



Safety risk management for freight fleets



Project within Traffic Safety and Automated Vehicles

Sofia Löfstrand, Mikael Söderman, Volvo Group Trucks Technology
Christina Stave, Swedish National Road and Transport Research Institute

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FFI in short

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. FFI has R&D activities worth approx. €100 million per year, of which half is governmental funding. The background to the investment is that development within road transportation and Swedish automotive industry has big impact for growth. FFI will contribute to the following main goals: Reducing the environmental impact of transport, reducing the number killed and injured in traffic and Strengthening international competitiveness. Currently there are five collaboration programs: **Vehicle Development, Transport Efficiency, Vehicle and Traffic Safety, Energy & Environment and Sustainable Production Technology.**

For more information: www.vinnova.se/ffi

1. Executive summary

In the project *A holistic approach to increased traffic safety* (Löfstrand 2013), a pilot study of Postnord Logistics' operations in Sweden was performed to investigate the cause of accidents in long haul, regional and urban distribution. This was achieved by taking a holistic approach, and by focusing on vehicles, drivers and organisation during the investigation, all of which affect the risk of accidents. The results from the project showed that the way of prioritising and working with safety in an organisation, i.e. its safety culture and climate, plays an important role in how well a company performs when it comes to safety.

The aim of the project is to increase knowledge and develop methods to improve safety at transport companies by improving the safety climate. The model focuses on organisational changes and was tested and evaluated in a case study at a Gothenburg branch of Postnord in Sweden.

A way of working to improve the safety climate at transport companies was developed and tested with Postnord. During the one year of testing a change process started at the studied branch of Postnord, but it did not lead to measurable improvements in the safety climate survey or in the amount of accidents. A key-factor to implement new ways of working is time (Stave et al, 2008). Therefore, one year was probably too short a time to measure any significant changes in the safety climate. Two other findings which are crucial for improved safety climate are the management's commitment and to anchor changes in the whole organisation. Moreover, efficient communication channels in the company are important to achieve the changes for improved safety in the whole organisation.

One interesting questions/topic for future research would be to further investigate what factors would trigger the top management to be committed to implement changes for improved safety. Another topic for research is how effective communication could be realised in a transport company considering the complexity of the working conditions of the drivers and transport business.

2. Background

In the project *A holistic approach to increased traffic safety* (Löfstrand 2013), a pilot study of Postnord Logistics' operations in Sweden was performed to investigate the cause of accidents in long haul, regional and urban distribution. This was achieved by taking a holistic approach, and by focusing on vehicles, drivers and organisation during the

investigation, all of which affect the risk of accidents. The results from the project show that the way of prioritising and working with safety in an organisation, i.e. its safety culture, plays an important role in how well a company performs when it comes to safety.

2.1 Safety climate and safety culture

A safety climate is the employees' common interpretations of how they perceive the organisations' policies, procedures and practice affecting the safety (Neal och Griffin, 2002 and Wills et al, 2009). Safety climate can therefore be said to form the measurable part of the safety culture in an organisation. Clarke (2006) noted that there was a connection between a good safety climate and less accidents. Safety climate can be summarised in the following seven themes (Arbetsmiljöverket, AV):

1. The management's commitment and ability regarding safety
2. The management's ability to involve the employees in safety issues
3. The management's fairness when it comes to safety
4. The employees' commitment to safety work
5. The employees' priorities when it comes to safety and level of risk acceptance
6. The employees' learning and communication
7. The employees' trust in the efficiency of the safety system

An assumption is also that an organisation that is improving the above mentioned points will also improve their effectiveness. First, by reducing the cost for accidents, and second by being better at cooperation and communication within the company.

An organisation can be more or less mature when it comes to safety culture (Fleming, 2001). Improving the safety culture and safety climate is an on-going learning process, to prioritise safety, learn by mistakes, and to make visible and monitor the considerations influencing risks. The goal is to reach a positive, self-generated process throughout the whole organisation.

The safety culture maturity model presented in figure 1 has a number of stages. Each level is building on the strengths of the previous level.

