has described as the level of artifacts including visible and audible behavior patterns.

Organizational climate and organizational culture are closely related according to Asforth (1985) and sometimes hard to separate. Despite this, the differences are in fact real and meaningful. The culture influences the climate

through values and norms that are based on assumptions and convictions established on a deep psychological level. The individuals within the organization receive information about the behaviors and attitudes that are considered acceptable. This has an impact on the kind of climate that evolves. The culture can be regarded as possessing affecting-abilities that are present in the background. In this way the organizational climate is considered to be derived from the organizational culture.

Reichers and Schneider (1990) define organizational climate as shared perceptions of organizational polices, practices and procedures, and describe organizational culture in terms of shared meanings or understandings about the organization and its problems, goals and practices.

Denison (1996) concludes that both concepts struggle with a highly similar set of general problems. Both perspectives attempt to address the problem of social contexts simultaneously being the product of individual interaction and a powerful influence on individual interaction. Proponents of both perspectives have attempted to understand the process of reciprocal evolution but they often have been more successful at explaining one process or the other rather than both. In Schein's (1992) definition, the culture focuses on how social contexts develop out of interaction, while the climate approach is more likely to focus on the perceptions of social contexts and their impact (Dennison, 1996). Despite the differences between the concepts, Dennison (1996) illustrates that they share a common ground in trying to describe and explain the relationships that exist among groups of people who share some sort of common situation.

Because the nature of culture is so deep and inaccessible, the concept of climate is considered to be more closely in touch with reality. Schein (2000) claims that the climate can only be changed to the degree that the desired climate is congruent with the underlying assumptions. One cannot create, for example, a climate of teamwork and cooperation if the underlying assumptions in the culture are individual and competitive, because those assumptions will have created a reward and control system that encourages individual competitiveness. All too often, programs of change fail because they do not take into consideration the underlying culture.

The two concepts can further be distinguished in terms of applied methodology. Organizational culture mostly engages qualitative methods while organizational climate research mostly depends on quantitative methods (Guldenmund, 2000). Accordingly, the two concepts stem from different disciplines. Glick (1985) argues that research on organizational climate de-

veloped primarily from a social-psychological framework, while culture is rooted firmly in anthropology.

Organizational culture can thus be described as a global, integrating concept underlying most organizational events and processes, whereas organizational climate can be described as the overt manifestation of culture within an organization. Climate follows naturally from culture according to Guldenmund (2000) or put another way, organizational culture expresses itself through organizational climate.

3.2. Situational leadership

The importance of leadership in safety is a constantly recurrent theme in the literature (e.g. Barling, Loughlin & Kelloway, 2002; Clarke, 1999; Hofmann, Morgeson & Gerras, 2003; Flin, 2003; O'Dea & Flin, 2001; Zohar, 2002). The impact of leadership on safety relates to both attitudes and actions among managers. Management commitment, management style and visible management have been identified as organizational factors that are associated with a good safety culture (HSE, 1999) as well as first-line supervisors' leadership style and team management skills (Flin, 2003). Leadership has further been identified as influential regarding psychosocial work related stress. Stress reducing leadership practices can be identified in terms of supportive leadership style (Bakker, Killmer, Siegriest & Schaufeli, 2000) and participative leadership (Oaklander & Fleishman, 1964). Assigning tasks, specifying procedures and clarifying expectations can further have a positive effect on reducing role ambiguity and increasing job satisfaction (Gray-Toft & Anderson, 1985).

In a general sense, approaches to leadership have attempted to study the extent to which successful leadership is a result of either specific characteristics of the leader, features in the situation in which those qualities emerge or a combination of these elements (Haslam, 2001).

Trait-based theories argue that leaders are set apart from followers by their possession of distinctive intellectual and social characteristics such as intelligence, interpersonal skills, emotional stability, integrity cognitive skills, etc. (e.g. Bray, Campbell, & Grant, 1974). A slight variant on this perspective is offered by researchers who have sought to identify leaders not on the basis of their character but on the basis of their behavior and actions. Leadership behavior in this sense has been described in terms of *Consideration* and *Initiating Structure* (e.g. Fleishman, 1953) or *task-oriented behavior* and *relationship-oriented behavior* (e.g. Katz & Kahn, 1952). Task-oriented behavior implies

that effective leaders concentrate on task-oriented functions such as planning and scheduling, coordinating activities, etc., while relationship-oriented leadership concerns supportive and helpful behavior with subordinates including showing trust and confidence, acting friendly and considerate and trying to understand subordinates' problems, etc. Other theories have suggested that successful leaders are those whose personal qualities enable them to articulate a vision for a given organization or group. Charismatic leadership derives from the leader's ability to set an example that provides a behavioral model for others, enabling them to contribute to the realization of the vision (e.g. Conger & Kanungo, 1998). Transformational and transactional approaches to leadership arrive at similar conclusions but from a different angle. The basis for leadership is not found in the individual leader but rather in the quality of the relations between the leader and other group members (e.g. Bass, 1997).

Situational leadership approaches that argue that effective leadership is largely determined by the interaction of both personal and situational factors stand in contrast to approaches which look for the key to leadership in the nature of traits, behavior or charisma of the leader. Since leadership processes are a function of the leader, the subordinates and other situational variables, the desire to have a single ideal type of leadership behavior seems unrealistic (Hersey & Blanchard, 1996). Probably the most well-known approach to situational leadership has been Fiedler's contingency model (Fiedler, 1967). This model regards effective leadership to be a consequence of the agreement between the characteristics of the leader in terms of relationship-behavior or task-behavior, for example, and specific features of the situation such as the quality of relations between the leader and other group members or to the degree the leader has power.

Hersey and Blanchard (1996) have developed a contingency theory that specifies the appropriate type of leadership behavior according to different levels of subordinates' *maturity* in relation to their work. A high-maturity subordinate has both ability and confidence to do a specific task while a low-maturity subordinate lacks ability and confidence.

The theory is based on task and relationship leadership behavior. Subordinate maturity determines the appropriate combination of task and relationship behavior for the leader. Hersey and Blanchard distinguish between four levels of maturity ranging from M1 to M4 even though they are simply elements of a continuum ranging from immature to mature.

The leaders should use considerable task-oriented behavior, referred to as leadership style S1, when a subordinate is very immature in relation to the task (M1). In this situation the leader should be direct in defining roles, clarifying standards and procedures and monitoring progress on achievement of work objectives. The leader can reduce the degree of task-oriented behavior when subordinate's maturity increases to a moderate level (M2 and M3). In these situations the leader should provide more relationship-oriented behavior and act supportive, consult with the subordinate and provide praise and attention (leadership style S2-S3). The leader should use a low amount of both task and relationship behavior (S4) when subordinates are very mature (M4). Mature subordinates have necessary abilities and skills to perform the work without much direction or monitoring by the leader, and the confidence to work without much support.

3.3. Psychosocial work environment

The term "psychosocial work environment" is a multidimensional concept describing various psychosocial aspects in the working environment. No precise definition of the term appears to exist but according to Westlander (1980), three aspects can nevertheless be identified concerning the psychosocial work environment: one dealing with psychosocial factors as causal conditions in the work environment, one concerning the effects on the individual's experiences and behaviors, and one treating psychosocial factors as the effects of the interaction between the individual and the environment. Despite the differences between these concepts, they still indicate that there is a close relationship between the individual and the environment.

The consequences of long-term exposure to psychosocial stressors at work could be significant for employees, workplaces and society. Stress as a consequence of a poor psychosocial work environment can have detrimental effects on quality of life and work: it might influence overall well-being among employees, their social relations and family life. Effects can be noticed in terms of absence from work, early retirement, low productivity and low quality in service or products (Kristensen et al., 2005). Furthermore, chronic stress can be indirectly related to mental and physical ill health and in extreme cases to death. It is scientifically supported, that chronic stress can increase the risk of heart disease and depression and that stress can weaken the immune system and thus our resilience to illness (e.g. Peter & Siegrist, 2000; Tennant, 2001). According to Orasanu (1997), certain cognitive components of naturalistic decision making also appear to be vulnerable to the effects of stressors in terms of attention and working memory.

Research has demonstrated that people make more errors on a wide variety of tasks when stressed than when not stressed (e.g. Flin, Salas, Strub, & Martin, 1997). In organizations working with operations requiring high reliability such as air traffic control where the performance of the air traffic operators has a direct link to safety outcomes, this is an aspect that cannot be ignored.

The reaction to similar psychosocial exposures may differ among individuals. Some people can cope with high demands and high levels of psychosocial risk factors, while others cannot. It is always the subjective assessment of the situation that is critical for the stress reactions (e.g. Grimshaw, 1999). This implies that it is not possible from the situation alone to determine the stress reactions without reference to the context, the individual and the individual's group.

Even though psychosocial stressors exert their effects on individuals in different ways and have specific individual manifestations, there are some aspects such as *demands*, *control* and *social support* that appear to be commonly associated with the term psychosocial work environment (Eriksson, 1996).

Control refers to the amount of influence the employee enjoys in regard to work tasks and overall planning in terms of possibilities to influence the working environment and working conditions, but also in terms of the ability to influence aspects such as breaks and working hours. The control aspect can further include information concerning important changes, activities and future events within the organization. The amount of control in the work is regarded as critical for worker health and well-being in terms of job satisfaction (Becherer, Morgan & Lawrence, 1982; DeCarlo & Agarwal, 1999). Further studies have shown that work tasks with low levels of control as well as work which is heavily routinized are associated with low mastery, low personal control and high powerlessness (Gecas, 1989; Link, Lennon & Dohrenwend, 1993).

A theoretical framework that explains the relation between the psychosocial characteristics of the work environment in terms of demands and control and health outcomes has been suggested by Karasek and Theorell (1990). Work demands refer to different sorts of workloads and can be operationalized in terms of amount of work, time pressure and conflicting demands.

