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SINTEF REPORT

TITLE

The Track to Safety Culture (SafeCulture).

A Toolkit for operability analysis of cross border rail traffic, focusing on safety culture

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ABSTRACT

SINTEF has carried out a study of safety culture at interfaces for the International Union of Railways (UIC) to develop a method for managing cultural interface.

The study consists of three main activities:

1. A review of existing knowledge applicable to safety culture at interfaces,
2. The development of a method for managing cultural interfaces (documented in this report) and
3. Piloting of the method in three railway undertakings. (At MAV/Hungary, BV/Sweden and Eurostar/UK-France-Belgium).

This document is a product of activity 2 and 3, and documents the tools to be used to assess, manage and develop safety culture at interfaces.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Railway	Jernbane
GROUP 2	Safety culture	Sikkerhetskultur
SELECTED BY AUTHOR	At Interfaces	Grensesnitt
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CHANGES INCORPORATED

This section is a record of revisions to this document, which result from a re-issue.

Issue	**Issue Date**	**Description of Change**
15/03 17/05	15/03-04 17/05	First revision based on experience from the two first Pilot's Final comments from Steering Committee and experience from Eurostar are implemented in the final document.
8/06	8/06	Changed the name of the method from SafeTrack to SafeCulture.

PREFACE

As legislation is introduced to ensure the interoperability of railway systems across Europe (EU-96), the issue of safety at cultural interfaces has become a subject of considerable interest to the rail industry. It is recognised that different cultures exist in organisations that will be increasingly required to interface with each other in the years to come. Cultural interfaces represent a potential source of safety problems, but also a potential for learning from other cultures.

To approach this challenge proactively, UIC (The International Union of Railways) engaged SINTEF to develop a method to identify and prevent safety problems that could arise due to cultural interfaces by cross border rail traffic. This work has been done in the UIC project – Safety Culture at Interfaces (SCAI). SCAI started in February-2003 and ended in March-2004.

The SCAI project consisted of:
1) A review of existing knowledge applicable to safety culture at interfaces,
2) The development of a method for managing cultural interfaces, documented in this report, and
3) Piloting of the method in three railway undertakings.

Based on the review of existing knowledge, experts' interviews, workshops and Pilots in several Railway Undertakings this report presents the method developed by the SCAI project.

The Steering Committee (SC) of the UIC project has consisted of:

ORGANISATION	**REPRESENTATIVE(S)**
BV	JAN CHRISTENSEN International Safety Affairs
IRISH RAIL	BRIAN GARVEY
JBV(JERNBANEVERKET)	OVE SKOVDAHL
	KJETIL GJONNES Senior Safety Advisor
MAV	ANDRÁS SZABÓ Project Director
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	KARINE VAN CEUNEBROECK
ZSR	JOZEF MOLKO Safety Director
ÖBB	RICHARD ULZ
	CHRISTIAN SOMMERLECHNER Safety Expert

Some important challenges regarding railway traffic at interfaces that were identified by the project:

- There are few common rules and means being used across EU to improve communication and common understanding at interfaces between countries, rail operators and infrastructure owners of the infrastructure
- The rail industry and UIC should focus more on Human Factors (HF) issues. The railway industry should improve focus on the challenges at interfaces.
- It is important to establish a simple method to aid the industry in establishing preventive traffic safety measures

These challenges have been used as a basis for establishing the goal and scope of the SafeCulture method.

The actual operational problems among the railway undertakings have been the starting point for the method and in addition results from the review of existing knowledge have been used during the development of the method.

The method has been developed via research, interviews, workshops and Pilots. The workshops have taken place at:

- UIC in Paris 25/9 and 26/9-2003, involving ZSR, Railway Safety, NMBS/ SNCB, Jernbaneverket(JBV), UIC& SNCF and MAV
- SINTEF in Trondheim at 30/10-2003, involving Connex, BaneService, NSB, JBV, FlyToget, Cargonet, Lokomotivmandforbundet (Union of Train Drivers)

The Pilots have taken place at:

- MAV/Hungary in Budapest at 18/2 and 19/2 - 2004. Project manager Laszlo FENYVES at fenyvesl@axelero.hu and SCAI Project Director ANDRÁS SZABÓ
- BV/Sweden in Stockholm 26/2 and 27/2 – 2004. Project Manager Jan Christensen in the Swedish BanVerket, jan.christensen@banverket.se
- Eurostar in UK at 23/4 – 2004, (mini-pilot) discussing with management the experience from EUROSTAR related to interface issues in UK, France and Belgium.

The project team consisted of scientists and railway professionals with a broad and varied background from social sciences, psychology, management, safety science and technical sciences. This enabled us to use different perspectives and "cultural" approaches in our work. Scientists with different perspective wrote the report. This means that some sections of the report intentionally represent different point of views.

We gratefully acknowledge the contributions from the Steering committee members and users participating in the work, specially UIC, MAV, BV, ZSR, RSSB- Railway Safety, NMBS/ SNCB, Jernbaneverket(JBV), SNCF, Connex, BaneService, NSB, JBV, FlyToget, Cargonet and Lokomotivmandforbundet (Union of Train Drivers). RSSB has been especially helpful in discussing use of the method in UK and arranging a "mini" pilot with Eurostar.

A special thank to Project Director András Szabó, Deputy Project Manager Bill Gall and Louise Ragget, Henri Delemme, International Operations Director Eurostar and Richard Sharpe Head of Safety Assurance Eurostar.

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1. INTRODUCTION

1.1 THE TRACK TO SAFETY CULTURE (SafeCulture)

This report presents a Toolbox of methods called The Track to Safety Culture (SafeCulture).
The toolbox mainly consists of a Safety Culture Questionnaire and a Scenario analysis method. In addition the toolbox contains checklists and guidelines.

The questionnaire is used to explore the safety culture in each of the companies that operate at interfaces.
In the scenario approach, different cross border scenarios are identified and analysed. Such scenarios could be based on differences at interfaces identified by the questionnaire, based on incidents or accidents or based on the scenario outlines in Appendix A.

The scenarios should be analysed by a group of people representing the various railway undertakings, infrastructure managers, and traffic control. The analysis is based on an event diagram, and an evaluation of differences at interfaces. The method is intended to assist the various railway undertakings, infrastructure managers' etc to implement preventive measures in order to control the risk at interfaces. The effort to perform a SafeCulture analysis is between 3 to 4 working days of effort from the participants. This comprises an initial, ½ to 1 day preparation, then 2 days workshop in a group setting and lastly ½ to 1 day effort to wrap it all up and follow up on recommendations and actions.

1.2 READERS GUIDE

This report consists of the following parts:

- Preface/Introduction. This section gives a short background of the Safe Track method.
- Safe Track in short. This section presents goals, definitions and an overview.

The following sections give a detailed description of the SafeCulture activities:

- **Activity 0: Preparation and Organisation**
- **Activity 1: Assessment of safety culture via questionnaire**
- **Activity 2: Scenario Analysis**
- **Activity 3: Recommendations and actions**
- **Activity 4: Implementation and follow-up**

The following sections present additional information:

- Appendix A: Outline scenarios - To be used in Activity 2: Scenario Analysis
- Appendix B: Guidelines in facilitating the group process – To be used in group processes
- Appendix C: Description of Safety Critical functions
- Appendix D: Table 6- Checklist to identify Safety Challenges
- Appendix E: Questionnaire used to assess safety culture

2. SafeCulture IN SHORT

2.1 GOALS OF SafeCulture

Goal:	To ensure that no accidents and serious incidents occur at interfaces due to cultural differences by cross border rail traffic
Goal:	To proactively plan and organise train traffic across borders and interfaces to ensure that no serious accidents or incidents occur at interfaces by including safety culture as an issue.
Goal:	To establish an arena for organisational learning of safety culture at interfaces

2.2 TERMS AND DEFINITION

For the purpose of this method, the following terms and definitions apply:

- **Safety Culture**: 'The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine commitment to, and the style and proficiency of, an organisation's health and safety management'. [From Advisory Committee for Safety on Nuclear Installations-93].
- **Safety culture at Interfaces**: "Characteristic interaction patterns, i.e. how people collaborate and communicate at interfaces."

Other terms and abbreviations are:

HF	Human Factors, Human Factors is a scientific discipline that applies systematic methods and knowledge about people to evaluate and improve the interaction between individuals, technology and organisations. The aim is to create a working environment, that to the largest extent possible, contributes to achieving healthy, effective and safe operations
SCAI	Safety Culture at Interfaces
SPAD	Signals Passed At Danger
STEP	Sequentially Timed and Events Plotting
UIC	International Union of Railways

2.3 SCOPE

Safety Culture is directly influenced by issues such as: Infrastructure, Organisation, Environment, Routines, Individual and Team. We consider National culture, Organisational culture and Professional culture indirect influencing factors, working through Infrastructure, Routines, and Organisations etc. See Helmreich (1998) and Lamvik (2004) where this is discussed. We have a "System view" of safety culture and consider Safety Culture as patterns of interactions between the total systems as suggested in figure 1.