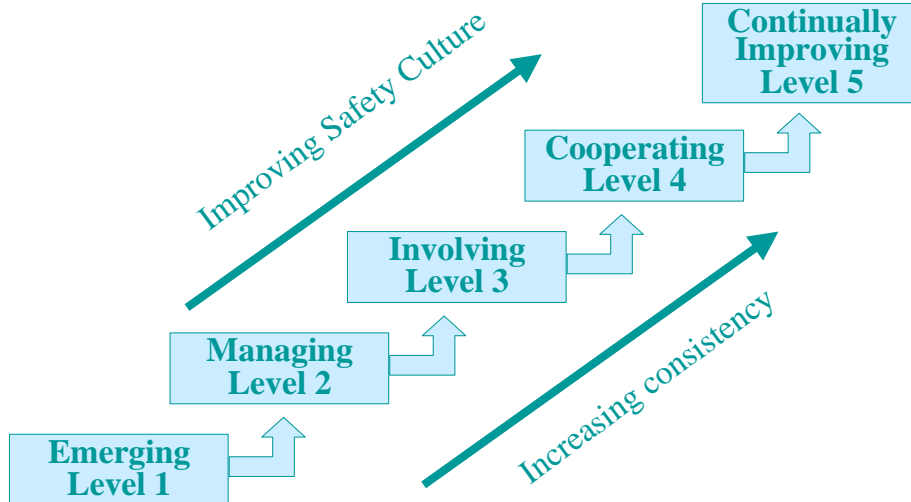


Figure 1, Safety Culture Maturity Model (Fleming, 2001).

Level 1: Emerging

Safety is defined in terms of technical and procedural solutions and compliance with regulations. Many accidents are seen as unavoidable and as part of the job. Safety is not seen as a key business risk and the safety department is perceived to have primary responsibility for safety.

Level 2: Managing

Safety is solely defined in terms of adherence to rules and procedures and engineering controls. Accidents are seen as preventable. Managers perceive that the majority of accidents are solely caused by the unsafe behaviour of front-line staff. Senior managers are reactive in their involvement in health and safety (i.e. they use punishment when accident rates increase).

Level 3: Involving

Managers recognise that a wide range of factors cause accidents and the root causes often originate from management decisions. A significant proportion of frontline employees are willing to work with management to improve health and safety. The majority of staff accept personal responsibility for their own health and safety. Safety performance is actively monitored and the data is used effectively.

Level 4: Cooperating

Health and safety is seen as important from both a moral and economic point of view. Managers and frontline staff recognise that a wide range of factors cause accidents and the root causes are likely to come back to management decisions. Frontline staff accept personal responsibility for their own and others health and safety. The importance of all employees feeling valued and treated fairly is recognised. The organisation puts significant effort into proactive measures to prevent accidents.



Level 5: Continuous improvement

The prevention of all injuries is a core company value. The organisation has had many years without an accident, but there is no feeling of complacency. The organisation is constantly striving to be better and find better ways of improving hazard control mechanisms. All employees share the belief that health and safety is a critical aspect of their job and accept that the prevention of non-work injuries is important.

3. Objective

The aim of the project is to increase knowledge and develop methods to improve safety at transport companies by improving the safety climate.

The purpose and goal of WP2 *Accident causation analysis model*, and WP3 *Case study at Postnord*, was to develop a model to improve the safety climate, decrease the amount of accidents and related costs for transport operators. The model focuses on organisational changes and was tested and evaluated in a case study at a Gothenburg branch of Postnord in Sweden. The model contains a frame for how to work with safety climate, follow up and analyse accidents. It is an instrument for getting insight in safety and risks as well as developing leadership and cooperation. It includes a change of attitudes at an organisational level, with the aim of achieving a continuous learning organisation (Senge, 1990).

The purpose of WP4, *Foundations of a safety service model*, is to describe how the knowledge gained in the case study and safety work with PostNord (WP2 and WP3) could be used in safety work with other transport operators.

The purpose of WP5, *Potential technical solutions for improved safety*, is to describe technical solutions with potential to support transport companies to increase safety, based on the knowledge gained in WP2 and WP3.

4. Project realization

The project method is close to that which is called action research (Reason & Bradbury, 2001). Action research focuses on inclusion of stakeholders in the research process and the measurement and evaluation of action taken by the participants. Project participants at Volvo, Swedish National Road and Transport Research Institute and Postnord have been collaborating actively during the case study to develop and evaluate the safety model.

The project work was divided into two parts, where the first part consisted of a safety assessment of Postnord Gothenburg branch performed by Volvo and Swedish national road and transport research institute. The second part consisted of a change process in



terms of ways of working with safety with the goal to increase safety climate and reduce the amount and costs for accidents (Stave et. al., 2007).