Quantitative work demands are thus related to the amount of work to be done, and the basic source of stress is the possible mismatch between the amount of work and the time available (Kristensen, Bjorner, Christensen &

Borg, 2004). Demands can further be referred to as the cognitive abilities needed on the job such as decision making and memory processes, but also to emotional aspects involved as well as sensory and psychomotor skills. According to Karasek and Theorell (1990), control includes two theoretically distinct concepts: skill discretion and decision authority. Skill discretion refers to the possibility for the employees to decide how their knowledge is used and developed. If employees have high skill discretion, their ability to exert control in unexpected situations is relatively high. Decision authority incorporates the employees' possibilities to influence work content and how the work is carried out. High demands imply high risk for ill health. High control, on the other hand, is considered to reduce the ill health risk. According to this model psychological strain does not result from single aspects of the work environment, but from the combined effects of the demands of a work situation and the range of decision-making freedom available to the employee facing those demands. Job demands and control when combined make it possible to distinguish between four main types of job: high-strain jobs (high demands and low control), low strain jobs (low demands and high control), active jobs (high demands and high control) and passive jobs (low demands and low control). High-strain jobs are believed to create higher levels of stress because the individual is not given the opportunity to manage the high demands. Low or reasonable demands in combination with a high degree of control should result in a limited risk for stress and stress related problems.

It has further been established that social support reduces the health effects of job strain (Johnson & Hall, 1988). Studies have frequently found that individuals who report a high level of social support also enjoy enhanced health and well-being (e.g. Kahn, Hessling & Russel, 2003; Pierce, Sarason & Sarason, 1996). Social support can be defined as the availability and quality of the employee's relationships with supervisors, co-workers, family and friends and the amount of positive consideration and task assistance received from them (Spielberger, Vagg, & Wasala, 2003). Social support can have a direct effect in reducing stress or act as a buffer in interaction with the stressors (Cooper, Dewe & O'Driscoll, 2001). Two support categories can be identified: perceived organizational support and social support. These two categories are assumed either to have beneficial effects on employees or to protect the employee from the potentially negative effects of stressful events. Perceived organizational support is generally defined as the degree to which employees believe the organization is committed to rewarding their work effort and meeting their need for approval (Spielberger, Vagg, & Wasala, 2003).

In addition, other factors in the psychosocial work environment can be identified as important for health and job performance such as job insecurity and commitment (e.g. Hallier & Lyon, 1996), role conflict and ambiguity (e.g. Fried, Ben-David, Tiegs, Avital, & Yeverechyahu, 1998), and shift work (e.g. Costa, 1996).

3.4. Safety culture and safety climate

There has been a shift of focus within safety research in recent years driven by awareness that organizational, managerial and human factors rather than purely technical failures are prime causes of accidents in high risk environments (Flin et al., 2000). Increasing emphasis has been placed on psychoorganizational factors as important aspects in preventing incidents and accidents in contrast to the past, when more individualistic and technical approaches where favored. By closely monitoring safety conditions using predictive measures, there is less need to wait for the system to fail in order to identify weaknesses and take corrective actions (Falbruch & Wilpert, 1999). In high risk and high reliability industries, this realization has opened doors to concepts such as safety culture and safety climate which have started to attract the attention of safety researchers.

A broad range of factors have been identified in the literature as important components reflecting an organization's safety culture or safety climate (Flin et al., 2000). Even though no obvious consensus is present concerning the number of components or their mutual importance for safety behaviors or safety performance, five global components can be identified according to Wiegmann et al. (2004). These include organizational commitment (e.g. Flin, 2003; Arboleda, Morrow, Crum, & Shelly, 2003) management involvement (e.g. Clarke, 1999; Flin, 2003; O'Dea & Flin, 2001), employee empowerment (e.g. Geller, 1994), reward systems and reporting systems (e.g. Reason, 1997).

Reason (1997) further identified four critical aspects of a safety culture: a reporting culture, a just culture, a flexible culture and a learning culture which together interact to create an informed culture. A reporting culture refers to an organizational climate in which individuals are prepared to report their errors and near-misses. An effective reporting culture is very much dependent on how the organization handles blame and punishment which is manifested in the just culture. A just culture could be described as an atmosphere of trust where individuals are encouraged, even rewarded for providing essential safety related information. A flexible culture means being prepared to deal with unusual situations. It is manifested in the or-

ganization by a respect for skills, experiences and abilities among operators and supervisors. Finally, a learning culture can be described as the willingness and the competence to draw the right conclusions from the organizational safety information system and the motivation to implement major reforms when needed.

Other important aspects of a safety culture that can be identified in the literature are working situations which involve factors such as cooperation, support, adequate training in work practices and influence (e.g. Zohar, 1980); communication which assure that the right people are kept informed of the state of the system in order to make the appropriate decisions (e.g. Glendon & Stanton, 2000); attitudes towards safety which constitute individual and organizational attitudes regarding the importance of safety (e.g. Mearns, Flin, Gordon & Fleming, 1998); safety related behaviors which constitute individual and organizational behaviors in relation to safety (e.g. Geller, 1994); and risk perception which describes the organizational members' beliefs that the work is performed in a safe way (e.g. Mearns et al. 1998).

The concepts of safety culture and safety climate have their roots in the extensive research concerning organizational culture and organizational climate. The longstanding debate concerning the nature and usefulness of organizational culture versus organizational climate is also present in safety research. Sixteen definitions of safety culture and safety climate were presented in a review by Guldenmund (2000). Nine of these were about safety climate and seven were about safety culture. It was concluded that organizational members' perceptions were more associated with safety climate whereas attitudes were considered to be a part of safety culture.

As in the differentiation between organizational culture and organizational climate, safety culture tends to focus on a deeper psychological level than safety climate, and deals with shared core values, norms and attitudes based on assumptions and convictions about safety in the organization (DeJoy, Schaffer, Wilson, Vandenberg, & Butts 2004). The safety climate concept can be regarded as a specific form of the organizational climate. An emerging consensus tends to differentiate safety climate from safety culture implying that safety climate consists of an organization's underlying safety culture assessed by the workforce's attitudes and perceptions at a given point in time (Flin, 2003). Safety climate emphasizes shared perceptions held by employees regarding the importance of safety in their work environment and organization (e.g. Denison, 1996; Guldenmund, 2000; Wiegmann et al., 2004).

3.5. System view and need for integrating the perspectives

According to Reason (1990, 1997), human operator error is a consequence of different organizational deficiencies rather than a primary cause in major accidents and disasters. The meltdown of the Chernobyl nuclear power plant is one example of this.

Reason makes an important distinction between active failures on the one hand and latent conditions on the other. He argues that the active failures of human operators that caused the accident at Chernobyl, along with numerous others, are only the final event in a series of poor design, management and maintenance decisions, many of which existed long before the active failure.

Thus latent conditions may be present for many years before they combine with local circumstances and active failures penetrate the system's defense layers. They arise from strategic and other top-level decisions made by government, regulators, manufacturers, designers and organizational managers. The impact of these decisions spread throughout the organization, shaping a distinctive corporate culture and creating error-producing factors in the individual workplace.

The principal stages involved in the development of an organizational accident start with organizational factors such as strategic decisions, generic organizational processes, allocating resources, scheduling, communication, managing, etc. These processes will be colored and shaped by the culture or the unspoken attitudes and unwritten rules concerning the way an organization carries out its activities. The consequences of these activities are then communicated throughout the organization to individual workplaces where they emerge as factors likely to promote unsafe acts. These include undue time pressure, inadequate tools and equipment, poor human-machine interfaces, insufficient training, under-manning, poor supervisor-worker relations, macho culture, ambiguous procedures, poor communication, etc. In the workplace, these local factors combine with natural human tendencies to produce errors and violations – collectively termed "unsafe acts".

There are also recent examples of accidents in the ATM context where human and organizational factors were identified as contributing causes. One example is the accident over southern Germany in 2002 when a Russian commercial aircraft, model Tupolev 154 from Basjkirian Airlines with 69 passengers onboard collided with a cargo aircraft, model Boeing 757 at an altitude of 35,000 ft. At the air traffic control center in Zurich which was responsible for the air traffic over southern Germany, steps in introducing

a safety culture were taken but still not implemented. Only two air traffic controllers were responsible for the entire air space of ATCC Zurich at the time of the accident and the air traffic controller responsible for the colliding aircraft was working alone (BFU, 2004). Another example is the accident at the Linate Airport in Milan, 2001, when a Boeing MD-87 from Scandinavian Airlines with 110 people onboard collided with a Cessna 525-A from AIR EVEX during take off. At Linate, instructions, training and working conditions were not up to standard. These shortcomings prevented the air traffic control personnel from sufficiently controlling and supervising the movements on the airport (ANSV, 2004).

Even though the shortcomings identified in these investigations were extensive and a large number of imperfections were due to the technical equipment, psycho-organizational factors certainly played a major role in the development of both accidents. As mentioned previously, when such knowledge has become more and more apparent, doors have opened to concepts such as safety culture and safety climate. Reason (1997) further states that since the quality of both production and protection is dependent upon the same underlying organizational processes, safety cannot be treated as an issue that is separate from other organizational aspects. Safety culture or safety climate is likely to be affected by other existing organizational aspects. Even though the research is limited, relationships between organizational climate and safety climate have further been established in a number of studies (Neal, Griffin & Hart, 2000; Silva, Lima & Baptista, 2004; DeJoy et al., 2004; Ek, Akselsson, Arvidsson & Johansson, 2005). As already mentioned, the importance of management influence on employees regarding commitment, attitudes and behavior concerning safety culture, safety climate and safety related issues is also repeatedly stressed in the literature (e.g. Barling et al., 2002; Clarke, 1999; Hofmann et al., 2003; Flin, 2003; O'Dea & Flin, 2001; Zohar, 2002). Because of the mutual relationship between production and protection, it is difficult to prevent latent conditions from being sown into the system since they are an unavoidable product of strategic decisions according to Reason (1997). Therefore, what can be done is to make them visible to management and operators so that the most serious one can be corrected. In order to achieve this and to develop and form an improved understanding and knowledge of organizational safety, the safety culture should be studied along with other organizational aspects such as organizational climate and leadership. There is also a need to include psychosocial work environmental factors in such an analysis since these have an impact on human behavior and decision making (Flin et al., 1997).