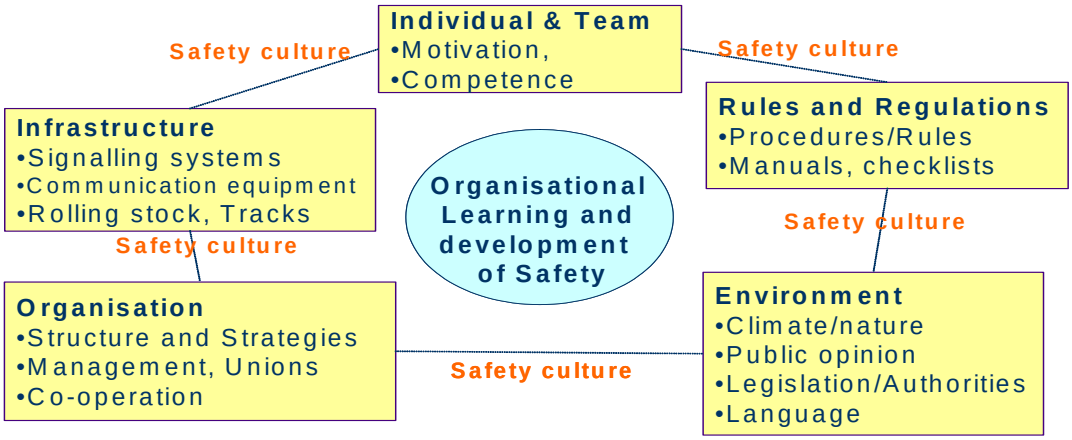


Figure 1: Safety culture – Pattern of Interaction

Safety culture at interfaces should be a natural part of the planning and operation of train traffic crossing interfaces and planning maintenance arrangements between companies crossing several interfaces. Because safety culture is seen as patterns of interaction, it is important to approach safety culture as an integrated part of the whole operation, and not as an added activity or an added point of view.

Our research has indicated that Culture can be measured and Culture can be managed and manipulated by managers and consultants (but this takes time and effort). See Schein (-92).

The important stakeholders and interfaces related to cross border undertakings related to traffic and maintenance are illustrated in figure 2:

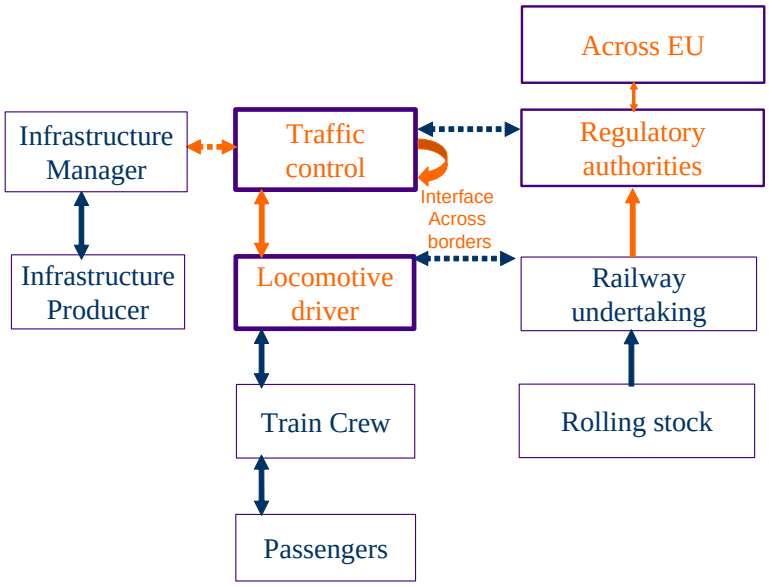


Figure 2: Key stakeholders and Interfaces

The focus of our method is the interaction between key stakeholders at the important interfaces.

Key stakeholders could vary based on interfaces of interest. As an example, the interfaces could be:

- Interaction between different Locomotive drivers and Traffic control cross borders,
- Interaction between Traffic control and Infrastructure managers cross borders or cross organisational boundaries
- Other interfaces.

Inspiration from "The Hearts and Minds Programme" in Shell

The content of the SafeCulture Questionnaire has been developed in close collaboration with the railway industry by interviews and thorough evaluations, to be a tool for the railway industry.

However, the structure of the SafeCulture Questionnaire has been inspired by the Hearts and Minds programme used by Shell International, based on the excellent experience of Shell as illustrated in Figure 2B.

In 1986 Shell International Exploration and Production started sponsoring a research programme to better understand why accidents occur and what can be done to avoid them. The Hearts and Minds programme was an outcome from this research programme. This programme is an evolutionary approach to HSE culture and enables organisations and individuals to understand the HSE culture and their personal behaviours in the context of the culture (Hudson and van der Graaf, 2002; Hudson et. al., 2002b). The philosophy of Hearts and Minds' safety culture is that development is characterised by the possible gradual development from unskilled to highly skilled performance at managing safety. Skills have to be developed and require practice and discussions. This means that focus on safety has to be kept up, it is not enough to succeed once (Hudson et. al., 2002b), and it should be done in a group setting.

Shell International has worked with the Hearts and Minds concept since 1986. Figure 2B from (Hudson and van der Graaf, 2002) shows a graphical presentation of different HSE indicators; LTIF (Lost Time Injury Frequency), TRCF (Total Reportable Cases Frequency) and FAR (Fatal Accident Rate).

Shell experienced significant improvements in the years since the research started in 1986, as the figure below shows.

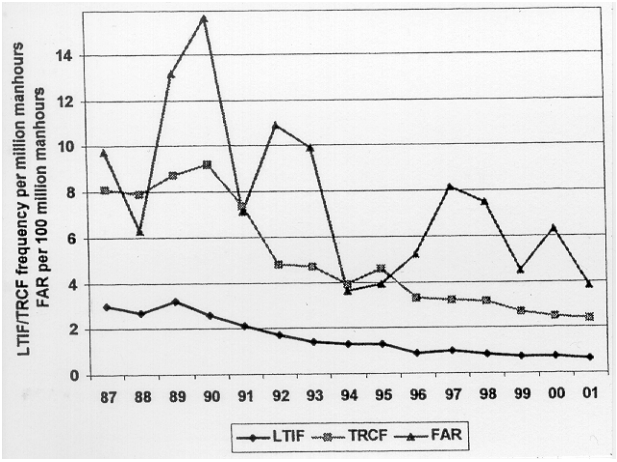


Figure 2B Safety statistics of Shell E&P companies (Hudson and van der Graaf, 2002).

Correlation between good safety culture and registered incidents and accidents

Within the railway industry, Itho and Andersen (2003) have shown a correlation between safety culture and incidents and accidents. That research has been exploited in developing SafeCulture.

2.4 OVERVIEW OF SafeCulture

SafeCulture consists of a set of tools (Questionnaire, Scenario Analysis, Checklists etc.) that can be applied during planning and operation of cross border traffic, maintenance and it is also useful in planning any activities where new interfaces are introduced. The questionnaire and the scenario analysis can be used independently.

The main activities of the Safe Track method are:

ACTIVITY 0. Preparation and organisation
ACTIVITY 1. Assessment and reflection of Safety Culture cross interfaces based on a questionnaire using best industry practice.
ACTIVITY 2. Scenario analysis and reflection performed by an experienced team involving relevant stakeholders cross interfaces
ACTIVITY 3. Prioritised actions – as agreed in team-work
ACTIVITY 4. Implementation and follow-up

The effort needed in a SafeCulture analysis is around 3 to 4 day's effort from the involved organisation. The main activities are:

Effort	**Activities**	
½-1 Day	Preparation and Organisation –Identifying relevant scenarios and identify people to attend the workshop, filling out questionnaire in advance.	Activity 0.
2 Day Workshop	Assessment and reflection of Safety Culture cross interfaces Scenario analysis and reflection performed by an experienced team Actions – as agreed in team-work	Activity 1. Activity 2. Activity 3.
½-1 Day	Follow up	Activity 4.

The agenda and invitations used in the Pilot testing are attached in Appendix-B. The main activities of the method are described below:

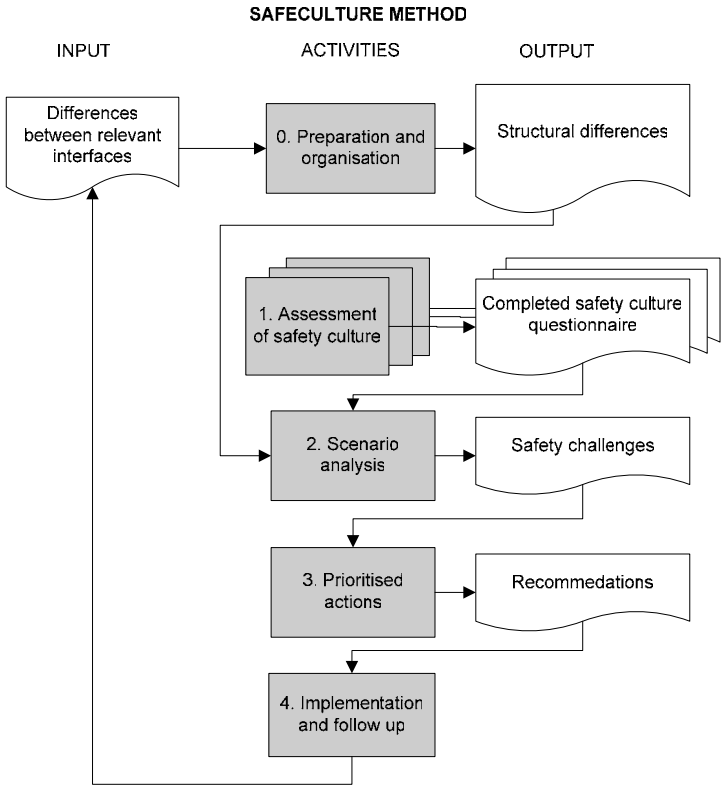


Figure 3: SafeCulture Logic

Each activity is roughly explained below (for further details see descriptions of each activity in Chapter 3.).