To make the safety assessment and describe the safety situation at case study branch of Postnord, a number of data collection methods were used:

- Accident statistics was collected and based on accident reports made by drivers employed at the case study branch of Postnord.
- Interviews were held with drivers, transport management staff, union representative, work safety representative, vehicle responsible and management staff at the Gothenburg branch to map the current process and way of working.
- Observations of transport management and back office were done to complement interviews in understanding the way of working.
- Documentation such as manuals and forms for accident reporting and routines for safety work was collected.
- A safety survey was performed to evaluate the safety climate of the selected case study branch.

Although the safety assessment started off the change process, the main work to develop and improve the safety climate took place in the second part of the work. The data collection methods included:

- Workshops to engage drivers, traffic management and management at the studied branch in developing new ways of working.
- Meetings to plan and follow up the activities at the Postnord branch.
- A second safety survey was performed to evaluate if any change in safety climate took place in the selected case study branch.

In addition to the work done in cooperation between Volvo, Swedish National Road and Transport Research Institute and Postnord, safety activities took place internally at Postnord. The safety assessment and the change process that took place during the project are described in the following two chapters.

5. Results and deliverables

The results from the project are presented in the three following chapters WP2 WP3 *Accident causation analysis model and case study at Postnord*, WP4 *Foundations of a safety service model*, and WP5 *Potential technical solutions for improved safety*.

5.1 WP2 WP3 Accident causation analysis model and case study at Postnord

The purpose and goal of WP2 *Accident causation analysis model*, and WP3 *Case study at Postnord*, was to develop a model to improve the safety climate, decrease the amount of



accidents and related costs for transport operators. The model focuses on organisational changes and was tested and evaluated in a case study at a Gothenburg branch of Postnord in Sweden.

5.1.1. Safety assessment

The purpose of the safety assessment was to analyse the current safety situation at the Postnord branch in Gothenburg. It included statistics of the number and type of accidents, a description of the current way of working when it comes to safety, and a measurement of the safety climate by a survey. The branch is part of the western region, which is one of six regions of Postnord Sweden.

To assess the status of Postnord's safety climate a survey was made. The purpose was to measure attitudes about safety and to compare the answers with the number of accidents reported and costs caused by accidents. The Swedish Work Environment Authority (Arbetsmiljöverket, AV) has created a measurement tool for Swedish organisations to evaluate safety culture (2012:2). The questionnaire used in the survey is a simplified version of the well-known tool NOSACQ-50, that was developed during several years by a group of Nordic researchers (Kines et al, 2011).

<http://www.arbetsmiljoforskning.dk/da/publikationer/spoergeskemaer/nosacq%2050>

The questionnaire can be found at the The Swedish Work Environment Authority (Arbetsmiljöverket) webpage for safety culture.

<https://www.av.se/arbetsmiljoarbete-och-inspektioner/arbeta-med-arbetsmiljon/sakerhetskultur--ett-samspel-mellan-manniskor-och-riskstyrning/#4>.

The survey has been developed to assess companies' safety climate. The AV tool was chosen because it is an established method and it is applicable for the transport sector.

The safety assessment result indicates that the organisation is between step one and two on the stairs in Safety Culture Maturity Model (Fleming, 2001). This is a safety level with great potential for improvements.

Level 1: Emerging

Safety is defined in terms of technical and procedural solutions and compliance with regulations. Many accidents are seen as unavoidable and as part of the job, safety is not seen as a key business risk, and the safety department is perceived to have primary responsibility for safety.

Level 2: Managing

Safety is solely defined in terms of adherence to rules and procedures and engineering controls. Accidents are seen as preventable. Managers perceive that the majority of



accidents are solely caused by the unsafe behaviour of front-line staff. Senior managers are reactive in their involvement in health and safety.

Drivers, transport management and branch management believe that safety is important, but lack the urgency and time to put effort on improving the safety climate and reducing the amount of accidents. There are many tasks that have a higher priority and that are strictly followed up by management. These tasks are mainly linked to the efficiency in transports, i.e. delivering on time.

In sum, the employees are committed and engaged in safety matters, but find it difficult to prioritise safety in their work. The management's ability in safety leadership and communication are important factors in order to improve this situation.

5.1.2. Change process

The safety project was anchored in the branch management, i.e. the branch manager, the production manager, the transport management and representatives from the union. The branch management was informed about what safety climate is and how a process towards improved safety climate can be structured. At this point, the process towards changes for improved safety had started. To further anchor the project, interviews were carried out with people responsible for and involved in the accident reporting procedures. The research team also investigated what kind of feedback was given to the drivers who had reported accidents and if this could have an influence of their willingness to report accidents.