Latent conditions are derived from the top-level and from there they spread throughout the organization. Accordingly, safety-critical errors happen at all levels of the system, not just in the sharp end (Reason, 1997). Hence, there is a need to include all organizational levels, not just the operators, in order to fully understand organizational aspects and their involvement in safety. The work should be based on a system perspective for controlling safety (Rasmussen, 1997) with an awareness that a socio-technical system is divided into levels (politicians, legislators, regulators, managers, safety officers, work planners and operators) and that these levels need to have functioning coordination for safety. Strong connections between the levels are important in the forming of goal directedness with feedback, learning and action both within and across levels. Learning becomes a basic principle in the dynamic socio-technical system and in creating proactive risk management for safety.

CHAPTER **FOUR**

4 METHODOLOGY

4.1. Instruments

Four different instruments were used in the research process to collect data regarding organizational climate, psychosocial work environment, situational leadership and safety culture. In this section a brief description of the instruments is presented with a focus on the dimensions included and psychometric data.

4.1.1. Organizational climate assessment

The *Creative Climate Questionnaire* (CCQ) was chosen to assess the organizational climate (Ekvall, 1990). The questionnaire consists of 50 items covering 10 dimensions with five items each. The dimensions are the result of several large factor analytic studies (Ekvall, 1996). The 10 dimensions are as follows:

Challenge/ Motivation	The degree of emotional involvement, commitment and motivation in operations and goals.
Freedom	The level of autonomy, discretion and initiative in behavior exerted by individuals to acquire information, make decisions, etc.
Support for ideas	The degree to which new ideas and suggestions are attended to and treated in a supportive manner.
Trust/ Openness	The degree of emotional safety and openness found in relationships.
Dynamism/ Liveliness	The dynamics and eventfulness of life in the organization.
Playfulness/ Humor	The display of spontaneity, ease, good natured joking and laughter.
Debate	The expression and consideration of many different view-points, ideas and experiences.

Conflicts	The presence of personal and emotional tensions or hostilities.
Risk taking	The tolerance of ambiguity and uncertainty.
Idea time	The amount of time people can use for elaborating new ideas.

The questions are answered on a 4-point scale in which 0=do not agree at all, 1=agree to some extent, 2=agree to a great extent and 3=fully agree. All scales except *Conflicts* describe dimensions that have a positive relationship to creativity and change. *Conflicts* have a negative relation to creativity and change.

The CCQ is an organizational measure, not an individual one, according to Ekvall (1996). The respondent is addressed as an observer of life in the organization and asked to tell how individuals in the workplace normally behave. The individual is not asked about his or her own behavior or personal feelings. The questions are therefore not of the attitude or job-satisfaction type and there is no mention of "I" or "me" in the items. The respondent is further requested to report on common behavior not on common opinions.

The item scores of the respondents are aggregated to the ten dimension scores by the mean score per five items. The internal consistency of the 10 CCQ dimensions was calculated using Cronbach's alpha according to Table 1.

Table 1. Cronbach's coefficient alpha for the ten organizational climate dimensions in the air traffic control studies and reference alpha values (Ekvall, 1990).

Scale		Questions (N)	ATM units Cronbach's α	CCQ Cronbach's α
1.	Challenge/Motivation	5	.74	.81
2.	Freedom	5	.62	.67
3.	Support for ideas	5	.88	.88
4.	Trust/Openness	5	.76	.76
5.	Dynamism/Liveliness	5	.78	.76
6.	Playfulness/Humor	5	.78	.70
7.	Debate	5	.72	.67
8.	Conflicts	5	.85	.84
9.	Risk taking	5	.55	.66
10.	Idea time	5	.73	.78

Table 1 shows that the alpha coefficients for the ATM units are in correspondence with the CCQ Cronbach's alpha (Ekvall, 1990). All dimensions except *Risk taking* have a good or reasonable internal consistency. The risk taking dimension does not directly refer to risks as commonly understood in a high risk environment, but rather to risks attached to ambiguity and uncertainty in business activity. It is still possible, however, that a number of respondents have interpreted some of the questions included in this dimension as dealing with operational risks. This probably explains the lack of internal consistency in this dimension.

4.1.2. Situational leadership assessment

A modified version (Holmkvist, 2000) of the *Leader Effectiveness and Adaptability Description* (LEAD) was used to assess situational leadership (Hersey & Blanchard, 1988). LEAD is a standardized instrument that measures specified aspects of leadership behavior in terms of the situational leadership theoretical model (Hersey & Blanchard, 1996) with documented reliability and validity (Greene, 1980).

The questionnaire consists of 32 items. Each question reflects a specific work situation which is described to the respondent. Each item is answered by one of four alternatives. The alternatives describe different leadership behavior strategies. The respondent is asked to choose the alternative that best describes the respondent's expected behavior of the leader in each situation, see example below.

LEAD question example:

Situation

The project group that your leader is supervising has come to a dead end. The group has misunderstood parts of the project definition and puts the blame on poor briefing. Meetings are used for pseudo-activities.

Alternative actions

A. Your leader gathers the group and ensures that everybody who has any views is allowed to speak his mind. Your leader responds to misapprehensions, supports realistic proposals and shares her or his experience.

B. At a meeting your leader makes a point of bringing out the group's own resources for solving the problems.

C. Your leader collects the group as soon as possible and finds out what has gone wrong. He or she clarifies the project description until convinced that everyone has understood.

D. Your leader helps the group to understand why the group has got into trouble and supports their own way of grappling with the problems.

Each alternative action (A, B, C or D) reflects a specific leadership style referred to as S1-S4, see Figure 3. Thus the method generates data concerning a leader's leadership style profile (the frequency of the four leadership styles S1-S4 used by the leader across the 32 situations). This profile provides an overview of a leader's task oriented and relationship oriented leadership behavior.

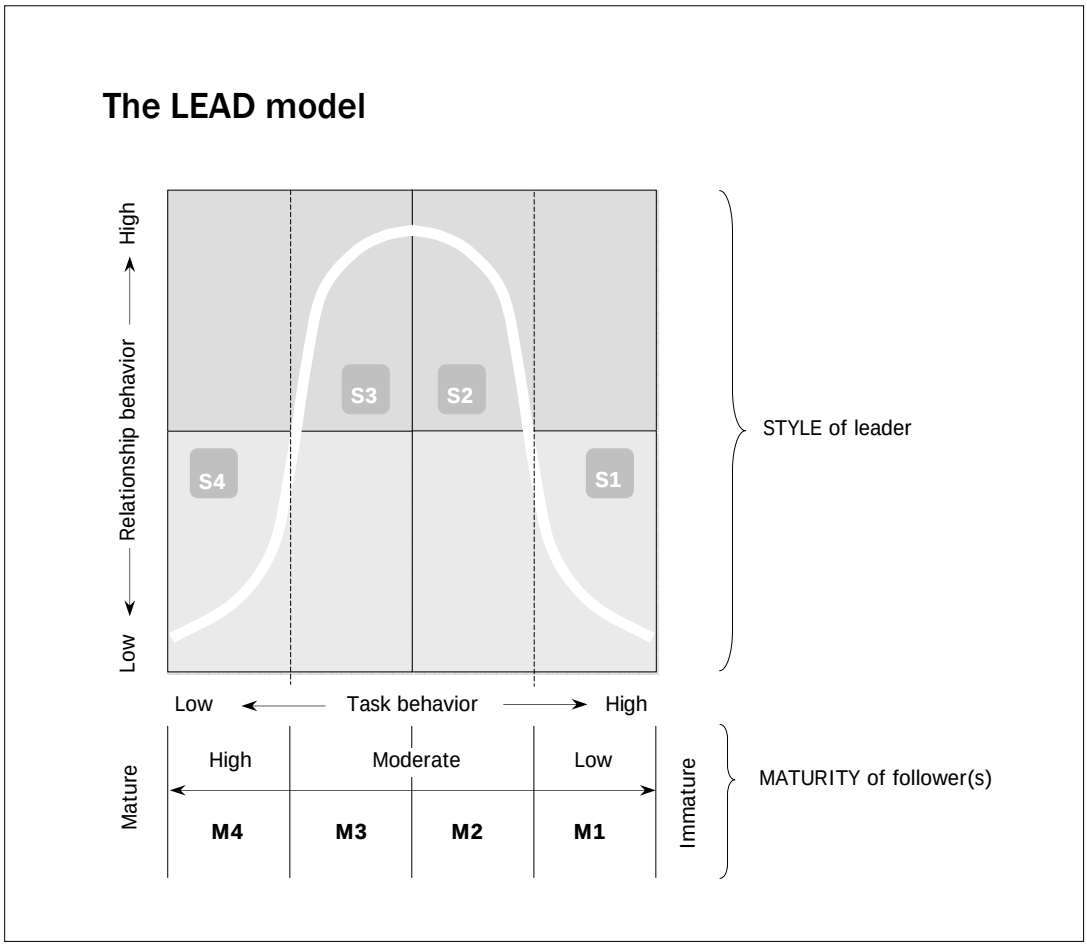

Figure 3. The situational leadership model (Hersey & Blanchard, 1996).

Each situation described in the questionnaire further reflects a specific maturity level (M1-M4) of a group or an individual employee. The situation

described corresponds to one of the alternative leadership actions which are considered to be most appropriate in the given situation according to situational leadership theory. Thus an M1 situation calls for an S1 leadership style, an M2 for an S2 and so on. The method provides a further measure of the leader's style adaptability (the leader's ability to adapt the leadership style to the maturity level of the group or an individual employee).

The leadership adaptability score ranges from +2 to -2 and depends on the match between the situation described and the chosen alternative. A score of +2 is given when the leader has managed to adapt the leadership style to the situation, i.e. the chosen alternative matches the situation. A score of +1 to -2 is given when there is a mismatch between the described situation and the chosen alternative, and it is dependent on how inappropriate the chosen action is according to the theory.

The method provides an additional measure referred to as "under task behavior" and "over task behavior". This measure describes how a lack of leadership adaptability is constituted. When a leader does not manage to adequately adapt the leadership style, this measure describes if the leadership action is more or less task oriented than appropriate. The score ranges from 0 (no under or over task behavior, i.e. perfect adaptability) to 3.