KEY PRINCIPLES OF THE SafeCulture METHOD

The key principles are:

- Form an interdisciplinary team cross interfaces, involving management, work force and scientists/human factors specialists across the firms and interfaces involved.
- Assess and discuss the level of safety culture by means of the safety culture questionnaire in a team setting.
- Assess and discuss the level of safety culture by means of scenario analysis in a team setting.
- Agree on problems and their solution in the interdisciplinary team. (This approach is based on the principles in Action Research as described in Levin (-98).)
- Improve operation through stepwise improvements based on "double loop organisational learning." (The SafeCulture process should constitute an important arena for organisational learning across the firms being involved.)

SafeCulture specifies that workers, management and planners should meet to discuss safety culture and key scenarios in an environment supporting open and free exchange of experiences across interfaces. The goal of this process is to achieve a "double loop organisational learning" as opposed to single loop organisational learning (see figure 4), by taking action to change the "governing variables" such as values, norms, introducing new meeting arenas, changing procedures or other governing variables. (See Argyris and Schøn, 1978).

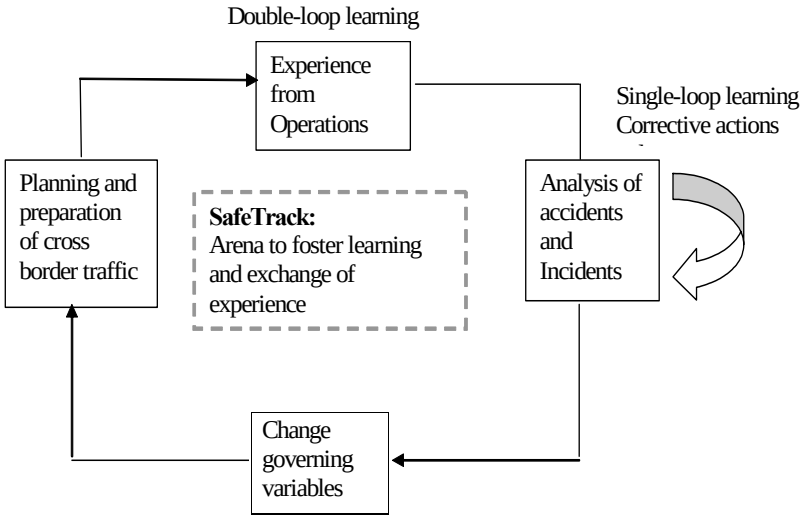


Figure 4: Double loop learning

It is suggested that SafeCulture will be available via a WEB-site and will be continually updated. The WEB site will contain recommendations, references to SafeCulture projects, experiences and contact information for key personnel.

ACTIVITY 0. PREPARATION AND ORGANISATION OF THE SAFECULTURE ANALYSIS

The purpose of this activity is to:

1) Identify the important stakeholders, define the scope and gather documentation identifying differences at interfaces
2) Establish the analysis group
3) Identify important structural differences between interfaces that can be a basis for possible scenarios to be elaborated

The "structural differences" are differences influencing the operation of rail at interfaces such as:

1. Infrastructure (Signalling systems, Communication equipment and Rolling stock)
2. Organisation (Structure, Responsibilities, Management policies and routines to Co-operate cross interfaces)
3. Routines (Procedures, Rules, Manuals and Checklists)
4. Environment (Climate/nature, Legislation, Authorities and Inspectorates (structure and policies), Languages)
5. Individual and Team (Training, competencies and collaboration)

A "Checklist-1 for structural differences" in Table-1, page 16, has been established as an aid.
Activity-0 can be seen as a General analysis of the differences and challenges at interfaces. The General Analysis has an important function in making the analysts familiar with the safety challenges at interfaces.

ACTIVITY 1. ASSESSMENT OF SAFETY CULTURE

The purpose of this activity is to assess the safety culture to identify safety challenges. At the same time we are establishing common "mental" models or understanding between the different railway undertakings.

The assessment of safety culture is done stepwise:

- First individually and then in groups within one railway undertaking and
- Then between Groups that is meeting at interfaces to identify potential differences that can influence safety

We have based our work on classifying the culture in the following five stages, which have their origin in Westrum (1992):

1 Denial culture
2 Reactive culture
3 Calculative culture – a bureaucratic, purely rule based culture
4 Proactive culture
5 Generative culture – the learning culture

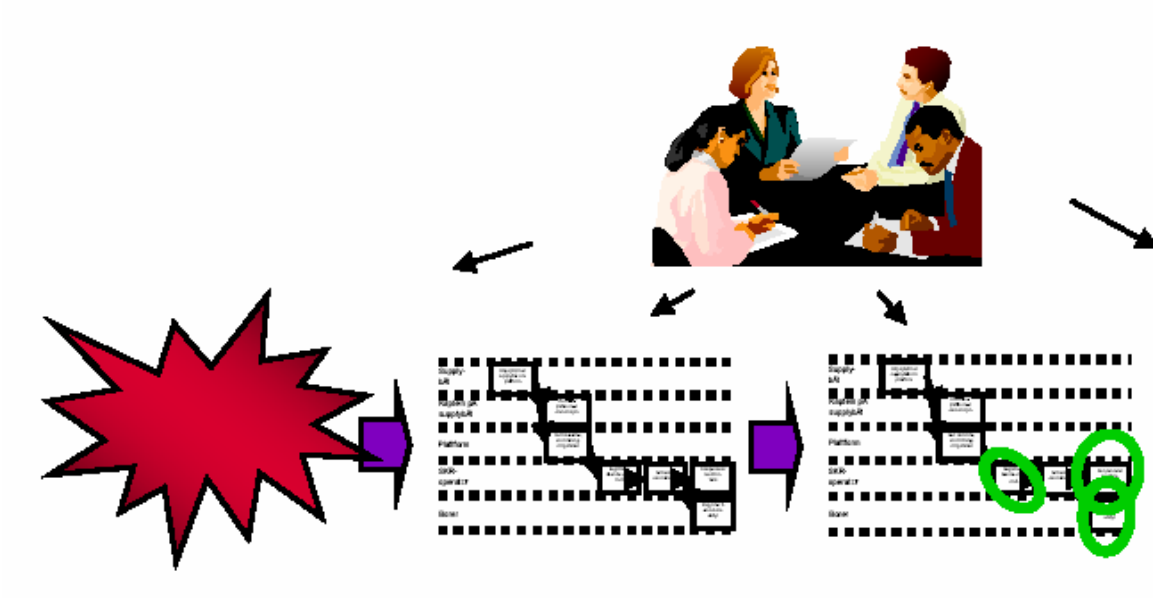
The "bold" cultural stages are described in the questionnaire.

ACTIVITY 2. SCENARIO ANALYSIS – IDENTIFY CHALLENGES

The purpose of the Scenario Analysis is to discuss relevant scenarios among a team of participants cross interfaces. The scenarios are analysed by a Checklist-2 describing safety challenges related to collaboration and communication at interfaces. Safety problems are identified and structured by means of Safety Critical Functions.

Based on the scenarios and discussions in the group, recommendations are given and later prioritised. The scenario analysis is based on four main steps, see figure 5:

1. Selection of a realistic scenario at interfaces (could be based on the questionnaire, experience or the outline scenarios from Appendix A). A scenario that can lead to an accident should be selected.
2. Description and development of the scenario by means of a Sequentially Timed Events Plotting (STEP) diagram see (Hendrick and Benner, 1987).
3. Identification of safety challenges related to collaboration and communication at interfaces by means of the Checklist-2. Structuring of safety problems by means of Safety Critical Functions (SCF).
4. Analysis of the decisions and possible evaluation of barriers



1. Selection of a scenario	2.Description of the scenario	3. Identification of safety Challenges 4. Analysis of decisions and barriers

Figure 5: The main steps in a scenario analysis

Through systematic analysis of scenarios, the analyst identifies possible weak points in handling the situations, which are used as a basis for recommendations. Even though the Scenario Analysis is based on a selected sequence of events, the method also addresses alternative sequences, i.e. “what could have happened if “. In this way, the analysis may cover a broader selection of events than the scenario indicates.

The Scenario Analysis is rather detailed, and the corresponding findings are subsequently on a more detailed level than the assessment of safety culture. The two parts of the analysis therefore supplement each other.

ACTIVITY 3. RECOMMENDATIONS AND ACTIONS

Recommendations are discussed with management and actions are agreed upon. All actions should be given a budget, time limit and assigned to a responsible person.

ACTIVITY 4. IMPLEMENTATION AND FOLLOW-UP

The actions are implemented and followed up. The analysis group should be informed of the action plan and how the implementation is going.

3. SafeCulture – DETAILED DESCRIPTION OF THE ACTIVITIES

In this chapter a detailed description of each activity in the method is given.