As part of assessing the safety climate the research team carried out two surveys with one year between the measuring points. The outcome of the results from the surveys was an increased awareness of the branch management's role and responsibility to take initiatives to work for improved safety, e.g. to set up a routine for follow up on accidents and to make the intentions and initiatives for improved safety visible to the drivers.

After the raised awareness of different safety issues, the succeeding step in the change process was to ask the branch management to formulate a vision and to set up some goals for improved safety. The goals were summarised as:

- No injuries
- Clear roles and responsibilities in the organization regarding accidents
- Increase safety awareness and understanding
- Decrease the number of accidents and the costs calculated per km.

The branch management was also asked to define the reasons for initiating the work for improved safety.

The following reasons were identified for initiating a process for improved safety:



- Many accidents can be avoided
- Drivers and other people can get injured
- The working environment is not good if many accidents happen
- Accidents cause significant costs
- Accidents have negative impact on the uptime for the vehicles
- Accidents have negative impact on our commitments to our customers
- Improved safety will enhance our brand image with clean and safe vehicles

A clear and concise definition of accidents could contribute to a coherent conception about “accidents”. The branch management formulated the following definition:

An Accident is defined as any situation a vehicle collide with something, regardless the degree of damages.

A workshop was carried out with the branch and production management of the branch where an action plan was made with the following steps:

- Inform all people involved
 - The branch management will inform the drivers and other employees about the reasons and goals for the work for improved safety.
- Actions and roles
 - Transport management should check with each driver when finishing his/her shift, ask about his/her day and if s/he has experienced any safety related matters during the shift, and make sure that the drivers change broken/damage parts they can fix by themselves, for example lamps and fuses.
 - Transport management should collect all accident reports and secure that they are correctly and completely filled in, hand them over to the production manager who is responsible to follow up reported accidents with each driver, and put together all data accident data in the corporate database.

The branch management’s attitudes regarding safety

The branch management’s attitudes regarding the drivers seemed to be a bit ambiguous. On one hand they stated they have a strong trust in their drivers in general and think they do a great job. On the other hand accidents are often seen as a result from carelessness. The discussion revealed that the branch management should work on their attitudes in order to reach the goals to reduce the number of accidents and to better understand the causes to the accidents. If the drivers are reluctant to report accidents it will be difficult to know the true amount of accidents and to understand the causes the accidents, which in turn affect the work for improved safety in a negative way.

The research team introduced a method to the branch management to analyse causes to accidents. The purpose was to show that focusing on *why* accidents happen rather than on *what* happened and *who* did it can provide a better basis to prevent accidents.



In a workshop with the research team they worked with real accident cases. The accidents were analysed by listing possible causes to the accidents and breaking down possible reasons to the causes by asking *Why* a number of times, i.e. a variant of a root cause analysis. In some cases possible solutions were mentioned, but this was not the primary objective in the workshops).

With the knowledge and awareness gained from the work in this project the branch management also considered how to improve the accident reporting template to gather data in order to better understand the circumstances and causes to the accidents.

Workshop with drivers

A workshop was carried out with the drivers of the branch with the purpose to discuss the following topics as part of anchoring the safety project.

- What are the reasons for the accidents?
- What can be done to decrease the number of accidents?
- What can be done to improve safety?

The two main factors identified as important for improved safety were organisational and technical matters.

Organisational matters:

- Support the drivers to reduce stressful situations (the drivers believed that stress is a major reason for accidents), e.g. strict delivery time windows, irregular workload, tiredness and malfunctioning technical tools.

Technical matters:

- For better monitoring when reversing: rear-view cameras, heat in mirrors and rear-end sensors.
- Accident reporting should be possible to do on-site with the hand-carried computer, just like they today are coding delivery errors. This would make it possible to report, e.g. what time at the shift the accident happened, how the schedule looked like before the accident.

Follow up meeting with the branch management

In a follow up meeting the research team and the branch management discussed what changes towards improved safety had been achieved so far and what the obstacles to the wanted changes. The branch management stated that they had achieved another understanding of accidents. They now ask themselves *Why* accidents happen and think about the causes to the accidents. This was an important change in their attitudes compared to their previous mind-set about accidents, i.e. they only were concerned about *What* had happened.