Each item in the questionnaire further concerns leadership in *Group* or *Individual situations* or in terms of *Success* or *Hardship situations*. The method therefore covers four types of situations: *Group* or *Individual situations* and situations characterized by *Success* or *Hardship*. Thus, the method makes it possible to analyze how the profile of the leadership style, the leadership style adaptability and under and over task behavior change with the situation.

4.1.3. Psychosocial work environment assessment

The *Copenhagen Psychosocial Questionnaire* (COPSOQ) (Kristensen et al., 2005) was chosen to assess the psychosocial work environment. The COPSOQ instrument is a valid and reliable tool for workplace surveys, analytic research, interventions and international comparisons (Kristensen et al., 2005). The questionnaire includes most of the relevant psychosocial dimensions according to several important theories on psychosocial factors at work (Kristensen et al., 2005). It comes in a short, medium and long version, the last of which consists of 141 items and 30 dimensions.

From the long research version, 73 items encompassing 15 dimensions were selected to cover the following four areas: (1) demands, (2) control, (3) support and (4) stress.

Demands:

Quantitative demands	The relationship between the work extensions and the time required to accomplish the tasks.
Cognitive demands	Demands related to decision making, memory processes, ideas and overview.
Emotional demands	Demands dealing with feelings, understanding and compassion.
Sensorial demands	Demands on sensorial and psycho-motor skills.

Control:

Influence at work	Possibilities to influence working environment and working conditions.
Degree of freedom at work	The individual's influence over breaks and working hours.
Predictability	Information concerning future events within the organization.
Insecurity at work	Insecurity at work creating worry and anxiety among the employees.

Support:

Social support	Support at the right time from co-workers and managers.
Feedback at work	Appreciation and constructive feedback from co-workers and managers.
Social relations	Relations to colleagues, customers or clients.
Sense of community	The atmosphere, working climate and fellowship at the workplace.

Stress:

Behavioral stress	Symptoms of stress connected to behavior.
Somatic stress	Symptoms of stress connected to bodily functions.
Cognitive stress	Symptoms of stress connected to cognition.

The COPSOQ questionnaire focuses on scales measuring psychosocial factors at work, individual health and well-being, and personality factors such as coping style and sense of coherence. All scales in the long research version go from 0 to 100 with high values representing a high level of the concept being measured. Thus a high value on *Social support* implies good social support, while a high value on the *Somatic stress* scale indicates a high level of stress. All of the scales are constructed as simple averages with equal weights for the items and equal intervals between the response options (Kristensen et al., 2005).

The 30 dimensions are derived from the 141 questions by principal-component factor analyses and analyses of internal reliability (Kristensen et al., 2005).

Table 2 presents the internal consistency for the 15 COPSOQ dimensions calculated for the ATM units and the COPSOQ Cronbach's alpha (Kristensen et al., 2005).

Table 2. Cronbach's coefficient alpha for the 15 COPSOQ dimensions in the air traffic control studies and reference alpha values (Kristensen et al., 2005).

Scale		Questions (N)	ATM units Cronbach's α	COPSOQ Cronbach's α
1.	Quantitative demands	7	.75	.80
2.	Cognitive demands	8	.70	.86
3.	Emotional demands	3	.79	.87
4.	Sensorial demands	5	.70	.70
5.	Influence at work	10	.84	.83
6.	Degree of freedom at work	4	.87	.68
7.	Predictability	2	.54	.78
8.	Insecurity at work	4	.54	.61
9.	Social support	4	.63	.74
10.	Feedback at work	2	.51	.64
11.	Social relations	2	.33	.65
12.	Sense of community	3	.69	.80
13.	Behavioral stress	8	.81	.79
14.	Somatic stress	7	.67	.76
15.	Cognitive stress	4	.77	.85

The dimension *Social relations* appears to be dysfunctional in the ATM settings given that Cronbach's α equals .33. There are just two items included in this dimension where one question refers to the degree of cooperation at

work whereas the other refers to the degree of social contact in the work situation. The air traffic controllers sometimes work alone in the operative position, but there are still many possibilities to interact with other colleagues working in different positions. This situation probably affects the internal consistency in this dimension. Similar explanations can be found for the low internal consistency in the dimensions *Predictability*, *Insecurity at work* and *Feedback at work*.

4.1.4. Safety culture assessment

The method used to assess safety culture is based on nine aspects that according to the literature are considered central in a safety culture. These aspects are listed below with a short description:

Working situation Concerns cooperation, support, appreciation of work, fatigue, adequate training in work practices, staff size and influence in the design of work (e.g. Coyle, Sleeman & Adams, 1995; Zohar, 1980).

Communication The amount of information given and clarity of information; communication between people and between work groups; training in communication during accidents; and clarity about whom to contact concerning safety issues (e.g. Glendon & Stanton, 2000; Ostrom, Wilhelmsen & Kaplan, 1993).

Learning Concerns whether employees have a routine of looking for safety problems on their own; encouragement to pay attention to lack of safety; actions taken or not taken upon receiving information about safety deficiencies; proactiveness in improvements in work and safety (e.g. Reason, 1997).

Reporting Concerns whether employees express their opinion about safety at work; if management listens to employees regarding safety matters; the reaction received when reporting anything concerning safety (e.g. Reason, 1997).

Justness The fairness in judgment made when something goes wrong at work; fear for what would happen if something turned out wrong; acknowledgement for safe work; attention when not performing the work in a safe manner (e.g. Reason, 1997).

Flexibility	The appreciation of knowledge and experiences of all employees; the encouragement for putting forward ideas and suggestions for improvements at work; the acceptance in suggesting changes in somebody else's area of responsibility (e.g. Reason, 1997).
Attitudes towards safety	The belief that top and middle management as well as operators are working for good safety; management's interest in the well-being of operators; encouragement of safe practices; appreciation of safe work; personal responsibility for safety; if education and training are deemed important by management; employee participation in planning for safety (e.g. Mearns et al., 1998; Niskanen, 1994).
Safety related behaviors	Concerns improvements leading to increased safety; encouragement of orderliness from supervisors; encouragement from co-workers to work safely; usability of safety rules; sufficient training for emergency situations; pressure from different levels to take short cuts; taking unnecessary safety risks (e.g. Geller, 1994).
Risk perception	The belief that the work is carried out safely; the size of risk for the individual getting injured on the job or that one's work could lead to others being injured; the experience of having influence on safety at work; trust for middle management concerning safety at work; belief that work is carried out with good safety margins (e.g. Mearns et al., 1998; Rundmo, 1997).

The nine safety culture aspects are distributed in a questionnaire where items corresponding to a given safety culture aspect are grouped together in order to draw the respondents attention to the specific aspect when answering the questions (Ek, 2006). The majority of the items are answered using a five-point scale (e.g. Not at all, Barely, A little, Much, Very much, *or* Never, Seldom, Sometimes, Often, Very often), where a higher value on the scale indicates a better safety culture.

The internal consistency for the nine safety culture aspects was calculated as Cronbach's alpha for the ATM units according to Table 3.

Table 3. Cronbach's coefficient alpha for the nine safety culture aspects in the air traffic control studies and reference alpha values (Ek, 2006).

Safety culture aspect		Questions (N)	ATM units Cronbach's α	Ground handling Cronbach's α	Passenger shipping Cronbach's α
1.	Working situation	21	.80	.90	.87
2.	Communication	10	.70	.86	.83
3.	Learning	12	.82	.83	.88
4.	Reporting	12	.74	.83	.84
5.	Justness	12	.65	.82	.82
6.	Flexibility	7	.61	.64	.68
7.	Attitudes towards safety	14	.83	.91	.87
8.	Safety related behaviors	13	.72	.86	.85
9.	Risk perception	7	.43	.74	.74

Table 3 shows the reliability analysis for the ATM units and reference data from two other transport settings. The alpha value for *Risk perception* was notably low for air traffic control (.43), which may reflect the highly regulated nature of the air traffic controller's work. There is in addition a small risk for the individual of getting injured on the job while there is a considerable risk that one's work could lead to others being injured.

4.2. Study locations

The studies were conducted at three study locations within the Swedish Air Navigation Services (ANS) referred to as the *en route ATCC*, the *arrival and departure ATCC* and the *ANS division* head office. Altogether 635 individuals were invited to participate in the studies at the three study locations. 39 respondents dropped out due to maternity/paternity leave, leave of absence, sickness leave, etc. The final response rate for all three locations was 65% (390/596) for the organizational climate study, 52% (309/596) for the leadership study, 65% (386/596) for the psychosocial work environment study and 66% (391/596) for the safety culture study.

Response rates and a short description of the specific settings for each study location follow in this section.

4.2.1. En route air traffic control center

The term "en route air traffic" refers to aircraft flying at high altitudes between their departure and arrival destination. Since the flying route is outlined in advance, this air traffic does not need constant direction. Thus the air traffic control work at this ATCC mostly consists of surveillance in order to keep the necessary separation between the aircraft. The air traffic controllers intervene mainly to prevent potential conflicts.

At the time of the studies, the en route center employed 213 individuals of which 189 were engaged in some kind of operative air traffic control work. All employees were invited to participate in the studies. Altogether, nine respondents dropped out for reasons such as maternity/paternity leave, leave of absence, sickness leave, etc. The final response rate at this study location was 69% (141/204) for the organizational climate study, 53% (108/204) for the leadership study, 69% (141/204) for the psychosocial work environment study, and 69% (141/204) for the safety culture study.

4.2.2. Arrival and departure air traffic control center

In contrast to the en route ATCC, the arrival and departure ATCC mostly manages air traffic approaching or leaving airports. The air traffic is therefore managed at low altitudes and requires a great deal of active directions especially when approaching a specific airport. The air traffic work is thus conducted in small sectors and is characterized by an active working situation.

