

Summary:

Safety culture in transport

The concept of "safety culture" arose in the late 1980s as a consequence of the Chernobyl accident in 1986, and the lack of an adequate safety culture was identified as a major cause of the accidents. An adequate or good safety culture within an organization is characterized by a strong focus and high value on safety; it is part of an organization's "culture". Studies of safety culture have been conducted in a number of organizations and companies faced with potential dangers, although to a limited degree within the transport sector. This report presents the results of surveys conducted in various transport companies in which pilots and drivers were questioned on safety-related issues. The safety culture of different transport modes was compared in a study using the safety culture index constructed by the Global Aviation Network. Aviation was shown to exhibit the best safety culture, followed by rail transport, while bus companies were shown to have the poorest safety culture. The results also demonstrated a strong link between safety culture and the work environment and between safety culture and job-related sickness absence. The employees' perception of their company's safety culture influenced their own safety behaviour, both within and outside the work environment. There was also shown to be a close relationship between an adherence to rules and instructions at work and self-reported accidents and incidents at work.

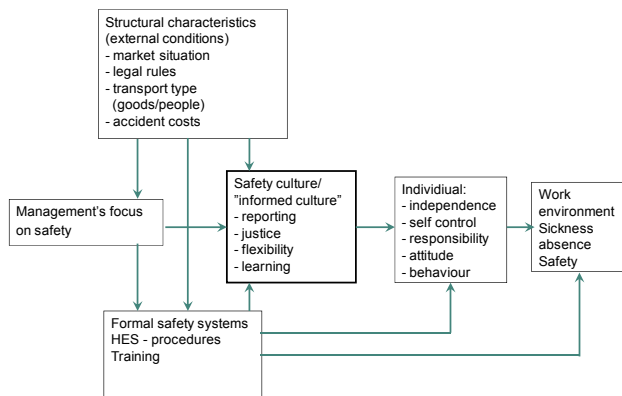
Safety culture – a concept with many facets

There have been many different attempts to define "safety culture" and the concept has been widely debated among researchers and scholars. One fundamental and controversial issue is whether it is even possible to measure safety culture. In this report, we follow the concept of what James Reason defines as an understanding of a good safety culture. He identifies five important aspects:

- a) **Informed culture:** The organization collects information about both accidents and incidents, and carries out proactive counter measures by the use of safety audits and surveys on safety climate.
- b) **Reporting culture:** All employees report their errors or near misses, and take part in surveys on safety culture and so on.
- c) **Just culture:** There is an atmosphere of trust within an organization that encourages and rewards its employees for providing information on errors and incidents, with the confidence of knowing that they will receive fair and just treatment for any mistake they make.

- d) **Flexible culture:** The organization has the ability to change its practices.
- e) **Learning culture:** The organization learns from incident reports, safety audits and so forth, resulting in improved safety.

In addition to these characteristics, Reason and others maintain that an organization's safety culture is tightly bound to its overall culture, and also influenced by external conditions such as laws and regulations, governmental supervision, market situation and the like. Since an organization's safety culture is assumed to be part of its general culture, we expect that there will be a close relationship between safety culture and the work environment. We also expect safety culture to be influenced by formal safety systems such as rules and procedures within an organization cf. Figure S.1. It is also assumed that the safety culture influences the attitude and behaviour of employees towards safety, which is reflected in their safety records.



Source: TØI report 1012/2009

Figure S.1 A model of the relationships between safety culture and other factors.

Safety culture index

Attempts to measure and quantify safety culture have traditionally been accomplished by the use of surveys. These surveys have normally been very closely oriented towards the specific activities within the organization in question, thus hampering the possibility of comparing safety cultures between different sectors or trades. However, there have been attempts within the aviation industry to construct a more general and less activity-specific safety culture (climate) survey, so as to make precise comparisons across various types of organizations and activities possible.

We have chosen to use one such questionnaire developed by the Global Aviation Network (GAIN). This questionnaire consists of 25 safety-related questions covering five presumably safety-relevant issues:

- 1) Management’s attitude and focus on safety;
- 2) The attitude and focus on safety among employees;
- 3) Culture of reporting and reactions to reported errors and incidents;
- 4) Safety training and education; and
- 5) General questions about safety within the organization.

The respondents answered all questions using a scale from 1 (disagree completely) to 5 (agree completely). The safety culture index is computed as the sum of the scores of the 25 questions.

We have used the questionnaire and index to try to measure the safety culture across different transport modes. One question was, however, left out due to the fact that the question’s wording was unfamiliar to rail and bus drivers. Accordingly, our safety culture index

has a maximum score of 120 (24 x 5) and a minimum score of 24 (24 x 1).

