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Published in:
The XVth Triennial Congress of the International Ergonomics Association

2003

LUND UNIVERSITY

Department of Design Sciences
Ergonomics and Aerosol Technology

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This is a version of a paper presented at the 15th World Congress on Ergonomics, 2003
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Citation for the published paper:
Åsa Ek, Roland Akselsson, Marcus Arvidsson, Curt R Johansson "Safety Culture and Organizational Climate in Air Traffic Control" in
Proceedings of the 15th World Congress on Ergonomics, 2003, Seoul, Korea, August 24-29, Vol 5, Safety I, pp 364-367

The XVth Triennial Congress of the International Ergonomics Association
24-29 August, 2003, Seoul, Korea, vol 5, Safety I

SAFETY CULTURE AND ORGANIZATIONAL CLIMATE IN AIR TRAFFIC CONTROL

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Due to organizational changes in the Swedish air navigation services (ANS), which in extension could impact flight safety, the safety culture (SC), organizational climate (OC), and related areas are monitored. Study locations are the two main air traffic control centers in Sweden and parts of the central ANS office. This paper reports on a first attempt to investigate whether relationships exist between SC and OC. The findings show that such relationships exist.

INTRODUCTION

Air traffic control is an activity where safety has high priority, but is subject to pressure in the form of increasing demands on efficiency, technical development and changing conditions in air traffic. In order to adapt to these demands, the Swedish air navigation services (ANS) are undergoing major changes concerning e.g. establishment of commercialized spheres, new leadership structures, new work organizations and new work practices, i.e. transition to a more computerized air traffic control system.

These organizational and work changes can have an impact on the safety culture and, in extension, flight safety. It is known that organizational changes, such as downsizing, have contributed to major accidents in other sectors (Baram, 1998; Erlandsson, 2001). Thus there are strong reasons for the aviation sector to look for and implement strong safety management routines.

The Swedish Civil Aviation Administration (SCAA) is aware of this fact and attaches great importance to maintaining a good safety culture. A joint research project - Human Factors in ANS (HUFA) - performed by the SCAA and Lund University aims at studying and monitoring the safety culture (SC) as well as the organizational climate (OC), psychosocial working environment, work climate at a team level, and the leadership effectiveness (on a team level). The aim is to investigate whether and how these areas will be affected by the ongoing organizational changes. Study locations are the two main air traffic control centers (ATCCs) in Sweden and parts of the central ANS office. Four measurement rounds will be conducted using standardized questionnaires, observations and interviews. The first measurement round has been completed and yielded baseline values.

Concepts of safety culture and organizational climate

A successful safety management depends on the existing safety culture in an organization, and the safety management in turn influences the safety of operations.

A global definition of safety culture does not exist. Most investigators agree that safety culture includes elements such as good communication, organizational learning, senior management commitment to safety and a working environment that rewards identifying safety issues (Sorensen, 2002).

The term safety culture itself implies that it is a subset of a larger 'organizational culture' even though their relationship is unclear. Sorensen (2002) refers to Apostolakis and Wu, (1995) who "...question the wisdom of separating safety culture from the culture that exists with respect to normal plant operation and power production. The dependencies between them are much stronger because they are due to common work processes and organizational factors". Reason (1997) also notes that the quality of production and protection depend on the same organizational processes.

The difference between organizational culture and organizational climate is unclear and hard to distinguish.

One definition of organizational climate is that it is a conglomerate of the attitudes, feelings and behaviors that characterize life in an organization (Ekvall et al., 1983). Organizational climate seems to affect different organizational and psychological processes as communication, problem solving, decision-making, learning and motivation. This in turn might affect the effectiveness and productivity of the organization, and the working environment and well-being at the work place (Ekvall, 1985).

The aim of this paper is to present selected results concerning associations between the safety culture and the organizational climate in the air traffic control study. The organizational climate was treated as an explanatory or independent variable, and the safety culture as an outcome or dependent variable. Focus will be on attitudes and behavior concerning safety, reporting and justness.

Dimensions of SC and OC

The following nine dimensions were included when safety culture was assessed (Ek & Akselsson, manuscript): *Learning*: willingness to learn and to introduce changes. *Reporting*: willingness to report incidents and anomalies. *Justness*: just judgments of human errors. *Flexibility*: ability to transform the work organization to changing demands. *Communication*: good communication within and between work levels. *Safety-related behaviors:* comprise e.g. discussions about and encouragement of increased safety. *Attitudes towards safety*: commitment to safety from both management and staff. *Working situation*: concerns cooperation, support and appreciation. *Risk perception*: perceived risk of harming others or oneself and one's own influence on safety in work.