At the time of the studies, the arrival and departure center employed 233 individuals of whom 206 were engaged in some kind of operative air traffic control work. All employees were invited to participate in the studies. Altogether, 26 respondents dropped out for reasons such as maternity/paternity leave, leave of absence, sickness leave, etc. The final response rate at this study location was 63% (130/207) for the organizational climate study, 49% (102/207) for the leadership study, 62% (128/207) for the psychosocial work environment study, and 63% (130/207) for the safety culture study.

4.2.3. Air navigation services head office

The ANS organizational unit is part of the LFV Group Swedish Airports and Air Navigation Services central head office. No operative air traffic control work is conducted at this study location. Instead, this unit works as an administrative support unit for the ATCCs. The work includes strategic

air traffic management issues such as local regulations, air sectors division, etc.

At the time of the studies the ANS unit employed 189 individuals. All employees were invited to participate in the studies. Four respondents dropped out for reasons such as maternity/paternity leave, leave of absence, sickness leave, etc. The final response rate was 64% (119/185) for the organizational climate study, 54% (99/185) for the leadership study, 63% (117/185) for the psychosocial work environment study, and 65% (120/185) for the safety culture study.

4.3. Data analysis

The basis for most statistical analyses conducted involves mean scores for the dimensions or aspects included in the different instruments. These were calculated based on the individual's answers to the items associated with the particular aspect or dimension.

In papers II and IV comparisons were made to study differences in the average assessment of the organizational climate and the psychosocial work environment between different operating conditions, different work tasks and different positions. A 2x2x2 factorial ANOVA and a 3x2 factorial ANOVA were used.

In paper II the organizational climate dimension means were also tested for statistical differences using t-test for independent samples, against available reference data on innovative and stagnating organizations.

In paper III the leadership style profiles were calculated as mean scores of the occurrence of each of four possible leadership styles, S1-S4, for each study location and for each type of situation (*Success, Hardship, Individual* and *Group*). T-test for dependent samples was used to test for statistically significant differences between *Success situations* and *Hardship situations* and between *Individual situations* and *Group situations* for each leadership style. T-test for independent samples was used to test for statistically significant differences in the occurrence of each leadership style between the three study locations. Leadership data was also calculated as mean scores with respect to leadership style adaptability and over and under task behavior for each situation and study location. T-test for independent samples was used to test for statistically significant differences in leadership style adaptability, and over and under task behavior between the three study locations for each situation.

In paper V differences in safety culture mean scores between subgroups were tested using a t-test for independent samples or a one-way analysis of variance (ANOVA). Pearson correlation coefficients were calculated to determine the strength of association between the nine safety culture aspects. Multiple linear regression analyses were also performed to examine the relationships between each of the nine safety culture aspects and the ten organizational climate dimensions.

In papers II, IV and V the internal consistency of the included dimensions or aspects was tested using Cronbach's coefficient alpha.

CHAPTER **FIVE**

5 SUMMARY OF PAPERS

The thesis is based on five different papers concerning psycho-organizational aspects in air traffic control settings. This section summarizes the papers with a focus on the results in the respective studies.

Paper I. The influence of organizational climate and leadership on safety culture and safety climate from an air traffic management perspective – a review

Even though the literature often claims that safety culture and safety climate largely exist in close relationship with other organizational aspects and processes, the research concerning such relationships seems to be limited.

The relationship between organizational climate and safety climate has largely been a theoretical assumption, without any strong empirical support. Past research about safety culture and safety climate has mainly focused on the relations between safety culture or safety climate and various aspects of safety related outcomes such as incidents and accidents and safety work behavior and practice. Thus considerably little is known about how safety climate is related to and influenced by the general organizational climate.

Empirical support can, however, be found in the literature regarding the overall importance of managerial influence on employees concerning commitment, attitudes and behavior when it comes to safety culture, safety climate and safety related issues. Since most of this research is based on employees' perceptions of what is required of management regarding safety rather than on leadership processes or the managers' own perceptions regarding safety, there is still a lack of knowledge in this area.

The aim of this study was to review the safety literature in order to present an overview of the empirical research that has been conducted on relationships between general organizational climate and safety climate or safety culture. The study also aimed to outline empirical research that in a mean-

ingful way had introduced already established knowledge of leadership theories in safety research.

Four papers were reviewed concerning relationships between organizational climate and safety climate or safety culture (Neal, Griffin & Hart, 2000; Silva, Lima & Baptista, 2004; DeJoy et al., 2004; Ek, Akselsson, Arvidsson & Johansson, 2005). All studies were able to establish relationships between organizational climate and safety climate or safety culture.

Five papers were reviewed on the topic of leadership (Zohar, 2002; Barling, Loughlin & Kelloway, 2002; Hofmann & Morgeson, 1999; Hofmann, Morgeson & Gerras, 2003; O'Dea & Flin, 2001). The influence of leadership processes on safety climate was studied in terms of transformational and transactional leadership theories, leader-member exchange theories and preferred leadership style theory.

The main conclusion from the literature review was that even though the studies reviewed made valuable contributions to this research field, more research is needed. Some problematic issues were also discussed in relation to the reviewed studies concerning external validity, differences in operationalizations, differences in theoretical assumptions and definitions of the concepts under study, etc.

Paper II. Organizational climate in air traffic control: Innovative preparedness for implementation of new technology and organizational development in a rule governed organization

A positive and innovative organizational climate does not easily evolve in organizations engaged in activities that are dependent on rules and regulations to safely carry out the work. Standardized routines and instructions seem to have a negative impact on creativity and thus prevent an innovative climate from developing (Ekvall, 1994). An innovative climate is in turn an important factor in stimulating change and innovation in an organization.

The Swedish Air Navigation Services Provider (ANSP) is an organization whose activities are very much governed by rules and regulations because of the great risks involved in managing air traffic. It operates simultaneously in an environment that is constantly changing because of the technological developments and ongoing growth in air traffic transportation volumes.

The aim of this paper was to study the innovative organizational climate within the Swedish ANSP during technological and organizational changes. Study locations were two air traffic control centers (ATCCs) with different operational conditions referred to as the *en route ATCC* and the *arrival and departure ATCC*. Included in the study was also the *ANS unit* (Air Navigation Services), which is a part of the LFV Group Swedish Airports and Air Navigation Services central head office.

Out of 596 employees, 390 took part in the study (65%) and a standardized questionnaire, the *Creative Climate Questionnaire* (Ekvall, 1990) was used to assess the innovative organizational climate.

It was hypothesized that the innovative organizational climate would differ between the study locations due to differences in operational conditions and working tasks. It was further assumed that personnel with operational working tasks would differ from administrative personnel as well as managers and non-managers in their assessment of the organizational climate.

In an overall comparison between the study locations and available reference data from innovative and stagnating organizations, the results implied that the climate was quite positive with consideration to the rule governed work. The results further implied that different operational conditions and work tasks had an effect on the climate. Thus the organizational climate was assessed to be statistically significantly more innovative at the arrival and departure ATCC on the climate dimensions *Trust, Playfulness* and *Conflicts* and less innovative concerning the dimension *Idea time* than the en route ATCC. The ANS unit further assessed the innovative climate to be statistically significantly more positive in the dimensions *Freedom, Trust* and *Conflicts* than the en route ATCC and less positive on the dimensions *Trust* and *Conflicts* than the arrival and departure ATCC.

Furthermore, the administrative personnel assessed the climate to be statistically significantly more innovative on the dimensions *Freedom, Support for ideas* and *Debate* than the operative personnel.

No differences were found in the comparison between managers and non-managers.

Paper III. Situational leadership in air traffic control

Effective leadership is often described as a key factor contributing to successful organizational achievements. The impact of leadership in terms of

attitudes and behaviors is repeatedly stressed in the literature concerning the development and maintenance of a positive safety culture especially in high risk environments such as air traffic control. Leadership actions and behaviors can also be influential in terms of reducing or increasing work related stress in a demanding work environment. It is thus important for all organizations to understand the role of leadership and to identify the leadership styles most effective in their business.

The Swedish Air Navigation Service Provider (ANSP), which operates in a high risk environment, has been successful in creating an overall positive safety culture (Ek, Arvidsson, Akselsson & Johansson, 2002) and psychosocial work environment (Arvidsson, Johansson, Ek, Akselsson & Josefsson, 2004). The general purpose of this study was to investigate and describe *situational leadership* characteristics and leadership styles in this distinctive environment.

Situational leadership theory claims that effective leadership is mainly a result of a leader's ability to adapt the leadership style to the situation. Leadership style is understood as a combination of task-oriented and relationship-oriented behaviors and is operationalized in four different leadership styles from S1 (high task/low relationship) to S4 (low task/low relationship behavior). Different situational conditions are mainly explained in terms of followers' maturity.

Study locations were two air traffic control centers (ATCCs) with different operational conditions and leadership structures referred to as the *en route ATCC* and the *arrival and departure ATCC*. Included in the study was also the *ANS unit* (Air Navigation Services), which is a part of the LFV Group Swedish Airports and Air Navigation Services central head office.

The situational leadership was assessed with the questionnaire *Leader Effectiveness and Adaptability Description* (LEAD) (Hersey & Blanchard, 1988) in a modified version (Holmkvist, 2000) which measures *leadership style profiles, leadership adaptability* and *over and under task* leadership behaviors in four types of situations (*Success, Hardship, Individual* and *Group*). The questionnaire was distributed to all 596 employees at the three units. 309 completed questionnaires were returned (52%).

It was hypothesized that leadership style, leadership adaptability, over and under task behaviors are dependent on the working situation and thus would differ in *Group* or *Individual* situations and situations characterized by *Success* or *Hardship*. Furthermore, it was hypothesized that different opera-

tional conditions, different leadership structures and working tasks at the three study locations would contribute to differences in leadership style profiles. Finally, it was hypothesized that more experienced leaders would have more effective leadership style adaptability and practice less over and under task behaviors than less experienced leaders.

The results gave strong support for the first hypothesis. They indicated that there were statistically significant differences in the frequency of leadership styles in use between all situations and the leadership style adaptability was assessed as superior in *Success* and *Individual situations* compared with *Hardship* and *Group situations*. The same pattern existed for over and under task behavior which both were statistically less frequent in *Success situations* compared with *Hardship situations*. In *Individual situations* over task behavior was also less frequent than in *Group situations*.