Sample of pilots, rail and bus drivers

Safety culture questions were included as a part of surveys conducted in the various transport companies (three airline companies, two helicopter companies, two bus companies and two rail companies). In aviation, the safety culture questions were a part of a larger survey conducted in order to investigate aviation safety in Norway. For the rail and bus companies, the surveys also included questions about work environment. All respondents were drivers, i.e. pilots, rail or bus drivers, who received the same safety culture questions. The other questions that were asked differed between the different transport modes. The number of respondent in the net sample and the response rates are given in table S.1.

Table S.1 The net sample distributed by transport mode. Numbers and response rates.

	Sample (N)	Response (%)
Airplane	584	44.5
Helicopter	71	37.2
Bus	514	74.5
Rail	237	36.2
Total	1422	49.9

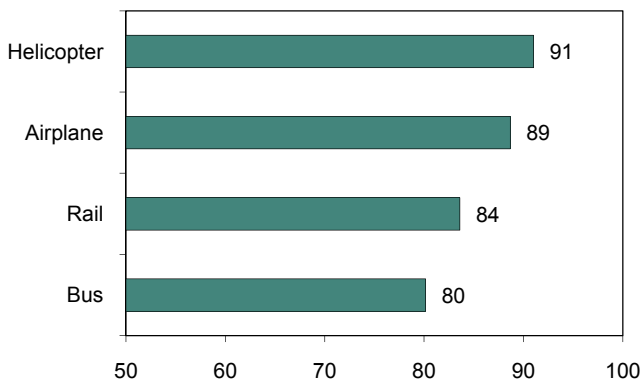
Source: TØI report 1012/2009

Aviation exhibits the best safety culture

Not surprisingly, aviation pilots achieved the highest score on the safety culture index followed by rail drivers. Bus drivers exhibited the poorest safety culture in this study, cf. figure S.2. These results are very much as expected, and in many ways can be seen to reflect the different external conditions of the various transport modes.

Aviation has traditionally had a very strong focus on safety, which is strongly regulated by international treaties. Rail transport also has a strong safety focus, with strict national safety regulations and a separate supervisory authority. Bus transport, being part of the road transport system, is not subject to similar safety regulations.

Figure S.2 gives the average score of the safety culture index for the different transport modes.



Source: TØI report 1012/2009

Figure S.2 Scores of the safety culture index distributed by transport mode.

Empirical test of the model with survey data

The model given in figure S.1 has been tested by using regression techniques with empirical data gathered from the surveys. In general, the assumed relationships in the model are supported by the data.

HES systems improve safety culture

In the model, it is assumed that the presence of formal systems for health, environment and safety issues (HES systems) are positively associated with safety culture. Regression models show a strong link between the safety culture index scores and questions concerning the knowledge of who to contact in regard to different HES issues. There are also indications that those who worry about insufficient technical maintenance perceive the safety culture as being worse when compared to those who do not worry about technical maintenance.

Safety culture influences individual safety behaviour

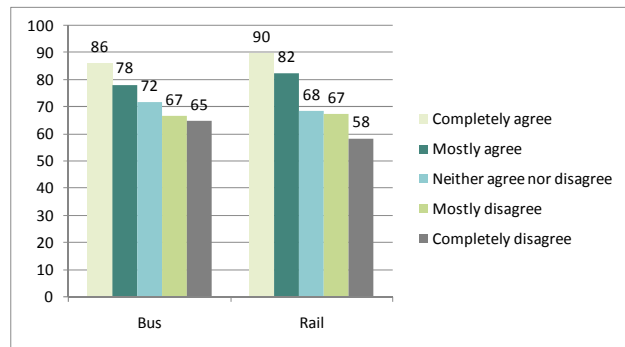
The analyses show a strong relationship between safety culture index scores and an adherence to rules and instructions at work. Those with high scores on the safety culture index perceive the safety culture within their organization to be good, and show a much stricter adherence to the rules and instructions than those who perceive the safety culture to be poor.

There are also clear links between adhering to rules and instructions at work and behaving in accordance with safety rules outside work. Those who adhere to

the rules and instructions at work buckle their seat belts in the back seats of taxis, pay attention to safety demonstrations on air flights, and maintain the speed limit while driving as compared to those who do not adhere to these same rules and instructions.

Close links between safety culture and work environment

Those who report a good safety culture within the organization where they work also tend to report a good work environment and greater job satisfaction. There are also clear indications that possessing the knowledge about who to contact in HES issues is positively associated with the perception of a good work environment and job satisfaction. The bivariate relationship between job satisfaction and safety culture index scores is given for bus and rail drivers in Figure S.3.