The following ten dimensions were included when the organizational climate was assessed (Ekvall, 1986): *Challenge*: employees' involvement in and commitment to the organization. *Freedom*: extent to which employees are allowed to act independently in the organization. *Support for ideas*: overall attitude towards new ideas. *Trust*: emotional security and trust in the relations within the organization. *Liveliness*: dynamics within the organization. *Playfulness/Humor*: easiness that exists in the organization. *Debate*: extent to which different views, ideas and experiences exist in the organization. *Conflicts*: presence of personal and emotional tensions. *Risk taking*: willingness to tolerate insecurity in the organization. *Idea-time*: time devoted to development of new ideas.

Brief descriptions of the SC and OC

A brief description of the results of the safety culture study at the three study locations is given by each sample's mean score for each dimension (scale range: 1-5). Generally, the study yielded positive evaluation for all nine SC dimensions, with similarity across the three study locations (Ek et al, 2002). Risk perception received the highest mean value (4.30, both ATCCs). Communication received the lowest (3.23, ANS office). Generally, Working situation, Learning, Reporting, Attitudes and Behaviors received high scores. Justness, Flexibility and Communication received somewhat lower scores.

The OC study (scale range: 0-3) showed that the dimension Conflicts received the highest mean value (2.48, low on conflicts) and Idea-time received the lowest (1.02) (both results from the ATCC:arrival/departure). Generally, Challenge, Freedom, Liveliness, Playfulness/Humor, and Conflicts (few) received high scores. Debate, Risk taking and Idea-time received somewhat lower scores (Arvidsson et al, 2002).

METHOD AND MATERIAL

Method

The methodology for assessing safety culture (Ek & Akselsson, manuscript) included 1) observations of the operative work to get experience of the daily work; 2) a standardized questionnaire consisting of 95 items representing the nine safety culture dimensions mentioned in the introduction. The majority of the questions were answered using a five-point scale; 3) a standardized interview with nine employees at each control center. The interview took approximately one hour. The purpose of the interviews with individuals belonging to different organizational levels was to get explanations and background knowledge for the results obtained from the questionnaire survey.

The organizational climate was assessed using the GEFA questionnaire consisting of 50 statements, each with a four-point scale. Factor analysis has grouped the 50 statements into the ten climate dimensions presented above. (Ekvall, 1986)

The safety culture and GEFA questionnaires were to be filled in anonymously by all personnel.

Material

The studies were conducted at the two main air traffic control centers in Sweden (one en route and one

arrival/departure center) and at the ANS office. The questionnaires were distributed to 635 employees at the three workplaces. Of these, 141 were filled out by employees at the en route center, 130 by employees at the arrival and departure center and 114 at the ANS office, with the following response rates: 66 % (en route center), 61 % (arrival/departure center) and 63 % (ANS office). Table 1 gives the distributions of operators and administrators, as well as males and females within the groups of respondents.

Table 1. Distributions of operators/administrators and males/females within the groups of respondents at the three study locations.

Location	Op/Adm	Male/Female
En route center	125/16	74/67
Arr./dep. center	117/13	63/67
ANS office	0/114	86/28

Statistics

All the SC and OC dimensions were represented by the mean score for the individual's answers to the questions belonging to that dimension.

Pearson's correlation coefficient was calculated in order to study possible associations between SC and OC dimensions.

Multiple linear regression analyses were performed with the purpose of examining the relationships between the nine dependent SC dimensions respectively and the ten independent OC dimensions. Only the first step in the analyses was made, i.e. the simple relation between each explanatory (independent) variable and the outcome (dependent) variable of interest. The regression statistics presented in the results section were obtained after removal of outliers in the dependent variables.

The statistical calculations were performed using the STATISTICA program.