Accident reporting tool



A new accident reporting tool was developed by the research team based on the branch management's needs and the research team's findings about the current accident reporting template. The overall purpose was to design a tool that allowed gathering comprehensive accident related data and to make statistical calculations and accident data analyses.

5.1.3. Results

To study if the intervention at Postnord during the project resulted in changed views about the safety climate, an analysis of survey 1 and 2 was done. The results showed a total mean value of 2.9 for all the safety culture related questions in both the first and the second survey. This is an indicator of the company's safety climate level. The mean value 2.70-2.99 is a relatively low level which demands improvement.

The average values show that statements 9 "The management's ability to involve the employees in safety issues", and 12 "The employees' priorities when it comes to safety and level of risk acceptance", generally have lower values, but at the same level as the average¹. For statement 14, "The employees' trust in the efficiency of the safety system" the value was higher compared to the average.

There were no measurable improvements in the amount of accidents and the results from the safety climate survey at Postnord. However, some changes in the attitudes and way of working have taken place. The changes have been noticed more clearly for the management of the branch than for the drivers, which can be explained by the more frequent project meetings and activities by the management in the project. The most apparent change is that the team has started to consider the reasons for accidents, i.e. why accidents happen, instead of simply noting that an accident took place. It is the first step to be able to perform accident causation analysis and be able to find solutions to the problem.

Another change is the way Postnord has clarified what an accident is. At the start of the project, only severe accidents where there were people injured or killed, or where there were extensive damages to the vehicles or property was considered an accident. During the project, the definition changed to "every time we hit something or someone". This change sends a signal that all collisions are accidents and should be prevented.

The last point of improvement is that a discussion has started to include KPI's for safety to clearly prioritise the area. If the work in this direction is continued, there is a possibility that measurable results will take place at Postnord.

The project work has had some impact on the maturity of the organisation when it comes to safety climate. Based on the qualitative evaluation, Postnord is after the project

¹ Average refers to the average score of safety climate investigations generally, for all industries that have reported to NOSACQ-50 database.



somewhere between step two and three in the Safety Culture Maturity Model (Flemming, 2001). This is more due to the change in attitude rather than actual implemented changes in the way of working.

5.2 WP 4 Foundations of a safety service model

The purpose of WP4, *Foundations of a safety service model*, was to describe how the knowledge gained from the work in WP2 and WP3 could be applied in other transport companies.

Three critical steps to be taken towards improved safety in transport companies are:

1. To prioritise safety
2. To perform a safety assessment
3. To implement the work for improved safety

The first step, to prioritise safety, is about reaching an agreement within the company to prioritize safety. This needs to be done at all management levels at the company. Financial benefits and other positive effects, such as improved productivity are important to motivate the management to prioritize safety.

The second step, to perform a safety assessment, is needed in order to understand the current situation in the company. The results from a safety assessment can be used to set the scope for a change process towards improved safety.

The third step is about making the changes happen in the company for an improved and sustainable safety culture. This requires a thorough action plan, clear roles and responsibilities, resources and commitment from the top-management and dedication from all employees involved in the work for improved safety.

5.3 WP5 Potential technical solutions for improved safety

The purpose of WP5, *Potential technical solutions for improved safety*, is to describe technical solutions with potential to support transport companies to increase safety, based on the knowledge gained in WP2 and WP3.

Based on the work at the Postnord Gothenburg branch, three major problem areas were identified:

1. Manoeuvring the trucks in reverse
2. Accident reporting
3. Communication between the drivers and the transport management.

Manoeuvring the trucks in reverse



The direct causes to this type of accidents are often described in terms of poor visibility and difficulties to estimate the distances to loading bays and other objects. In order to support the driver to manoeuvre the truck in narrow and busy places these round-view systems combined with example extra lighting to improve the visibility and with distance sensors for more accurate guidance when reversing to a docking port would be beneficial.

However, the interviews and workshops with the drivers revealed that the drivers believed that the main reasons for the accidents are stress related, for example to make the deliveries in time, finding delivery addresses, irregular workload, changes in driving schedules, working overtime etc. The management's general demands for being flexible, fast and efficient are also believed to cause stress. Malfunctioning vehicles and technologies were also mentioned to cause stress as well as lack of support from the management in critical situations. Another reason mentioned to the accidents was lack of driving skills, i.e. inexperienced drivers seem more involved in these types of accidents compared to the more experienced drivers.