ACTIVITY: 0. PREPARATION AND ORGANISATION PHASE

The main steps in activity 0 are:

1) Identify the important stakeholders, define the scope and gather documentation identifying differences at interfaces
2) Establish the analysis group
3) Identify important structural differences between interfaces that can be a basis for possible scenarios to be elaborated

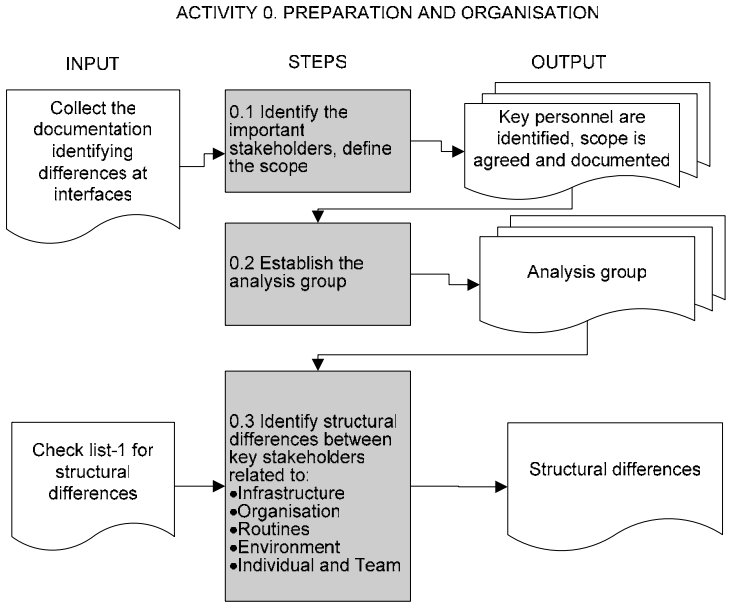


Figure 6: Activity 0. Preparation and organization logic

In relation to establishing organisational learning, the necessary guidelines to facilitate the Group Process during General analysis and Scenario analysis are described in Appendix B.

Step 0.1 – IDENTIFY THE IMPORTANT STAKEHOLDERS AND DEFINE SCOPE

- Identify and describe a team with responsibilities to perform the analysis which contains the stakeholders and the responsible parties. The role and responsibilities of the team members should be described.
- It is important to identify and contact the Safety Manager or the responsible manager within each organisation who is responsible for carrying out the recommendations from Activity 3: RECOMMENDATIONS AND ACTIONS.
- Estimate the necessary effort (budget) for the analysis.
- Document how disagreements are to be handled between the different stakeholders

Step 0.2 – ESTABLISH THE ANALYSIS GROUP

A typical analysis group for train operations consists of the following personnel:

- Two Train Drivers, one should be senior with long experience.
- Personnel from Train Control Centre
- Personnel involved in Maintenance
- A human factors specialist/Scientist
- Secretary or reporter – to document issues from the scenario analysis
- Management that can commit budget or resources

The analysis group should contain or be lead by a person with experience in human factors issues. The leader should be familiar with the method and responsible for managing discussions, keeping time schedules, etc.

In addition, the following personnel may be required for shorter periods:

- Training personnel

- Safety personnel
- Line workers
- Train Dispatchers
- Personnel responsible for Scheduling

Step 0.3 - IDENTIFY STRUCTURAL DIFFERENCES

This is an important step in making the evaluation efficient. It is important to compare and document differences at interfaces related to:

- Infrastructure,
- Organisation,
- Environment,
- Routines,
- Individual and Team.

To aid this process, use the "**Checklist-1 for structural differences"** Table 1 below.

Table 1: Checklist-1 for structural differences

1: Operating conditions/ Environment

Area	Risk Influencing factor	Major Differences (Examples)
1: Operating conditions/ Environment		
	1.1 Language *What different languages (or commands) are being used?*	
	1.2 Regulations *Do different practice and underlying assumptions influencing the structure of regulations?* *Is it a different legal and regulatory framework?*	
	1.3 Climate/Nature *Are there differences in Climate e.g. (more/less) snow or ice on the tracks? Differences in tunnels?*	
	Are there differences in Geography (Curvature and gradient different)?	
	1.4 Authorities *Are there different responsibilities or organisational structure cross borders?* *Are different routines and/or time schedules being followed by authorities cross border?*	
	1.5 Risk and Risk treatment *Are there differences in philosophy, perception and treatment of risks? Are there differences in allocation of funds?*	
	1.6 Public opinion *Are there differences in public opinion and publicity in newspapers and media related to the railway industry?*	

2: Infrastructure and Rolling Stock

	Risk Influencing factor	Major Differences (Examples)
2: Infrastructure and Rolling Stock	**2.1 Communication equipment** *Are different frequencies and/or different routines used when communicating with Train Control?*	
	2.2 Rolling Stock *Are there different technical standards?*	
	2.3 Tracks *Do different operating technical standards cross interfaces impose different conditions?*	
	2.4 Signalling systems *Do operators make different use of signalling system? Do they make different use of ATC?*	
	2.5 Power lines/Voltage/ *Do operators use different standards that must be adjusted at interfaces?*	

3: Organisation

Area	Risk Influencing factor	Major Differences (Examples)
3: Organisa		
	3.1 Structure *Are there different organisational structures/responsibilities between co-operating companies*? *Internal differences?*	

	3.2 Goals and Strategies *Are there different Goals and strategies related to safety?* *Are different definitions, terms and "mental models" being used?*	

4: Safety culture at Interfaces/ Reporting and Information

Area	Risk Influencing factor	Major Differences (Examples)
4 : Safety culture at Interfaces/ Reporting and Information		
	4.1 Reporting culture *Are there differences in accident or incident reporting?*	
	4.2 A just culture *Are there differences in Blame policies that could make open and honest co-operation difficult!*	
	4.3 Learning culture *Are there differences in approach – single loop learning vs double loop learning?*	

5: Rules, procedures and practice

Area	Risk Influencing factor	Major Differences (Examples)
5: Rules, procedures and practice	**5.1 Work practice** *Are the levels of flexibility in applying the rules different?* *Are e.g. different "gestures" being used when stopping a train?*	
	5.2 Contingency plans *Are there different contingency plans when crossing borders?*	
	5.3 Rule-books *Are there different rule books?*	

6: Individual and Team

Area	Risk Influencing factor	Major Differences (Examples)
6: Individual and Team		
	6.1 Competence *Are there different requirements? – Different basic training?*	
	6.2 Communication *Are there differences in who is contacted when a problem is encountered?*	

ACTIVITY: 1. ASSESMENT OF SAFETY CULTURE

Activity: 1 is to fill out and discuss the questionnaire in Appendix F to assess safety culture. The questionnaire can be used in several ways:

- It can be used within your own company. First individually and then discussed in groups to identify areas to be improved. Improvements could be done individually and by the group.
- It could be used across companies meeting at interfaces. The benefits are that this will establish a common framework and will help in identifying areas of differences that can lead to safety problems.
- It can be used by an external party, performing quality control of railway undertakings cooperating cross borders. (This is not elaborated in this report.)

It is suggested that you use the questionnaire in your own company and then to use it across companies meeting at interfaces.

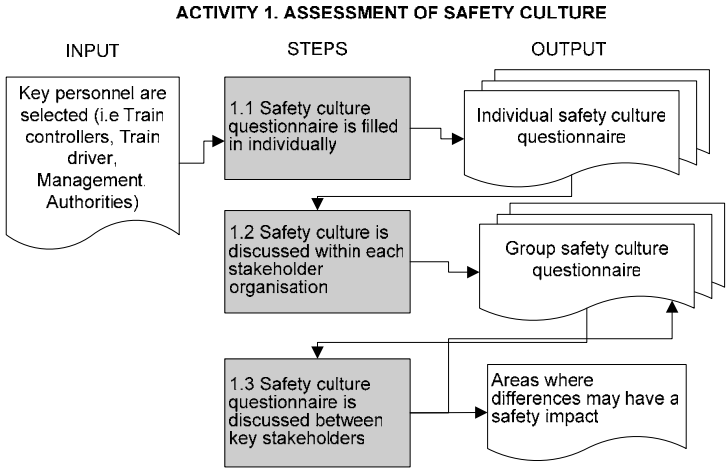


Figure 7: Activity 1. Assessment of safety culture logic

Key personnel meeting at interfaces and involved in developing the safety culture should be selected. When cross country traffic is planned, important stakeholders could be:

- Train Controllers (cross borders)
- Train drivers
- Maintenance personnel
- Management
- Authorities
- Leader of the analysis

The effort used to fill out the questionnaire and discuss it between stakeholders should be around 1 day of effort.

Examples of the questions being used to assess safety culture are described below:

6. How do the organisations adapt to new interfaces and co-operation across borders?

Three examples are given and the participants are asked to assess the safety culture on a scale from 1 to 5 based on the following examples:

Example of Denial culture – (Scale 1)

The organisation has not changed even if new interfaces and new "markets" have been established. There is unwillingness to do organisational changes.

Example of Calculative culture – a purely rule based culture (Scale 3)

There is a bureaucratic organisational structure, which is managed by rules and with few adjustments. Discussions concerning organisational evolution are almost negligible.