The second hypothesis was not supported in the comparisons between the two ATCCs or in the comparison between the arrival and departure ATCC and the ANS unit. However, some support for this hypothesis was found in the comparison between the en route ATCC and the ANS unit since four statistically significant differences were found in leadership styles across situations between the study locations.

The last hypothesis was not supported concerning leadership adaptability since no statistically significant differences were found in favor of the more experienced managers in any of the four studied situations in the comparisons between the three study locations.

Paper IV. Psychosocial work environment in air traffic control: Assessments with respect to ATM characteristics, task and organizational position

Air traffic control work is demanding and characterized by high mental workload in terms of perception, attention, information processing, problem solving and decision making. Other factors have also been identified to be primary stressors in the aviation industry such as lack of control over events and processes, shift work and disturbance in sleep patterns, social complications, interpersonal problems with co-workers and supervisors, organizational changes, organizational issues such as lack of management support, inadequate organizational climate and management style (Sloan & Cooper, 1985). Responsibility and risks involved in the work are other sources of stress.

The air traffic control industry in Europe will face additional demands in the near future since growth in air traffic volumes calls for major changes in organizational structures and technical development. Since changes in the environment can be an additional source of stress in an already demanding work situation, the focus of the current study was on the psychosocial work environment. This is an important factor in the ATM change process in order to maintain well-being, health and safety in air traffic control settings.

Study locations were two air traffic control centers (ATCCs) in Sweden referred to as the *en route ATCC* and the *arrival and departure ATCC* because of different operational conditions. The *ANS* (Air Navigation Services) *unit* which is a part of the LFV Group Swedish Airports and Air Navigation Services central head office, also participated in the study.

When assessing the psychosocial work environment at the three study locations the *Copenhagen Psychosocial Questionnaire* (Kristensen et al., 2005) was used. In focus were the psychosocial aspects *demands, control, support* and *stress*. Out of 596 employees, 386 took part in the study (65%).

It was hypothesized that the psychosocial work environment would be differently assessed due to different working conditions and working tasks at the three study locations and that personnel with operational working tasks would differ in their assessments from administrative personnel. It was further hypothesized that managers would assess the psychosocial work environment as more positive compared to non-managers.

The overall results indicated an overall positive assessment of the psychosocial work environment at the three study locations. However, three aspects of the working environment showed considerably less positive results in the dimensions *Sensorial demands, Freedom* and *Feedback*.

The results gave no strong support for the assumption that the different operational conditions would contribute to different assessments between the two ATCCs. Accordingly, just one statistically significant difference was obtained in which the arrival and departure ATCC assessed the control dimension *Predictability* as less positive compared to the en route center.

In the comparison between operative and administrative personnel, the results indicated that the operational personnel assessed the psychosocial working environment as statistically less positive at a significant level concerning *Sensorial demands, Influence, Freedom* and *Feedback,* and as statistically

significantly more positive on the dimensions *Quantitative demands* and *Social relations* compared to the administrative personnel.

The organizational position had an impact on the assessment since non-managers both in the comparison at the two ATCCs and at the ANS unit reported statistically significant less positive assessments than managers in dimensions such as *Cognitive demands, Influence, Freedom, Predictability, Feedback* and *Social relations.*

Paper V. Safety culture in Swedish air traffic control

European air traffic control is undergoing changes in organization and technology in order to increase efficiency in the air traffic. Change processes can have a negative impact on existing safety culture and safety itself. The aims of this study were to gain a better understanding of the safety culture concept in an air traffic control setting in general and, specifically, to obtain baseline data concerning the safety culture and the relationships between safety culture and organizational climate during organizational and technical changes in Swedish air traffic control.

Study locations were two air traffic control centers (ATCC) and the Air Navigation Service division (ANS) head office in Sweden. A total of 391 individuals employed at the three study locations participated in the study out of 596 (66%).

Even though the safety culture mean scores differed somewhat across the three study locations, the patterns of the mean score profiles were the same. The administrative ANS unit had generally somewhat lower scores compared to the two operative ATCCs. *Communication, Justness* and *Flexibility* generally received somewhat lower scores compared with the rest of the safety culture aspects.

Individual factors such as gender, age, time in company and time in current position had almost no effect on how safety culture aspects were perceived. Managers had more positive assessments of the safety culture than non-managers, with many statistically significant differences between the two groups.

Concerning the strength of the relationships between the nine safety culture aspects, positive and statistically significant correlations between all nine safety culture aspects were found for each of the three study locations. This implies that different aspects of safety culture are somewhat related.

The investigations concerning existing relationships between safety culture aspects and organizational climate dimensions showed that the two organizational climate dimensions, *Support for ideas* and *Conflicts*, were positively and most frequently related to the various safety culture aspects (a high score on *Conflicts* means a low level of conflict) at the two ATCCs. However, very few relationships were found between the safety culture and organizational climate concepts at the administrative ANS unit.

In order to investigate management's expectations, norms and goals concerning safety culture and how these correspond to employees' assessments of safety culture, five managers at each of the two ATCC were asked to make three judgments on each of eight questions representing eight of the nine safety culture aspects. The results showed that managers' goals were uniformly high. For the aspects *Communication, Reporting* and *Attitudes* towards safety, the managers' estimated reality responses were in accordance with the employees' actual ratings. For the other five safety culture aspects, the actual scores of the employees were on the average lower (i.e. poorer) than the managers' lowest acceptable limit for safety culture.

The main findings from interviews showed that the reporting culture within the ANS organization was very good with an open dialogue in a blame-free context in which operators shared their learning experiences and were not afraid of reporting safety problems.

CHAPTER **SIX**

6 DISCUSSION

The overall aim of the research presented in the thesis was to study psycho-organizational aspects in a high risk environment with highly reliable work operations in terms of air traffic control. Organizational climate, leadership, psychosocial work environment and safety culture are all aspects that can contribute to good safety performance in a high risk environment. One aim was to outline the empirical knowledge regarding relationships between organizational climate, leadership and safety that was provided in the literature. Other aims were to study the preparedness for forthcoming changes in a highly regulated work environment by investigating the innovative organizational climate and to study the psychosocial work environment in a demanding work situation. When studying the organizational climate and psychosocial work environment the aim was further to compare the assessments according to different working conditions, work tasks and organizational positions. The thesis also aimed to study leadership characteristics in a high risk, highly reliable work environment with a positive safety culture in terms of leadership style, style adaptability and over and under task behaviors and to investigate how leadership characteristics differed between situations, operational conditions and leadership structures. Another aim was to study safety culture in a high risk air traffic control setting and compare safety culture assessments according to study locations and individual factors. The aim was also to investigate possible relationships between safety culture and organizational climate.

The empirical studies were conducted at two operative air traffic control centers in Sweden referred to as the en route ATCC and the arrival and departure ATCC and an administrative air navigation services, ANS unit. In the assessment of the organizational climate, 390 out of 596 (65%) individuals participated in the study by answering the CCQ questionnaire (Ekvall, 1990). A total of 386 individuals out of 596 (65%) participated in the psychosocial work environment assessment by filling out the COPSOQ questionnaire (Kristensen et al., 2005). In the leadership assessment a total of 309 participants out of 596 (52%) were included in the analyses of the

LEAD (Hersey & Blanchard, 1988; Holmkvist, 2000) data and finally in the safety culture assessment 391 out of 596 (66%) individuals participated by filling out the safety culture questionnaire (Ek, 2006).

The overall results gave support for existing relationships between safety climate or safety culture and other psycho-organizational aspects even though the research was limited. The results further revealed a rather positive innovative organizational climate taking the role governed work conditions in consideration. The situations have a further impact on leadership characteristics as a relationship-oriented leadership style was experienced in *Success* and *Group situations* and a more task-oriented leadership style in *Hardship* and *Individual situations*. The overall psychosocial work environment was further positively assessed except for *Sensorial demands*, *Freedom* and *Feedback*. These areas seemed to be especially demanding for the operative personnel. The safety culture was positively assessed in general over the three study locations even though the ANS unit scored somewhat lower than the two ATCCs. Additional relationships were found between safety culture and organizational climate.

The following section summarizes the conclusions drawn from the conducted studies and takes some methodological issues in consideration.

6.1. Methodological concerns

All instruments included in the studies have been tested for validity and reliability elsewhere and discussions regarding those matters are documented in Greene (1980) concerning situational leadership (LEAD), in Ekvall (1990) concerning organizational climate (CCQ), in Kristensen et al. (2005) concerning psychosocial work environment (COPSOQ) and in Ek (2006) concerning safety culture.

There are however some issues that always have to be raised concerning survey research methods. We cannot always trust that people respond in a veridical manner. People might not understand the question or just not know the answer and thereby guess rather than provide a valuable judgment. Since people sometimes have a tendency to respond in a slightly more favorable way, *social desirability* could also bias the results. The organizational climate questionnaire is not a measure of individual evaluations however; instead the participants are asked to make an objective judgment concerning the overall climate in the organization which would reduce the risk of bias due to social desirability. This is probably also the case in the leadership assessment since the judgments concern the leaders rather than

the respondent. The psychosocial work environment is indeed a subjective measure but mostly it concerns the work situation rather than individual abilities or preferences apart from the stress reaction measurements where social desirability could be an issue. The safety culture assessments are probably more sensitive to this kind of bias since some questions concern issues about behaviors and attitudes towards safety of both the respondent and work colleagues in the organization.

Another issue concerns the response rate obtained in the studies. Since the response rates in some studies or at least for some groups was low, there is a risk that the results do not reflect the general view of the group. The employees that choose not to participate might be more positive or negative concerning the studied aspects than the rest of the group whereby the results will be biased and not representative for the whole group. On the other hand, since the population mostly consists of air traffic controllers who have passed through the same selection processes and share the same education and profession, the group is rather homogeneous which makes it less sensitive to low response rates. The low response rate for the leadership studies, however, resulted from the case wise deletion of missing data (only cases that do not contain any missing data for any of the variables selected for the analysis are included in the analysis) which was the only option. This approach significantly reduced the response rate of this instrument as a large number of respondents were excluded due to occasionally missing values. Low response rate was also a concern in the comparison of safety culture assessment data between measurement one and measurement two since only individuals participating in both measurements could be included.