Considering the complexity of the reasons to the accidents, technical solutions, such as round-view cameras with distance sensors alone may not solve the problems with the accidents when manoeuvring the trucks in reverse. A comprehensive strategy for improved safety climate, including handling the stress related matters as well as developing suitable technical solutions is needed to reduce the accidents.

Accident reporting

Today the drivers at Postnord use a paper form to report accidents and damages. There are several problems with these paper forms:

- The form is not designed to make comprehensive and detailed descriptions of the circumstances for the accident (traffic, environment, causes, time at the schedule etc.).
- Different drivers fill in the form differently, e.g. using different terms, leave out different information, the descriptions are sometimes insufficient or difficult to understand etc. This makes the accident reporting inconsistent and with great variations in quality.
- The paper forms are often filled some time (even days) after the accident occurred, which affects the quality of the information in a negative way. People tend to forget what happened, how it happened, and therefore, important information is missed.
- The filled accident reports are stored in different covers in the vehicle responsible's office, which makes the availability and the retrieval of data dependent on this person, which limits the access to data for statistics, analyses, follow-up etc.

The accident reporting is important to get a comprehensive and correct data on which appropriate decisions and measures can be made to improve the safety. The current accident reporting is lacking in two major respects; (i) the paper forms, which make the reporting incomplete and inefficient, and (ii) the drivers' reluctance to report damages,



since there is a risk that they be held personally responsible for the damages and disfavoured by the management. Consequently, important data is not reported which could have been useful to understand better the circumstances for the accidents and to achieve better knowledge about how to prevent accidents. Therefore, the problems with the accident reporting need to be managed from two angles; (i) facilitate the accident reporting, e.g. with an electronic form in a mobile device with predefined codes, for accidents, damages, objects, pictures of the vehicle to indicate the damages etc., and (ii) changes at the management how they treat the drivers to encourage reporting rather making the drivers reluctant to report.

Communication between drivers

Facilitating communication between the drivers could be a key-factor for improved safety. The drivers often experience stressful situations in their daily work. To be able to communicate with other drivers and ask for support could contribute to reduced stress, which is important, since stress is often mentioned as a major factor to accidents. Moreover, the communication could also strengthen the drivers' feeling of belonging to a team in which they can share experiences, knowledge and get and give support. A functional communication tool could therefore be valuable for the safety. Just as like with the accident reporting tool, the potential positive effects of a communication tool is also a managerial matter, i.e. it needs to be part of an overall strategy for improved safety.

5.1 Delivery to FFI-goals

The project has contributed with valuable knowledge on how transport companies can work to improve safety climate and by that, reducing the risk of accidents. The project has also described technical solutions with potential to improve safety. Combining organisational changes and technical solutions is a key to achieve sustainable results for safety and the knowledge gained in the project can guide future vehicle and service development in the transport industry. The systematic way of working which was tested and evaluated in the project can also be applied within other industry segments such as manufacturing industries.

6. Dissemination and publications

6.1 Knowledge and results dissemination

Results from the project was presented by Christina Stave during the seminar “Tung trafik och säkerhetskultur” (Heavy transport and safety culture) organised by SAFER, NTF Väst, Sveriges Åkeriföretag, Volvo Trucks on February 25, 2015, in Gothenburg.

<http://www.chalmers.se/safer/EN/news/events/tung-trafik-och>



6.2 Publications

There have been no publications during the project duration. However, discussions are on-going for to publish project results during 2017.

7. Conclusions and future research

A way of working to improve the safety climate at transport companies was developed and tested with Postnord. During the one year of testing a change process started at the studied branch of Postnord, but it did not lead to measurable improvements in the safety climate survey or in the amount of accidents. A key-factor to implement new ways of working is Time (Stave et al, 2008). Therefore, one year was probably too short a time to measure any significant changes in the safety climate. Two other findings which are crucial for improved safety climate are the management's commitment and to anchor changes in the whole organisation. Moreover, efficient communication channels in the company are important to achieve the changes for improved safety in the whole organisation.

One interesting questions/topic for future research would be to further investigate what factors would trigger the top management to be committed to implement changes for improved safety. Another topic for research is how effective communication could be realized in a transport company considering the complexity of the working conditions of the drivers and transport business.

8. Participating parties and contact person

Sofia Lofstrand
Volvo Group Trucks Technology
Advanced Technology & Research
Götaverksgatan 10, 405 08 Göteborg
Telephone: +46 31 3229965
Email: sofia.lofstrand@volvo.com

Christina Stave
Swedish National Road and Transport Research Institute

Luigi Johannesson
Postnord

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