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TEAM CLIMATE AND SAFETY CULTURE IN AIR TRAFFIC CONTROL

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In a joint project – Human Factors in ANS, HUFA - between the Swedish Civil Aviation Administration and Lund University the aim is to find out how a new team-based organization and the introduction of a new air traffic control system will affect safety culture and psychosocial working environment by changes in organizational climate, team climate and leadership. All in all, four studies will be conducted, before and after the system introduction, involving the two air traffic control centers (ATCC) in Malmö and Stockholm as well as the air navigation services (ANS) division in Norrköping. This paper focus on findings from the first study concerning the team climate and the safety culture. The results show an overall positive picture concerning the safety culture at all three units. The team climate is assessed as average at the two ATCCs and just above at the ANS-division. No clear patterns could be found that can explain if and how the safety culture and the team climate are related.

INTRODUCTION

The term *safety culture* seeks to describe the shared attitudes, values, beliefs and behavior of people at work concerning health and safety matters (Booth, 1996). Within the area of air traffic control, where safety has a very high priority, a good safety culture may be crucial in managing the day to day work in such manner that no room for incidents allows to evolve. The *team climate* refers to shared perceptions of the working climate that may evolve within different working teams at a workplace (Anderson & West, 1998). The Swedish Air Navigation Services (ANS) division, in focus for this study, is undergoing some major organizational changes in order to adapt to new demands that increasing air traffic volumes bring forward. The two air traffic control centers (ATCC) in Malmö and Stockholm has recently introduced a new team based organization and a new air traffic control (ATC) system will soon be installed. It is essential to keep the safety standards in at least the same level as today throughout the adaptation to the new system and thereafter.

In a joint project – Human Factors in ANS, HUFA - between the Swedish Civil Aviation Administration and Lund University the aim is to find out how the new team-based organization and the introduction of the new ATC system will affect the safety culture and the psychosocial working environment by changes in organizational climate, team climate and leadership.

All in all four studies will be conducted involving the two ATCCs in Malmö and Stockholm as well as the ANS Division in Norrköping. The first study, conducted about a year before the introduction of the new ATC system has recently been accomplished. The second study will be conducted close to the introduction of the new ATC system. The third study will be conducted directly after the introduction at about the same time of the year as the first study. The fourth study will be conducted approximately six months after the system implementation. This design gives the opportunity to compare the situations before and after the system introduction.

The safety culture is studied by Questionnaire for Safety Culture Assessment, (Ek & Akselsson, manuscript). The psychosocial working environment is studied by COPSOQ - Copenhagen Psychosocial Questionnaire (Kristensen & Borg). The organizational climate by GEFA (Ekvall, 1986), the team climate by TCI – Team Climate Inventory (Anderson & West, 1994), and the leadership by LEAD - Leadership Effectiveness and Adaptability Description., The later instrument is based on the situational leadership theory (Hersey & Blanchard, 1998) and designed to measure primary leadership. All five instruments will be used in all four studies.

In focus for this paper are findings from the first study concerning the team climate and the safety culture conducted for the evaluation of how the new team based organization is adapting to the new conditions and how it harmonize with the expectations and the current safety standards. Results concerning the organizational climate can be found in Arvidsson, Johansson, Ek & Akselsson (2002) and more detailed results concerning the safety culture in Ek, Akselsson, Arvidsson & Johansson (2002). The results presented here are bearing on the two ATCCs in Malmö and Stockholm as well as the ANS Headquarters in Norrköping.

The question at issue is if and how the team climate and safety culture differ between the two ATCCs and how different teams differ in their assessment of the team climate within each organization as well as between the different units under investigation. Such a comparison is of interest since the two ATCCs operate under somewhat different conditions. The ATCC Malmö has the characteristics of an en route center. About 35% of the ATC work is connected to air traffic arriving and leaving different airports in the area. The remaining 65% of the flights are en route flights implying that the air traffic controllers mostly serve airplanes passing by at high altitude. The work tasks therefore mostly consist of surveillance. At the ATCC Stockholm about 90% of the ATC work is connected to air traffic arriving to and departing from different airports in the area, mainly to and from the main Swedish airport Arlanda and the Bromma airport. Giving a simplified picture of the work at ATCC Stockholm it can therefore be characterized as an arrival and departure center. This means that the air traffic controllers have to be rather active, working within fairly small sectors and with airplanes flying at low altitude. The two ATCCs also differ in the work progress concerning the introduction of the new team-based organization. The ATCC Stockholm has reached a little further in this process because of an earlier start.

Of interest is also to investigate if and how the two ATCCs differ from the ANS-division with respect to the team climate and the safety culture. These three units differ mainly from each other with respect to working tasks and methods. Still they are part of the same organization, working together towards the same superior goals. The ANS-division acts as the head office and supports the ATCCs with administrative work.

To understand how the team climate is related to the safety culture it is also of interest to investigate the relationships between the four team climate dimensions and the nine safety culture dimensions.

The safety culture model used in the study is based on a system perspective for controlling safety. In a system perspective one is aware that a socio-technical system is divided into different levels (politicians, regulators, managers, safety officers, work planners and workers) and that these levels need to have well functioning co-ordinations for safety (Rasmussen, 1997). It describes the importance of strong connections between the levels in the form of goal directedness with feedback, learning and action both within and across levels. Learning becomes a basic principle in the dynamic socio-technical system.

The team climate concept is based on the shared perceptions approach of climate. This approach emphasizes the climate as consisting of shared perceptions of organizational policies, practices and procedures. Individuals are likely to identify most closely with their proximal work group and to have commitment to its ongoing social structure. The shared percepts are therefore most likely to evolve at a team level because individuals have the opportunity to interact and to co-construct perceptions within this immediate work environment.