Example of Generative culture – the ideal (learning) culture (Scale 5)

Overall goals, visions and values guide the organisation. Continuous research to identify best practice is done. There is a systematic development cross interfaces based on multinational project teams and good co-opting processes where the workers are actively participating. There are face to face meetings to create common understanding and confidence.

ACTIVITY: 2. SCENARIO ANALYSIS

Introduction

The scenario analysis is the second activity in the "The Track to Safety Culture"- process. The purpose of the Analysis is to discuss relevant scenarios among a team of participants cross interfaces. The scenarios are analysed by filling out Table 2: "Checklist-2" in Appendix-D, describing safety challenges related to collaboration and communication at interfaces.
Safety problems are identified and structured by means of Safety Critical Functions. Based on the scenarios and discussions in the group, recommendations are worked out and later prioritised.

The Scenario Analysis gives a possibility to assess safety culture and challenges in response to possible scenarios. The scenarios could be based on known accidents or incidents, analysis of one or more identified safety critical function, or on issues that are identified through the safety culture questionnaire.

Structure of the scenario analysis

The scenario analysis is performed in a group with participants from the interfacing companies. In appendix B you can find some guidelines for how to organize the group work. The analysis is based on four main steps as illustrated in figure 8:

1) Scenario identification and selection of a realistic scenario at interfaces
2) Description and development of the scenario by means of a Sequentially Timed Events Plotting (STEP) diagram.
3) Identification of safety problems related to collaboration and communication at interfaces by means of the Checklist-2. Structuring of safety problems. (Safety Critical Functions (SCF) could be used to aid in identifying safety problems).
4) Analysis of the scenario to identify safety challenges.

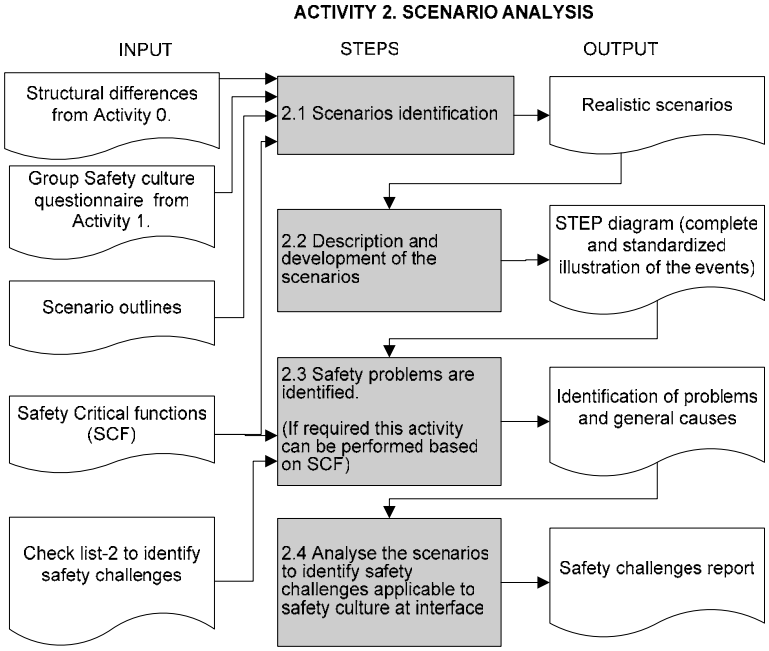


Figure 8: Activity 2. Scenario analysis

Further details related to the different steps are given below.

Step 2.1 Selection of a realistic scenario at interfaces

The first step in the scenario analysis is to select a scenario. The scenario could be based on known accidents or incidents or could be made up by the group members.

Some Key criteria to select Scenarios
The scenarios should be selected on the basis of the following criteria:

- The scenarios should be realistic. The involved parties should feel that they really might occur.
- The scenarios should have a potential of major losses.

- Human actions should be critical to the outcome of the scenario.
- The involved parties should be uncomfortable with their knowledge about the existing status.

The Scenario Analysis addresses alternative sequences, i.e. "what could have happened if ". In this way, the analysis may cover a broader selection of events than the scenario indicates.

Scenarios outlines

Nine scenarios have been outlined to support the analysis. The scenarios are:

- S1: Initiating emergency stop of train
- S2: Approach to level crossing
- S3: Events before and after SPAD (Signal Passed at Danger)
- S4: Detection of errors in track routing
- S5: Depart station
- S6: Assisting a failed train as a result of traction power
- S7: Accident and incident response to a major train accident
- S8: Accident because of differences in Infrastructure
- S9: Scenarios related to Maintenance (the Hatfield accident, work on track)

See Appendix A for descriptions of the scenarios.

These scenarios describe different types of emergencies in which the Train driver, Maintenance and/or Train Control plays an important role. During the scenario analysis these scenarios should be combined with incidents as:

- Technical problems
- Different Train Control shift involved
- Weather conditions
- Different Maintenance staff

Safety critical functions

The list of safety critical functions could be used as a support when the scenarios are designed. "Safety critical function" is defined as "function of a system for which a malfunction would immediately increase the risk of injury, or damage to health". The SCFs could be viewed as "basic events" in a Fault Tree Analysis (FTA), or "barriers" in an Event Tree Analysis (ETA). However, the scenarios do not have to be described to the level of detail and formalism as is usually done in FTA and ETA.

Combining a SCF analysis with a STEP-analysis has proved fruitful both with respect to getting a good understanding of the scenario being analysed cross interfaces, but also to ensure user commitment.

A complete set of safety critical functions would be of value when conducting a scenario analysis. So far we have categorised the safety critical functions into 7 areas:

1. SCFs related to normal operation
2. SCFs related to ordinary traffic disturbances
3. SCFs related to technical failures in signalling system/Central Train Control (CTC) system
4. SCFs related to degenerated infrastructure
5. SCFs related to work on the track
6. SCFs related to deficiency on rolling stock
7. SCFs related to cross border activity

Each area is divided in several primary safety critical functions, and these are listed in **Appendix C.**

Example 1: Collision scenario: See Figure 8-1 for a sketch of the situation.
Maintenance is carried out on track 1 near a border crossing. Train B is instructed from rail traffic controller in country B to cross to track 2 from station 2 towards station 1. The rail traffic controller in country B informs the rail traffic controller in country A correctly about the crossing. However the rail traffic controller in country A misunderstands the situation, and believes that train B is going to cross to track 2 from station 3 towards station 2, and not from station 2 to station 1. The rail traffic control in country A allows train A to continue on track 2, from station 1 to station2. This leads to an incident where train A collides with train B on the track between station 1 and 2.

Step 2.2 Description and development of the scenario by means of a Sequentially Timed Events Plotting (STEP) diagram.

In order to describe and develop the scenario we would usually *i*) draw a sketch of the situation, and *ii*) establish the STEP diagram.

Example 2: Sketch of a collision situation
We consider example **1** again, and draw a sketch of the situation where the two trains are colliding because of misunderstandings related to where the trains are crossing.

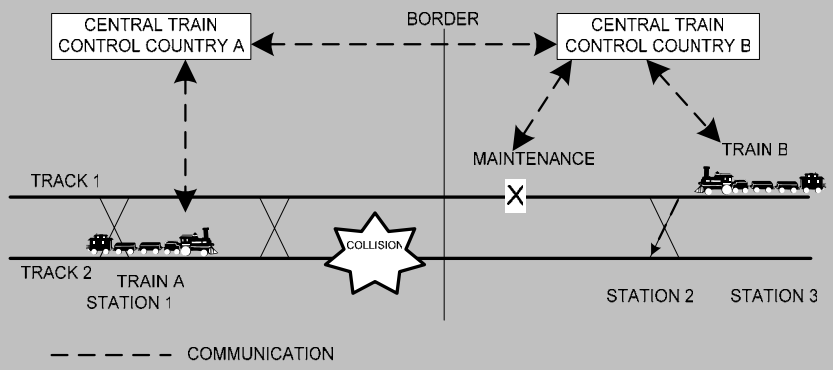


Figure 8-1: Interactions in cross border Rail-Traffic (Simplified example)

The STEP method was developed in order to analyse incidents and accidents in detail. When the STEP diagram is completed accordingly it will result in a complete and standardised illustration of the event (what happened and why). The method is conducted in the following manner:

Identification of actors: The first issue when drawing the STEP diagram is to identify the actors who were involved in the incident or accident. The term actor denotes a person or object that affects the event ”by their own force”. The actors do not only react in a passive manner to outside influence, they are actively involved in the events leading up to the accidents by e.g. their own actions, decisions or omissions. The actors are drawn under each other in a column on the left side of the STEP diagram.

Events identification: The next step is to identify the events that influenced the accident. The events are described by ”whom”, ”what” and ”how”, and are placed in the diagram according to the order in which they occurred. There should only be one event in each rectangle. A mental event, that is what the actor perceives, interprets or actions s/he intends to conduct should be included in the diagram. If the exact time of an event is not known, attempts should be made identify the correct order of events. In some situations it is better to identify the sequence of events first. This is not a problem as long as the investigator remembers to identify all the involved actors afterwards.

Identify relationships and causal links: The STEP diagram is completed by identification of the relationship between the events that caused each of them, by showing this in the diagram by drawing arrows to illustrate the causal links. For each event the previous events leading to this event are assessed. This is done by the use of a logic test. The logic test consists of a necessary and a sufficient test. The logic test addresses whether one event is sufficient to cause the following event. If not, then other events that are necessary in order to cause the following events are identified. Finally the connection between the events is shown using arrows. This will also ensure that the events are in correct order with regard to the time line.