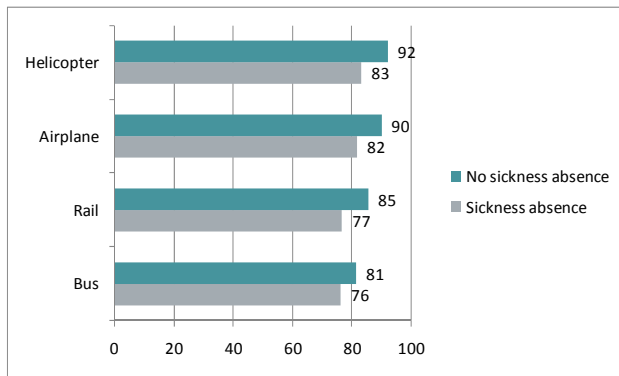
Source: TØI report 1012/2009

Figure S.3 Average safety culture index scores distributed by responses to the assertion “All in all, I am satisfied with the job in (name of company) “..

Less sickness absence when safety culture is good

With a strong relationship between safety culture and work environment, it is not surprising that we also find links between safety culture index scores and sickness absence cf. Figure S.4.

The link between safety culture and sickness absence is consistent across all transport modes. However, there are only links between job-related sickness absences and safety culture, and *not* between sickness absence due to factors outside work and safety culture.



Source: TØI report 1012/2009

Figure S.4 Average safety culture index scores distributed by job-related sickness absence and transport mode.

Subtle relationships between safety culture and incidents and accidents

Bus and rail drivers were asked about accidents and serious incidents during the last year. The analyses show a strong link between an adherence to rules and regulations at work and incidents and accidents: Drivers who always follow the rules and regulations have had significantly fewer accidents and incidents than those drivers who bend the rules.

The relationship between safety culture index scores and incidents and accidents is less clear. We find that those drivers who have reported one incident or accident are the ones who perceive the safety culture to be best, as opposed to those who have had no reported incidents or accidents. There are several probable reasons for this perhaps surprising result. First, one has to remember that the questions about safety culture all concern how a single employee perceives the general safety culture in their company, and are *not* about his/her own behaviour. We do find a close link between one's personal behaviour and incidents and accidents, although not between an individual's perception of safety culture and their safety record.

Second, a key element of a good safety culture is that employees trust management to the point that they are willing to report their own errors and incidents. This is undoubtedly an important reason for the test results; those who perceive the safety culture to be good are precisely the ones who dare to report their incidents.

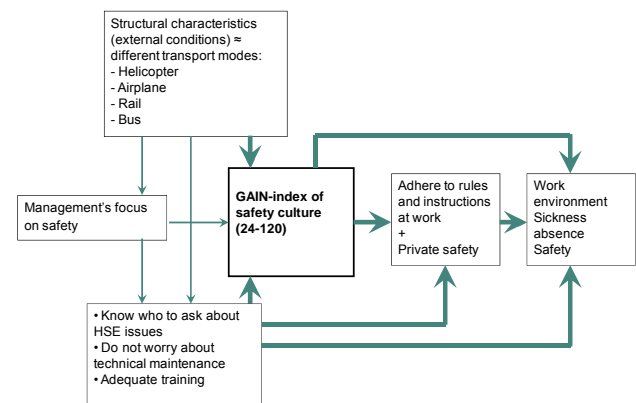
Third, it is also possible that those who have had a serious incident or accident have found that management had treated them fairly, and focused on finding the true causes behind the incident.

Accordingly, drivers who experienced accidents or incidents may perceive the safety culture as better than those who had not had any accidents or incidents precisely because of this experience of fair and just treatment after the incident or accident.

All these different explanations may be true, which indicates that the relationship between safety culture and actual safety should preferably be analysed by the use of register data, and not by self-reported incidents and accidents, although this is difficult to accomplish in transport modes with few accidents.

The model is supported by the data

The model presented in figure S.1 has been tested by the use of survey data and, in general, the model is empirically supported by the data. In figure S.5, this is indicated in the revised model, in which the operationalized variables are included in the boxes, while those relationships that have been tested and received support are indicated by the thick arrows.



Source: TØI report 1012/2009

Figure S.5 Revised model of the relationships between safety culture and other factors.

Better safety culture – better safety and work environment

The assumed relationships in the model generally received empirical support. However, the relationship between safety culture and actual safety is complicated and difficult to test by using self-reported incidents and accidents. Nevertheless, it is possible to study the relationship on an aggregate level – and we do find, as expected, that safety culture varies between transport modes in accordance with actual risk differences.

It would also be possible to study how safety culture relates to actual safety between companies within one transport mode, if all accidents were registered in the same way. One possibility, for instance, would be to study such relationships in road transport between bus companies or with other firms in a given transport mode.

Organizational factors such as safety culture have not traditionally been focused on in road safety

analyses. The close links between safety culture, work environment, individual safety behaviour, and incidents and accidents indicate that efforts to improve safety culture show a great potential for increasing transport safety. The results also indicate that an improvement in safety culture may yield both a better work environment and less sickness absence from work.