METHOD

Subjects

The studies were conducted at two Swedish ATCCs referred to as the *en route center* and *the arrival and departure center* respectively because of different prevailing operating conditions. The study also concerns the Swedish ANS-division in Norrköping. The team-based organization at the en route center consists of 16 teams with 10-15 individuals in each team. At the arrival and departure center, the organization consists of eight teams with approximately 20-25 individuals in each team. The organization at the ANS division consists of 13 teams with a variation from three to almost 30 individuals in each team. The questionnaires were distributed to all 635 employees at the three units. 390 completed questionnaires were returned. Of these 141 were filled out by employees at the en route center, 130 by employees at the arrival and departure center and 119 by employees at the ANS-division. Altogether, 39 respondents dropped out for reasons such as maternity/paternity leave, on leave for sickness, training, vacation etc. This resulted in a final response rate of 69% for the en route center, 63% for the arrival and departure center and 64% for the ANS-division.

Material

The team climate was measured with the Team Climate Inventory (Anderson & West, 1994). This questionnaire consists of 46 items which loads onto 13 sub-factors, which in turn load onto four second order factors of climate and one social desirability response factor. The main scales are as follows: *Participative safety* (information sharing, safety, influence and interaction frequency); *Support for innovation* (articulated support and enacted support); *Vision* (clarity, perceived value, shardness and attainability); *Task orientation* (excellence, appraisal and ideation).

The safety culture was measured with Questionnaire for Safety Culture Assessment, (Ek & Akselsson, manuscript). The questionnaire consist of 95 items which loads onto 9 sub factors which are as follows: *Reporting, Justness, Flexibility, Learning, Communication, Safety-related behaviors, Attitudes towards safety, Working situation, Risk perception*.

Procedure

To obtain an overall picture over the safety culture at the three units each sample's mean score for each safety culture dimension was calculated.

The four TCI main scales were computed as mean scores. One-way ANOVA was used to analyze differences between the teams within each unit and across units. T-test for dependent samples was used to calculate differences between different team climate dimensions. In analyzing the relations between the safety culture and the team climate, multiple linear regression was used. The safety culture dimensions were used as dependent variables and the four main TCI scales were used as independent variables. These analyzes were conducted separately for each unit.

RESULTS

Safety culture

All three units under study showed an overall positive picture of the safety culture according to the results obtained. Across the nine dimensions, the en route center generally reported the most positive safety culture, followed by the arrival and departure center. The ANS division scored somewhat lower with respect to the dimensions *Work situation, Learning, Communication* and *Risk perception*.

Team climate

The different teams at the ANS division reported, on the other hand, a significant more positive team climate over all main TCI dimensions measured when compared with the two ATCCs. At all three units, the team climate dimension *Participative safety* was significantly higher rated compared with the other dimensions. All in all the team climate was rated as average at the two ATC centrals and just above at the ANS division.

The relation between safety culture and team climate

When investigating the relationships between the safety culture and the team climate, by analysis of regression no clear pattern was found. In addition, large differences between the three units were also noticed.

Table 1 presents the results from the regression analysis. The table rows represent the nine safety culture dimensions and the columns the four main TCI dimensions. The abbreviation ERC stand for "en route center", *ADC* for "arrival and departure center" and **ANS** represent the ANS-division.

Table 1. Regression analysis, results.

	Participative safety	Support for innovation	Vision	Task orientation
Working situation			**ANS**	*ADC*
Flexibility	*ADC*		**ANS**	
Communi-cation			**ANS**	ERC
Reporting			*ADC* **ANS**	**ANS**
Justness		*ADC*		
Learning		*ADC*	*ADC*	
Behavior				*ADC*
Attitudes		**ANS**		
Risk-perception				

The result from table 1 shows that only one significant relationship appeared at the en route center. At the arrival and departure center, seven relationships appeared and at the ANS-division, five relationships appeared.

DISCUSSION

The safety culture at the three units seems to be highly positive according to the results. In an organization engaged in a branch where safety has high priority and where tasks are performed according to strict rules and routines, this may not be surprising. The safety work is, however an ongoing process that must never end and further research is needed to understand this process.

The team climate was rated as overall average at the two ATCCs and no clear differences were found between these two units. This indicates that the different prevailing operating conditions mentioned in the introduction have no impact on the team climate. Instead, it seems reasonable to believe that the existing similarities in the job contribute more in forming the team climate than the differences do. The overall higher scores obtained at the ANS division can be a result of a more mature and somewhat tighter team organization.

In the regression analyses, the results point out existing relationships between the safety culture and the team climate in several dimensions but no clear pattern was found that could give rise to how the two concepts are related.

The most striking result concerning the two ATCCs was the almost total lack of relationships between the two concepts at the en route center. At the arrival and departure center, on the other hand seven significant relations were found. As mentioned earlier, the safety culture achieves high scores at both ATCCs and no clear differences in team climate were found between the two units. It is therefore hard to find a reasonable explanation for the differences obtained. As mentioned in the introduction, the arrival and departure center launched their team-based organization at an earlier point in time compared with the en route center. This means that the teams at the arrival and departure center have had more time to adjust to the new organization and team structure. Even if the analysis of variance gave no significant differences in the team climate between the two ATCCs this may somehow have an impact on the relationships between the safety culture and the team climate.

Even though the results indicate an overall positive safety culture, at all three units under investigation no clear patterns could be found that illustrate how safety culture and team climate are related. No conclusions can therefore be drawn about if and how the safety culture and the team climate are related.

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