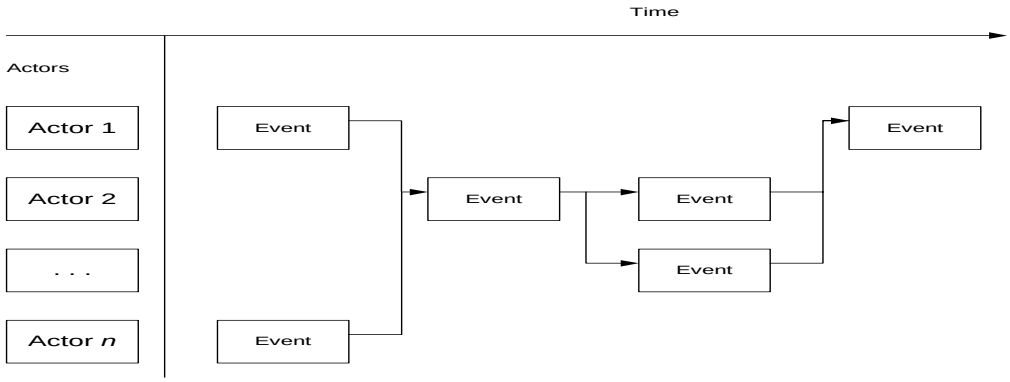


Figure 9: Schematic STEP diagram

Hint
It is practical to use yellow post-it notes and large pieces of paper when the incident is analysed. The text is written on the post-it notes, which are placed in the presumed correct position and moved when needed. The connecting lines should be drawn with pencil, so that they can be altered easily.

Example 3: STEP diagram for the collision situation
We consider example **1** again, and draw a sketch of the situation where the two trains are colliding because of misunderstandings related to where the trains are crossing.

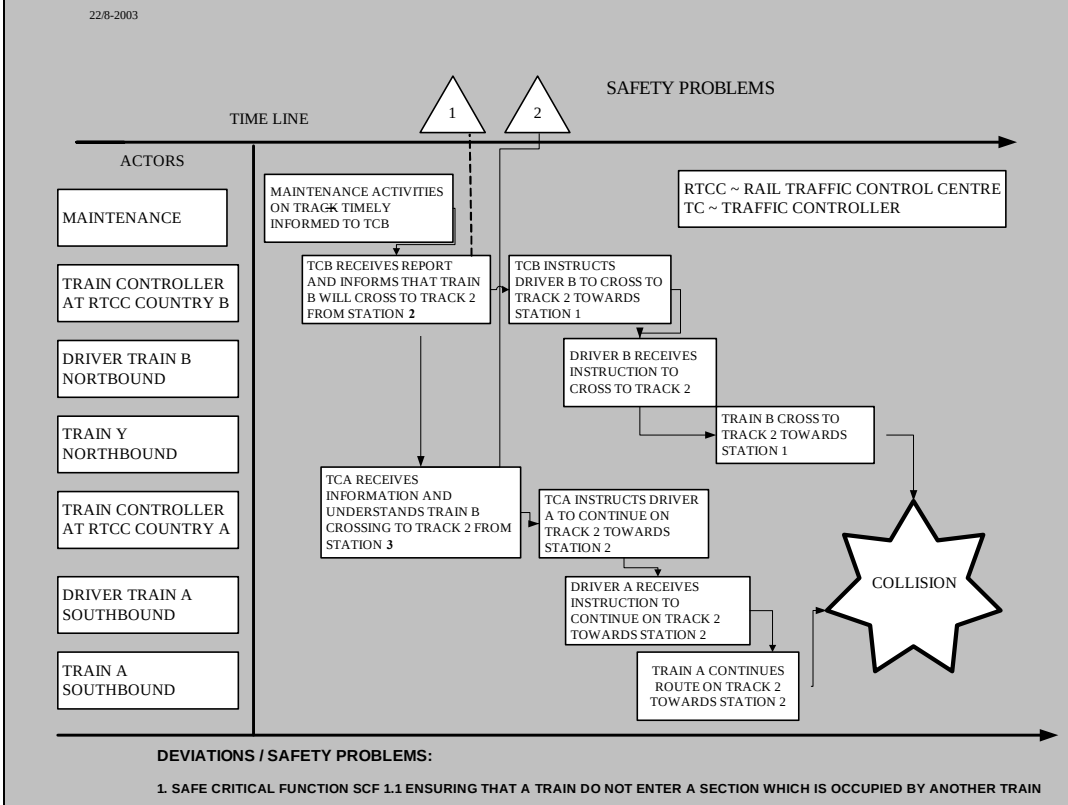


Figure 8-2: STEP diagram of collision between two trains

Even though the Scenario Analysis is based on a selected sequence of events, the method also addresses alternative sequences, i.e. "what could have happened if ". In this way, the analysis may cover a broader selection of events than the scenario indicates.

The Scenario Analysis is detailed, and the corresponding findings are subsequently on a more detailed level than the assessment of safety culture. The two parts of the analysis therefore supplement each other.
To fully understand the root causes and consequences of weak points and safety problems detected through the Scenario Analysis, the analysis team should evaluate the existing and missing safety critical functions.

Step 2.3 Identification of safety problems

Through systematic analysis of scenarios during the STEP analysis, the analyst identifies possible weak points in handling the situations, which are used as a basis for recommendations. The weak points are marked as red triangles at the figure as shown below. To explicitly stress the safety problems we could either *i*) phrase the problem in the setting for which the STEP diagram has been drawn, or *ii*) we could formalise the problem by explicitly stating a weakness or failure of a safety critical function (SCF).

Example 4: STEP diagram for the collision situation
In the STEP diagram we have now highlighted one safety problem related to understanding where the trains are positioned. This is again critical in order to fulfil SCF1.1: Ensuring that a train do not enter a section which is occupied by another train

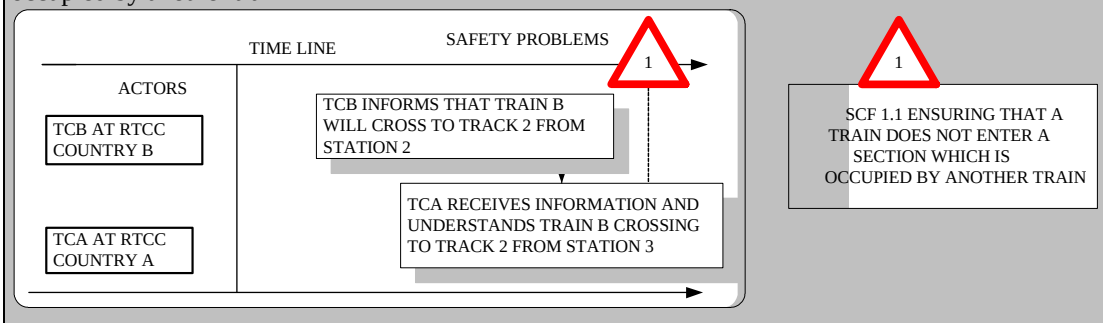


Figure 8-3: Identification of safety problem

Step 2.4 Analyse the scenario to identify safety challenges applicable to safety culture at interfaces

The idea in this step is to perform a detailed analysis of the identified safety problems (the triangles in the STEP diagram). For each safety problem we will try to identify challenges related to safety culture at interfaces especially, but also other risk influencing factors related to structural differences. When identifying safety culture issues related to the specific safety problem the discussion in Activity 1 (Safety Culture Questionnaire) will be of great value. With respect to other risk influencing factors, Table 3 presents a checklist that could be used in this part of the analysis. This checklist has been developed based on Reason (-97).
Please also see Appendix D: Table 2: Checklist-2.

Table 3 Risk Influencing factors

Risk Influencing factors	Description/examples
Environment	Public opinion, Climate/Nature, Legislation, Authorities, Language, Regulations,
Infrastructure & rolling stock	Tracks, Signalling systems, Communication equipment, Rolling stock, Human machine interface
Organisation	Structure, Goals, Strategies, Management, Co-operation across borders,
Safety culture at interfaces	Management involvement, Shared commitment, Focus on organisational learning, Reporting culture, A just culture, Industry wide co-operation, Legislative Co-operation
Routines	Work descriptions, Contingency and emergency plans
Individual and Team	Motivation, Risk perception, Identity, Competence, Communication

Example 5: Analysis of safety problems
We will now analyse in detail the safety problem related to the SCF 1.1 “Ensuring that a train does not enter a section which is occupied by another train”

Table 4 Analysis of safety problems

ID	Safety problem	Safety culture	Risk influencing factor
	Ensuring that a train does not enter a section which is occupied by another train	Background: TCA at RTCC in country A is not very familiar with the geography in country B. The message from RTCC in country B was rather unclear. Thus, we have identified the following issues related to safety culture Lack of commitment, i.e. does not use the command language (phraseology) as precisely as specified in the written procedures. Ignorance, rather than repeating the question when something is unclear.	Different Language being used, e.g. French and German Different systems being used, different frequencies, Important messages could be delayed in a contingency

The final step now is to identify means to overcome the identified safety challenges. In the example, this could be to perform training and control related to how the command language is used. Another measure would be to introduce a common European Command Language.