The extent to which the results can be applied to other industries or settings is also an issue that needs to be considered. Comparisons have been conducted concerning different operational conditions in terms of en route air traffic control and arrival and departure air traffic control as well as between different work tasks and positions, of which some would apply to settings outside the studied environment. Since Sweden is among the countries which are in the forefront regarding, for example, a well developed just culture in terms of a blame-free atmosphere and open-minded reporting, forgiving and learning organizational philosophy, differences from other air traffic control settings are certainly present. Due to international agreements and standards, other operative work factors are similar across borders and ATM organizations which make the results valuable and useful in other settings around the globe.

Air traffic control shares, in addition, certain conditions with other highly regulated environments that are automated and include significant risk factors. Therefore, some of the knowledge gained in these studies may also be valuable also outside the area of air traffic control.

Air traffic control operates today in a changing environment, with increasing air traffic volumes and technical, organizational and political changes. These specific conditions would have an effect on the results as well. When generalizing to other industries or even within the framework of air traffic control, these conditions have to be taken in consideration. Since the change process is ongoing, the conditions that were present at the time of the studies will not be the same at another point of time due to these changes.

The instruments used to measure both the organizational climate and the psychosocial work environment are mainly developed according to Scandinavian conditions, which could also affect the possibility to generalize the findings across borders. In addition, the organizational climate instrument is not developed for the somewhat specific working and environmental conditions prevailing in air traffic control which could affect the results to some degree.

As a tool for improvement of organizational and safety issues in daily air traffic control work, several feedback meetings concerning the results were held at the three study locations after each completed measurement. The results can help and stimulate the personnel to raise questions and to initiate discussions concerning safety related issues in the organization. The research process can also gain from this approach since the feedback may generate new issues to be handled in relation to safety. These sessions have been most valuable in interpreting the results and improving the understanding and knowledge base of the organizational aspects and their meaning in the specific context.

6.2. Conclusions and further research

Even though both empirical and theoretical findings presented in the thesis suggest that relationships between safety culture or safety climate and other psycho-organizational aspects can be identified, there appears to be a lack of empirical knowledge about these relationships, especially in the field of aviation and air traffic control. Organizational anomalies and accidents are seldom due to single causes or human error alone. Instead the cause can be identified in a series of events due to numerous organizational deficiencies

or latent conditions that together with local circumstances lead to active failures (Reason, 1997). The concept of safety culture has risen from this realization and is now established in the field of safety research. But since these concepts hardly can be separated from other organizational processes, the lack of knowledge concerning their relation to various organizational aspects must not be neglected. When implementing the Single European Sky, psycho-organizational issues will be in the forefront. To manage the transition to new technology and merging of organizational units from different cultures, climate, leadership structures and psychosocial work conditions, knowledge about how safety culture relates to other organizational aspects can be of utmost importance in making the transition as smooth as possible without affecting safety standards.

Since an innovative organizational climate is one of the driving forces for change, the transition to the Single European Sky could take advantage of such a climate. One of the main findings presented in the thesis and outlined in Study II was that despite the rule governed work, the innovative climate was fairly positive. Even though this finding was unexpected considering the regulated working conditions, a possible explanation can perhaps be found in the just culture that has been established in Swedish ATM. As long as a mistake or failure is not due to conscious or severe negligence, the air traffic controllers will not be held responsible. This philosophy of openness and trust in sharing safety information aims to promote reporting and learning instead of punishment, which is a cornerstone of a positive safety culture. Even though an innovative climate might not be consistent with a safety culture, there are aspects uniting them. The learning aspect of safety culture promotes routines of looking for safety problems and encouragement to pay attention to lack of safety. The flexibility aspect incorporates a culture that is capable of adapting efficiently to changing demands (Reason, 1997). Results from Study V also imply that relationships exist between safety culture and some aspects of the innovative climate. The organizational climate dimensions *Support for ideas* and *Conflicts* stood out in these comparisons and were positively and frequently related to various safety culture aspects. *Support for ideas* is defined as the degree to which new ideas and suggestions are attended to and treated in a kindly manner. Taking this definition under consideration, it is not surprising that safety culture and organizational climate share some common ground. It could be further concluded that low levels of conflicts were associated with a good safety culture. Thus an open, just and blame-free atmosphere will not be promoted if the safety climate is characterized by interpersonal conflicts. Since the safety culture appears to be well developed in Swedish ATM according to the findings in Study V and since an innovative climate is often

characterized by openness and trust (Saleh & Wang, 1993), the innovative climate assessment could have been positively influenced by those settings. Since safety culture and innovative organizational climate appear to benefit from each other there are several reasons to establish a positive safety culture within the European ATM industry since an innovative organizational climate also could facilitate a safe and smooth transition to the Single European Sky.

The results from Study III suggested that the leadership style was more supportive and relationship-oriented in *Success situations* than in *Hardship situations* in which the leadership was more task-oriented. Since organizational changes often are demanding and trigger anxiety and resistance, the leadership might become increasingly task-oriented during the organizational and technological changes in the European ATM industry. The research outlined in Study I regarding leadership further implied that the development and maintenance of positive safety practices benefit from good and supportive leadership relations with subordinates. To minimize the risk of reducing safety standards during the implementation of the Single European Sky, the promotion of a positive change process and supportive relationship-oriented leadership approaches could be significant. Although a relationship-oriented leadership style has to be maintained during the change process, the leadership style adaptability should still be efficient. It could be concluded from Study III that leadership adaptability suffers in *Hardship situations*. If the transition to the Single European Sky becomes problematic it is likely that the leadership will be affected as well. The changes will affect each individual employee and new demands will be identified in terms of new organizational structures, new roles, new working methods and new technology, etc. Therefore the sensitivity and diagnostic ability of leaders to perceive the situational factors and to adapt their leadership style to meet the demands of the environment might be even more important during the change process.

Even though the overall assessment of the psychosocial work environment in Study IV was positive some aspects could be identified as troublesome. The high assessments in *Sensorial demands* and the low assessments in *Freedom* and *Feedback* might reflect some characteristic features in air traffic control work. Support for this assumption can be found in the comparison between operative and administrative personnel since the air traffic controllers made a statistically significant less positive assessment of these dimensions compared with the administrative personnel. If these features are universal they might need extra attention during the change processes not just to prevent a further decline but also as an opportunity for improvement.

During the change process the leadership also becomes important in this context. In addition to the above discussion, a supportive relationship-oriented leadership style can be of significance concerning psychosocial work environmental factors. Such a leadership style can have a positive stress reducing effect in a demanding work context according to previous research (e.g. Bakker et al., 2000; Oaklander & Fleishman, 1964; Rowney & Cahoon, 1988).

During the feedback meetings held at the three study locations the air traffic controllers expressed feelings of increasing demands, worries and frustrations when adapting to the new organizational structures and changes in technology. Since increasing demands can be expected in a similar way along with the adaptation to new organizational structures and technology in the rest of the European ATM industry, psychosocial work environmental factors have to be brought into focus during the implementation of the Single European Sky.

Even though Sweden makes an interesting case in this environment since an adaptation similar to what will come to the rest of Europe has already been initiated, the knowledge base needs to be extended by carrying out similar studies in other European countries. Although the basic idea and methods used in air traffic control work may rest on the same foundations, different cultural conditions and local variations come into play affecting values, attitudes, beliefs, behaviors and the like. In order to make more extensive use of the findings presented in the thesis in the approach towards a united European air space it would be beneficial to involve a pan European research arena. Such a research agenda would benefit from a broad perspective and need to cover several organizational aspects. Different organizational levels also need to be included in such analyses in accordance with Rasmussen's (1997) system perspective in order to promote feedback, learning and actions both within and across levels.

As mentioned in the introduction, the thesis is part of the HUFA project which is an extensive longitudinal research program. The work will continue within this framework. Two major contributions will be made in the near future. Firstly, the different organizational aspects regarding organizational climate, situational leadership, psychosocial work environment and safety culture have to be analyzed in terms of their relationships and interaction. As discussed above, this is an important research area. Such an analysis would further benefit from a multilevel approach in which it is possible to identify specific areas or dimensions of the aspects under study. This would favor an improved understanding of organizational aspects and

the part they play in safety outcomes. Secondly, as soon as the third measurement is accomplished the change process has to be analyzed in greater detail including all three measurements. In this way the impact of changes in organizational structures and technology on organizational aspects and safety culture will be better understood. The change process is dynamic and through a longitudinal analysis it will be possible to see how the psycho-organizational aspects are affected at different stages of the change process and to monitor their development over time.

CHAPTER **SEVEN**

7 SUMMARY IN SWEDISH

Organisationspsykologiska aspekter och säkerhetskultur inom flygtrafikledning – avseende organisationsklimat, situationsanpassat ledarskap samt psykosocial arbetsmiljö

Föreliggande avhandling behandlar organisatoriska aspekter såsom organisationsklimat, psykosocial arbetsmiljö, situationsanpassat ledarskap samt säkerhetskultur inom den svenska flygtrafikledningen.

Avhandlingen är en del av ett större forsknings- och utvecklingsprojekt – Human Factors in Air Navigation Services (HUFA) – som drivs i samarbete mellan det svenska Luftfartsverket och Lunds universitet. Bakgrunden till projektet är att flygtrafiktjänsten i dag är föremål för stora förändringar. Flygledningscentralerna vid Malmö-Sturup och Stockholm-Arlanda har nyligen genomgått betydande organisationsförändringar samt infört ny teknik. Förändringarna har initierats som ett led i en internationell harmoniseringsprocess där målet är att möta ökande trafikvolymer. Det europeiska luftrummet är idag till stora delar uppdelat efter nationsgränser, vilket ger ett fragmenterat luftrum med många luftrumssektorer som inte tillåter en optimering av flygtrafikflödena. Då prognoser gör gällande att flygtrafiken kommer att fördubblas fram till år 2020 och systemet redan idag är överbelastat har Europakommissionen initierat ett projekt kallat ”Single European Sky” som syftar till att effektivisera flygledningsarbetet bl.a. genom att reducera antalet flygledningscentraler och skapa ett gemensamt Europeiskt övre luftrum. Flera flygledningscentraler kommer därför att slås samman med krav på nya organisationsstrukturer, ny teknik och nya luftrumsindelningar.