RESULTS

Correlations between SC and OC dimensions

Pearson's correlation coefficients (2-tailed) were calculated in order to obtain an indication of the strength of the association between the SC and OC dimensions in the three study locations respectively. The results yielded many statistically significant correlations within the three locations. In the en route center, r ranged from .22 to .71, with a mean r level of .43; 89 of the of 90 correlations were significant at $p < .04$ (2-tailed). In the arrival/departure center, r ranged from .02 to .66, with a mean r level of .29; and 61 of 90 correlations were significant at $p < .05$ (2-tailed). In the ANS office, r ranged from .03 to .66, with a mean r level of .32; 61 of 90 correlations were significant at $p < .05$ (2-tailed).

OC dimensions associated with several SC dimensions

At the en route center, the OC dimension, Conflicts, was negatively associated with the SC dimensions Communication, Reporting, Justness, Safety related behaviors and Risk perception. Support for ideas was positively associated with Flexibility, Communication, Attitudes towards safety and Risk perception.

At the arrival/departure center, the main OC dimension relating to SC dimensions was Support for ideas. It was positively associated with Flexibility, Communication, Reporting, Learning, Safety related behaviors, Attitudes towards safety and Risk perception.

At the ANS office, singular associations existed, but no OC dimension(s) related to several SC dimensions.

Attitudes towards safety and Safety related behaviors

At the en route center, three of the ten OC dimensions were significantly associated with the SC dimension Attitudes towards safety: Support for ideas, Playfulness/Humor (negative association) and Debate. Four of the OC dimensions were significantly associated with the SC dimension Safety related behaviors: Challenge, Playfulness/Humor (negative association), Debate, and Conflicts (negative association).

At the arrival/departure center, two of the ten OC dimensions were significantly associated with the SC dimension Attitudes towards safety: Support for ideas and Conflicts (negative association). Two of the OC dimensions were significantly associated with Safety related behaviors: Support for ideas and Trust.

At the ANS office, only one of the ten OC dimensions was significantly associated with Attitudes towards safety i.e. Challenge. The OC dimensions Trust, Liveliness (negative association) and Idea-time were significantly associated with Safety related behaviors.

Reporting and Justness

At the en route center, two of the ten OC dimensions were significantly associated with the SC dimension Reporting: Challenge and Conflicts (negative association). Three OC

dimensions were significantly associated with the SC dimension Justness: Trust, Debate and Conflicts (negative association).

At the arrival/departure center, only the OC dimension Support for ideas was significantly associated with the SC dimension Reporting. No OC dimension was associated with Justness.

At the ANS office, none of the OC dimensions was significantly associated with Reporting or Justness.

DISCUSSION

This paper reported results of a first attempt to investigate whether relationships exist between SC and OC, as applied in an air traffic control setting. The results of the correlation statistics showed that associations exist between SC and OC dimensions and that this was true within both the two ATCCs and the ANS office.

Linear regression statistics showed more clearly which OC dimensions were related to more than one SC dimension within the ATCCs (i.e. Conflicts and Support for ideas at the en route center, and Support for ideas at the arrival/departure center). Within the ANS office (an distinctly administrative unit), no predominant OC dimension(s) could be discerned.

At the two ATCCs interesting relationships were found concerning the SC dimension Reporting (willingness to report incidents and anomalies). At the en route center it was related to Challenge i.e. employees' involvement in and commitment to the organization, and a reversed relation to Conflicts i.e. presence of personal and emotional tensions. This ATCC had introduced a local reporting system for near-misses, and part of the operative staff were engaged in this. Introducing a local reporting system may have signaled management's interest in continuous improvements leading to more personal involvement and commitment in the work. At the arrival/departure center, Reporting was related to Support for ideas i.e. overall attitude towards new ideas. At this ATCC the reporting system was not as evolved and Support for ideas was somewhat lower.

Scores for the OC dimension Trust indicated that emotional security and trust in the relations within the organization was better evolved in the en route center than the arrival/departure center. Interestingly, both ATCCs had positive results on the SC dimension Justness but the en route center scored somewhat higher. This dimension concerns giving praise instead of punishment when individuals report incidents and safety anomalies. Justness and Trust are important characteristics when creating a well functioning reporting culture. At the en route center, Trust was related to Justness (as were Debate and Conflicts, negatively). At the arrival/departure center, no OC dimension was related to Justness.

The results of the study need to be interpreted in more detail to obtain a clearer picture of the complex relationships between SC and OC dimensions. If we can find a model clarifying the relationships between SC and OC and other related areas, we can hopefully find the relevant factors and method for improving safety.

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