ACTIVITY: 3. AND 4. RECOMMENDATIONS, ACTIONS, IMPLEMENTATION AND FOLLOW UP

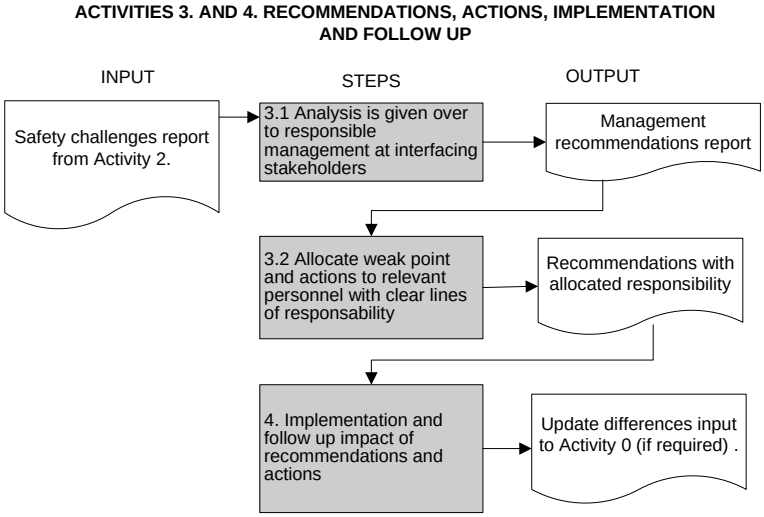


Figure 10: Activities 3 and 4. Recommendations, actions, implementation and follow-up.

The report from the analysis should be addressed to the responsible management in the organisation which initiated the analysis. The recommendations from the report should be allocated to relevant personnel with clear lines of responsibility regarding follow-up. The responsible person for each recommendation should as soon as possible make a plan for actions and deadlines for following up (see example in Table 4).

Table 4: Recommendations with allocated responsibility

Weak point	Action	Responsible person	Target date
No arena for operating personnel to discuss cross border issues between Norway and Sweden	Establish arena between operating personnel	NN	DD.MM.YY.

It is more challenging to implement the results from the method than to use the method itself. The implementation requires coordination, involvement and commitment between the management, work force and the involved parties cross interfaces.

4. SUMMARY OF THE WORKSHOPS AND PILOT STUDIES

The method has been developed via research, interviews, workshops and Pilots. The workshops were arranged at:

- UIC in Paris/France at 25/9 - 26/9-2003, involving ZSR, Railway Safety, NMBS/ SNCB, Jernbaneverket(JBV), UIC& SNCF and MAV
- SINTEF in Trondheim/Norway at 30/10-2003, involving Connex, BaneService, NSB, JBV, FlyToget, Cargonet, Lokomotivmandforbundet (Union of Train Drivers)

The Pilots have taken place at:

- MAV/Hungary in Budapest at 18/2 and 19/2 - 2004. Project manager Laszlo FENYVES at fenyvesl@axelero.hu and SCAI Project Director ANDRÁS SZABÓ
- BV/Sweden in Stockholm 26/2 and 27/2 – 2004. Project Manager Jan Christensen in the Swedish BanVerket, jan.christensen@banverket.se
- Eurostar in UK at 23/4 – 2004, (mini-pilot) discussing with management the experience from EUROSTAR related to interface issues in UK, France and Belgium.

The experiences from the workshops were very positive. Some of the key points from the participants were:

- **STEP method.** The experience of use of the STEP method to discuss scenarios was very positive in a cross border setting. People from different train companies in Belgium, UK and Hungary could quickly understand a scenario described by STEP and then participate in al discussion to find useful solutions that could function.
- **The "Safety Culture Questionnaire"** was found to be relevant and "to the point" among all participants. All the different participants in the workshops and Pilot's wanted to strive to reach the "Ideal culture". The issues in the questionnaire were very enthusiastically discussed. By filling out the questionnaire – prior to the workshops/pilots – it was found that the participants had the same "mind set" in the meeting.
- **The checklists** were found to be very useful to identify challenges at interfaces.

- **Two day workshop**. The participants in the workshops/Pilots were very enthusiastic after having participated in the workshops. Important issues were raised, common understanding was gained and relevant actions were identified.

4.1 BEST PRACTICE IN CROSS BORDER RAIL TRAFFIC

Through our work we have identified some suggestions for best practices, which have been incorporated in our method. Some of the issues that have been mentioned are:

1. Harmonisation of procedures by multinational project teams. Experience show that groups consisting of representatives from each of the countries involved in operations should be established. These groups should to the extent possible meet face to face, to create confidence and common understanding. It is essential that different parties meet to harmonise their procedures as much as possible so that operators adopt the same behaviour on every infrastructure.
2. The use of protocols or formalised communication templates is essential when communicating cross interfaces. Pre-determined protocols and forms reduce language difficulties, and should be mandatory.
3. "Grey areas" of responsibility should not be tolerated. Initial clear planning is very important. It is essential in international services to have a perfect clarity in tasks definition and responsibilities.
4. Both interfacing organisations will benefit from the ability to admit that they are different without inferring value or preference. One country's solution is not necessary the only right solution, even though it may seem like the only rational solution. It may be tempting to enforce one specific approach on the other party, but a better suggestion is to share experiences to provide an opportunity to learn from each other.
5. Avoiding potential misunderstandings caused by languages. Misunderstandings can appear when translating procedures. This can be corrected by translating back and forth. As an example Eurostar translate procedures from French to English and then back to French where the two French versions are compared and checked for possible misunderstandings. Another measure to avoid language problems is thorough language training for the train drivers by exchanging them between the two countries for a period of time.
6. Obligation to report any condition that could imply a risk for other companies. As far as international business is concerned, it is important that all parties share their databases regarding safety events and the resulting recommendations. This would ensure a possibility for an equal level of safety for all operators.
7. Intensive training for operators, focusing on communication and handling of deviations. A clearly defined specification and procedure for language training and assessment for all parties is required at the start and as ongoing maintenance activity of language competence. Good experience has been obtained by the use of simulator in addition to the normal training. In a simulator - scenarios including deviations from normal operations can be tested, and the other side of the interface can be included.
8. Common rules and procedures. Decide on one set of rules and change this as little as possible, after what is needed in comparison with the other rules. An important aspect of this issue is to ensure that not only the basic rules are the same, but also the common understanding of the rules. Rules should be kept as "living documents".
9. It would be helpful for both parties to agree on a similar model for identifying and managing risks and the resources to control risks. Some of the most difficult issues to resolve stem from differences in the conceptualisation of risk management.

5. CONCLUSIONS

The method that has been developed is based on sound research, proven methods such as STEP-method and the "Hearts and Mind" program from Shell. The project team has also collaborated closely with the railway industry such as UIC, ZSR, Railway Safety, NMBS/ SNCB, Jernbaneverket (JBV), SNCF, MA, BV (Banverket) and Eurostar in developing, refining and using the method.

The result of our work has been a set of new approaches and tools that has been found useful and inspiring to use among Railway Undertakings. The end result is a practical tool that has already been successfully used. See Johnsen (2004).

Based on our research, the use of proven method and feedback from the Pilot's - our opinion of the SafeCulture method is:

- Use of the method can **improve safety** at interfaces
- Exploration of the work in groups – is supporting organisational learning cross interfaces, and could aid in **promoting "Best Practice" at interfaces**
- Analysis of past incidents and future challenges via the STEP **method improves understanding and communication**
- Evaluation and comparison of safety culture by the Questionnaire promotes **understanding of challenges internally and at interfaces**

We wish new user of the method – Good Luck!!

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APPENDIX A: SCENARIO OUTLINES

This appendix contains outlines of the following scenarios:

- S1: Initiating emergency stop of train
- S2: Approach to level crossing
- S3: Events before and after SPAD
- S4: Detection of errors in track routing
- S5: Depart station
- S6: Assisting a failed train as a result of traction power
- S7: Accident and incident response to a major train accident
- S8: Accident because of differences in Infrastructure
- S9:Scenarios related to Maintenance (the Hatfield accident, work on track)

The outlines may be used as a basis for designing detailed scenarios that reflect the local conditions of the operations to be analysed. It may be necessary to change titles/designations of personnel categories, e.g. change "Rail Traffic Controller" to "Train Dispatcher" or "Signaller".

In developing some of the scenario outlines, we have utilised scenario descriptions developed in the HUSARE project.[1] However, the scenario descriptions below are generally less detailed, as the scenarios should be adapted to **local conditions**.

Scenario S1: Initiating emergency stop of a train

This is family of scenarios covers situations where somebody other than the train driver identifies an emergency situation where a train needs to stop as soon as possible, e.g.

a. A Rail Traffic Controller discovers that two trains are on collision course after a SPAD event (signal passed at danger).
b. A Train Dispatcher standing on the station platform notes that a train which has a crossing at the station leaves the station before the crossing train has arrived.
c. A line worker discovers that a wagon has derailed after a train has passed a place where track work is carried out.
d. The police have been notified by the public that the track has been damaged by an avalanche.
e. A train driver on a double track line detects signs of a dangerous condition on a meeting train (e.g. an open door, smoke).
f. A shunter (switchman) detects a dangerous condition which calls for a moving train to stop as soon as possible.