Tidigare forskning har påvisat att t.ex. organisationsförändringar kan ha negativ inverkan på säkerheten i organisationer vars verksamhet karaktäriseras av många riskfaktorer. Sedan tidigare är det också känt att organisationer vars verksamhet i stor utsträckning styrs av instruktioner, regler och rutiner har svårt att skapa ett gynnsamt förändringsklimat. Säkerhetskultur

och innovativt organisationsklimat är därför två centrala aspekter som avhandlingen behandlar. Man har också tidigare konstaterat att ledarskapet har stor betydelse för säkerhetskulturen där ledarnas engagemang, attityder och beteende i relation till säkerheten påverkar övriga medarbetares uppfattningar, attityder och beteende osv. Man vet också att psykosociala faktorer kan inverka på individens arbetsprestationer där t.ex. stress kan vara en orsak till slarv och misstag. Förändringar är också en extra belastning som kan få effekter för säkerheten i ett redan krävande arbete.

Tidigare forskning kring säkerhet och säkerhetsbeteende har i första hand satt fokus på individfaktorer som kritiska determinanter vid incidenter och avvikelser. Omfattande forskningsinsatser märks kring utformning av gränssnitt, rutiner och arbetsprocedurer osv. Under senare år kan dock ett trendskifte identifieras där psyko-organisatoriska aspekter som säkerhetskultur ägnas allt mer uppmärksamhet som viktiga faktorer för säkerheten i högriskorganisationer. Organisatoriskt lärande, attityder, tillit och rättvisa är exempel på psyko-organisatoriska dimensioner som anses viktiga i en säkerhetskultur. Dock verkar sambanden mellan säkerhetskulturen och andra psyko-organisatoriska aspekter dåligt utforskad. Då säkerhetskulturen anses utgöra en del av det övergripande klimatet på arbetsplatsen är det rimligt att tro att såväl organisationsklimat som ledarskap och psykosocial arbetsmiljö på något sätt relaterar till säkerhetskulturen och i någon utsträckning också påverkar denna. Begreppet säkerhetskultur antyder att det utgör en del av en mer övergripande organisationskultur även om relationerna mellan säkerhetskultur och organisationskultur inte är helt klara. Det ifrågasätts om det är klokt att separera säkerhetskulturen från den övergripande kultur som existerar i anslutning till den övriga verksamheten. Beroendet är mycket starkt då dessa är i förbindelse genom allmänna arbetsprocesser och organisatoriska faktorer. Den övergripande produktionskvaliteten anses också hänga samman med kvaliteten på säkerhetsarbetet. Detta till trots verkar ledarskapets relationer till säkerhetskulturen vara det enda område som är väl utforskat. Någon enstaka studie har fokuserat kring relationerna mellan organisationsklimat och säkerhetsklimat där samband mellan ett allmänt organisationsklimat och säkerhetsklimat har kunnat påvisas.

Projektet involverar tre enheter inom Luftfartsverket med sammanlagt 635 anställda. Av dessa enheter är två operativa flygledningscentraler, där den ena i huvudsak hanterar överflygande trafik sk. *en route*, (här omnämnd som överflygningscentralen) och den andra i huvudsak betjänar flygtrafik på väg till och från flygplatser sk. *arrival and depature* (här omnämnd som start- och landningscentralen). Utöver de operativa flygledningscentralerna ingår ock-

så en administrativ enhet vid Luftfartsverkets huvudkontor kallat *ANS* (Air Navigation Services).

Avhandlingen omfattar sammantaget fem olika studier där Studie I är en teoretisk litteraturstudie som behandlar relationer mellan organisationsklimat, ledarskap och säkerhetskultur och säkerhetsklimat. Studie II-V bygger på empiriskt material insamlat vid de ovan nämnda flygledningscentralerna och ANS.

Avsikten med Studie I var att genom en litteraturstudie undersöka vilken empirisk kunskap som finns med avseende på relationer mellan organisationsklimat och säkerhetsklimat eller säkerhetskultur. Avsikten var också att studera i vilken utsträckning och på vilket sätt etablerade ledarskapsteorier har tillämpats inom säkerhetsforskningen för att undersöka påverkansprocesser och relationer mellan ledarskap och säkerhetskultur eller säkerhetsklimat. Av de sammanlagt nio undersökningar som var föremål för granskning behandlade fyra relationer mellan organisationsklimat och säkerhetsklimat eller säkerhetskultur, där i samtliga fall samband mellan de undersökta aspekterna kunde konstateras. De övriga fem undersökningarna behandlade ledarskapets betydelse för säkerheten. Ledarskapsteorier som introducerades i dessa undersökningar var transaktionellt och transformellt ledarskap, utbytesteorier samt ledarskapsstil. Den övergripande slutsatsen som kunde dras från denna litteraturstudie var att även om samtliga granskade undersökningar bidrog med nyttig kunskap inom området finns fortfarande behov av mer forskning. Vissa problem kunde också identifieras med avseende på generaliserbarhet, definition av begrepp, operationalisering och grundläggande vetenskaps teoretiska utgångspunkter.

Syftet med Studie II var att undersöka beredskapen att möta förändringar i en verksamhet som till stora delar omgärdas av regler och rutiner genom att studera det innovativa organisationsklimatet. De övergripande resultaten påvisade ett klimat som trots den regelstyrda verksamheten var förhållandevis positivt. Resultaten visade också att personalen vid start- och landningscentralen uppfattade det innovativa klimatet som något mer positivt än personalen vid överflygningscentralen. De olika operationella förutsättningarna kan därför anses spela en roll för klimatet. ANS bedömde vidare organisationsklimatet som något positivare i jämförelse med överflygningscentralen samt något negativare än start- och landningscentralen. Resultaten kunde också visa att olika arbetsuppgifter inverkade på uppfattningen av organisationsklimatet då den administrativa personalen i vissa avseenden gjorde en signifikant mer positiv bedömning av klimatet. Vidare kunde

konstateras att organisatorisk position i termer av chef eller medarbetare inte hade någon inverkan på hur organisationsklimatet uppfattades.

Studie III syftade till att undersöka det situationsanpassade ledarskapet i en högriskmiljö med väl utvecklad säkerhetskultur. Ledarskapet operationaliserades i termer av ledarstil, stilanpassning samt över- och understyrning och studerades utifrån fyra olika situationer - utveckling, motgång, grupp och individ. Resultaten visade att situationen har stor inverkan på ledarskapet. Ledarskapsstilarna var signifikant olika i de undersökta situationerna. Ledarskapsstilen var mer relationsorienterad i framgångs- och gruppsituationer än i motgångs- och individsituationer. Stilanpassningen – ledarens förmåga att anpassa sitt ledarskap till medarbetarnas erfarenhet och vilja att ta ansvar – var statistiskt signifikant bättre i utvecklings- och individsituationer jämfört med motgångs- och gruppsituationer. Skillnaden i operativa förutsättningar mellan flygledningscentralerna verkade dock inte ha någon inverkan på ledarskapet.

Studie IV avsåg att undersöka den psykosociala arbetsmiljön inom flygledningen med avseende på krav, inflytande, stöd och stress. De övergripande resultaten gav en bild av en tämligen positiv arbetsmiljö. Utmärkande negativt för flygtrafikledning verkar dock vara *Sensoriska krav*, *Feedback* och *Frihetsgrader*, som alla bedömdes vara problematiska i arbetet. De olika operationella förutsättningarna mellan flygledningscentralerna gav inga signifikanta skillnader i arbetsmiljö. Skillnad i arbete verkar däremot ha betydelse då den operativa personalen uppfattade *Sensoriska krav*, *Inflytande*, *Feedback* och *Frihetsgrader* som mindre positiva och *Kvantitativa krav* och *Sociala relationer* som mer positiva jämfört med den administrativa personalen. Tydliga skillnader framkom också i jämförelsen av position, där chefer i allmänhet uppfattade arbetsmiljön som mer positiv än icke-chefer.

Den femte studiens övergripande syfte var att undersöka säkerhetskulturen inom svensk flygtrafikledning. De övergripande resultaten visade att säkerhetskulturen i stort bedömdes vara överrensstämmande mellan de olika undersökta enheterna. ANS gav dock generellt sett något lägre bedömningar. Det kunde också konstateras att chefer i allmänhet ansåg säkerhetskulturen som bättre utvecklad jämfört med övrig personal. Individuella faktorer som kön, ålder, anställningstid hade däremot liten eller ingen effekt på uppfattningen av säkerhetskulturen. Studien avsåg också att undersöka relationen mellan organisationsklimatet och säkerhetskulturen. På flygledningscentralerna kunde samband konstateras mellan i huvudsak organisationsklimatdimensionerna Idéstöd och Konflikter och säkerhetskulturen, medan inga starka samband kunde identifieras vid ANS. Säkerhetskulturen visade sig

också vara stabil under en 20-månadersperiod. Vid en intervjustudie visade resultaten att en väl utvecklad rapporteringskultur kan identifieras vid de undersökta flygledningscentralerna. Dialogen bedömdes som öppen och rättvis i vilken operatörerna kan dela sina erfarenheter utan rädsla för repressalier.

Då kunskapen kring hur organisatoriska aspekter inverkar på säkerheten i en högriskmiljö och relationerna kring organisatoriska faktorer och säkerhetskultur och säkerhetsklimat fortfarande är oklara, efterlystes mer forskning inom detta område, med ett särskilt fokus på flygtrafikledning. För att övergången till Single European Sky skall kunna genomföras så smidigt, säkert och effektivt som möjligt bör också liknande studier som de i avhandlingen behandlade genomföras i fler europeiska länder, då kulturella skillnader och lokala variationer sannolikt påverkar övergången.

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