Particular attention should be given to scenarios where personnel from different countries need to communicate efficiently in order to handle an emergency situation.

Scenario S2: Approach to a level crossing

Several situations related to level crossings may be analysed:
Scenario 2 a. An obstacle, e.g. a truck, blocks a level crossing. The level crossing is protected by an automatic system with barriers which are activated by approaching trains via an activation device. There is no obstacle detector on the level crossing. The driver sees a main (or special protecting signal) which displays a 'proceed' aspect, indicating that the level crossing is closed for road traffic. In this scenario the braking distance of the train exceeds the distance to the level crossing at which the obstacle is recognisable to the driver, so that a collision with the obstacle on the crossing is inevitable. The safety critical tasks for the driver and crew are to stop the train, protect the train from the danger of approaching trains and ensure that the passengers are safe.
Scenario 2b. Due to technical error, the barriers at a level crossing cannot be lowered, and approaching trains meet a main signal or a special protecting signal which displays the 'stop' aspect. The Rail Traffic Controller will have to decide whether trains can still pass the level crossing, and communicate this decision to drivers.

[1] HUSARE stand for "Human Safe Rail in Europe" - Managing the Human Factor in Multicultural and Multilingual Rail Environments Human Factor Analysis Techniques for Cross-Border Rail Operation". The project was sponsored by the European Commission under the Transport RTD programme under the 4th Framework Programme.

Scenario 2c. Due to technical error, the barriers at a level crossing cannot be raised after a train has passed. After some time, impatient pedestrians may start crossing the track in spite of the lowered barriers and the warning signal. At some level crossings, even cars may be able to by-pass the barriers and cross the line in spite of the lowered barriers.

Scenario S3: Signal passed at danger

This scenario may be divided into two parts:

Scenario 3a: Events leading up to a SPAD. A driver misjudges the track conditions i.e. poor adhesion and does not adjust his train handling techniques to compensate e.g. to allow a longer braking distance. Similarly a SPAD can occur if the brakes are applied too late to stop at the danger signal when there is an incorrect response to a warning signal. This may happen because a driver from Country A drives in Country B, where the distance between the caution signal and the stop signal is shorter than he/she is used to.

Scenario 3b: Events following a SPAD incident. The driver has applied the brakes of the train but has passed the danger signal. He/she must follow the procedures to inform the Rail Traffic Controller that a SPAD has occurred. The Rail Traffic Controller will ascertain whether the driver is fit to continue the journey and give the necessary instructions to the driver.

Scenario S4: Detection of errors in track routing

Diversionary routes are generally infrequently used and the driver may be uncertain as to whether he should follow the signalled deviation, particularly on a foreign infrastructure. It is not necessarily within the competence of the driver to judge the technical compatibility of the route for his train. A driver who drives the train beyond the route for which the train type has route acceptance creates a potentially unacceptable risk situation. Safety problems can also arise through measures taken to bring the situation back to normal.

The initiating event in this scenario is a signalling error. A Rail Traffic Controller has directed the train to an unplanned deviation route.

A passenger/freight train with driver and crew from Infrastructure A is travelling on Infrastructure B. The train is diverted to a deviation route. The train driver is given the appropriate line side signals. The safety critical task for the driver is to judge whether he is authorised to take the route to which he is being diverted. He must decide whether to accept or reject the Rail Traffic Controller's directions. Three possible driver behaviours may be considered:

Scenario S4a**:** The driver is uncertain about the routing signal. He has to decide whether to accept the signal or to stop the train and confirm the routing with the Rail Traffic Controller.

Scenario S4b: The driver has taken the diversion, but then realises en route that he has made an incorrect judgement and must now decide what action to take in a situation where he has incomplete route knowledge. In other words the driver and the route are not compatible.

Scenario S4c**:** This scenario is based on S4b but involves a freight train and the actions to be taken will be influenced by the train characteristics. In this scenario the train and the route are not compatible.

Scenario S5: Depart station

Procedures for "depart station" vary in the different countries and between cross-border routes. The train crews will learn specific procedures for cross-border operation, which may differ from those which they normally follow on the home infrastructure. Non-compliance with such procedures will be more likely when an unexpected situation arises.

An international passenger train from Infrastructure A, with passengers, driver and one guard (as the only crew member), arrives at a scheduled stop on Infrastructure B. The depart station procedures and the allocation of responsibility for giving the depart station signal are different on infrastructures A and B. Also different languages are spoken.
Two possible incidents which may happen if the depart station procedures are followed incorrectly are:
Scenario 5a: Trapping a passenger in the doors because an inadequate check is made after the doors have closed. E.g. the train driver has taken responsibility for the final check of the passenger doors and he has an inadequate view of the doors along the train.
Scenario 5b: Starting against a stop signal because the driver has misunderstood a depart station message from the train crew or station staff and incorrectly believes that he/she has a permission to drive past a stop signal.

Scenario S6: Assisting a failed train

A freight train with a driver and crew from Infrastructure A is travelling on Infrastructure B. The driver receives an indication of complete loss of traction. He follows the procedures to restore traction power whilst still moving but without success. The driver stops the train at an appropriate location on the open line between stations. The driver informs the Rail Traffic Controller he has a technical problem and will attempt to find and rectify the fault. Following investigation the driver concludes that he needs assistance from another train. He reports to the Rail Traffic Controller and they agree the arrangements to be made including the direction from which the assisting train will arrive.
The Rail Traffic Controller, train crew of the failed train and the assisting train carry out the necessary rules and procedures for that infrastructure associated with connecting the two trains and the onward journey. This will include the use of shunting procedures. Possible problems include confusion concerning the exact position of the stranded train (e.g. due to inaccurate communication).

Scenario S7: Response to major train accident

In this scenario the events after a major train accident such as a derailment is considered:
A passenger train with driver and crew from Infrastructure A is travelling on Infrastructure B. The train collides with the rear end of a freight train ahead and a derailment occurs obstructing the adjacent track. The driver of the passenger train is seriously injured and is not able to follow the required procedures such as radio alert and protection of line. The remaining train crew apply the track protection procedures. The passengers are in danger because a train is approaching on the adjacent line. The crew evacuate the passengers. A freight wagon containing dangerous goods has derailed and there is a danger the cargo will be released.

Scenario S8: Accident caused by differences in infrastructure

A variety of differences in infrastructure may cause or contribute to accidents, e.g.

Scenario S8a: Main lines in Country A are equipped with full ATC (Automatic Train Control), which monitors compliance with main signals as well as speed limitations. Main lines in Country B are equipped with partial ATC, which only monitors compliance with main signals. This difference may cause drivers in Country A to rely on the ATC to prevent excessive speeds. The difference may also cause drivers in Country A to read speed limitations off the ATC display in the cabin, rather than off external signposts. In both cases, drivers from Country A may be prone to exceed speed limitations when driving in Country B.

Scenario S8b: The ATC system used at main line stations in Country A effectively ensures that a train starting against an exit signal at danger will be stopped before there is danger of collisions with trains entering or leaving other tracks. In Country B, trains starting against an exit signal at danger are not always stopped soon enough by the ATC to avoid danger of collisions with trains entering or leaving neighbouring tracks. In Country B, the exit procedure therefore requires the train guard to check independently that the exit signal shows a “proceed” aspect before the train is started. Train crews from Country A driving in Country B may be prone to forget to perform this double check.

Scenario S9: Scenarios related to Maintenance (the Hatfield accident, work on track)

We have described several scenarios related to maintenance, among others a simplified description of the Hatfield accident – in order to show how such a scenario can be discussed and described via the STEP method – ref Wolmar (2001).

Scenario S9a: Scenario description of a simplified Hatfield accident

On 17 October 2000 four people were killed and 70 injured as a result of a derailment near Hatfield outside of London, Great Britain, this is known as the Hatfield accident. It should be noted that some simplifications has been made in the presentation of the accident and the circumstances, the full picture is thus not presented. It is rather to be seen as an example based on the Hatfield accident.

The immediate cause of the accident was a fractured rail, which in turn leads us to take a closer look at the maintenance system of the tracks and the administration and distribution of responsibility. The bad condition of the track section had been known for a while, and the first attempt to fix them was made in March 2000. Four attempts were made before the summer when busy traffic did not allow for the line closure the job required. So during the six months the problem had been known the line was not fixed.

The privatisation process of British Rail took place in 1996/1997, where Railtrack was the infrastructure owner and thus maintenance operator, who ordered the jobs from maintenance contractors, in this case Balfour Beatty.

Railtrack lacked the engineering knowledge to understand the criticality of the cracks, after the privatization the company was largely run by people without technical background and had no Research & Development department

(it had been subcontracted to consultants in the privatization process). Another fault was that there was no central record of defects, the maintenance contractors were supposed to be aware of the condition of the network. The inspectors did not look closely enough on the tracks, and could only inspect from a distance because of their own safety and did not get a good view of the tracks. In addition the inspector claimed that he had not been trained in gauge corner cracks, which was the type of crack which caused the track to break. Railtrack was not updated on ultrasound inspection, the results were difficult to interpret and the gauge corner crack was not detected. Because of this lack of knowledge Railtrack was not aware of the criticality of the cracked track and did not impose speed reductions nor allow shut down of the line to replace the track.

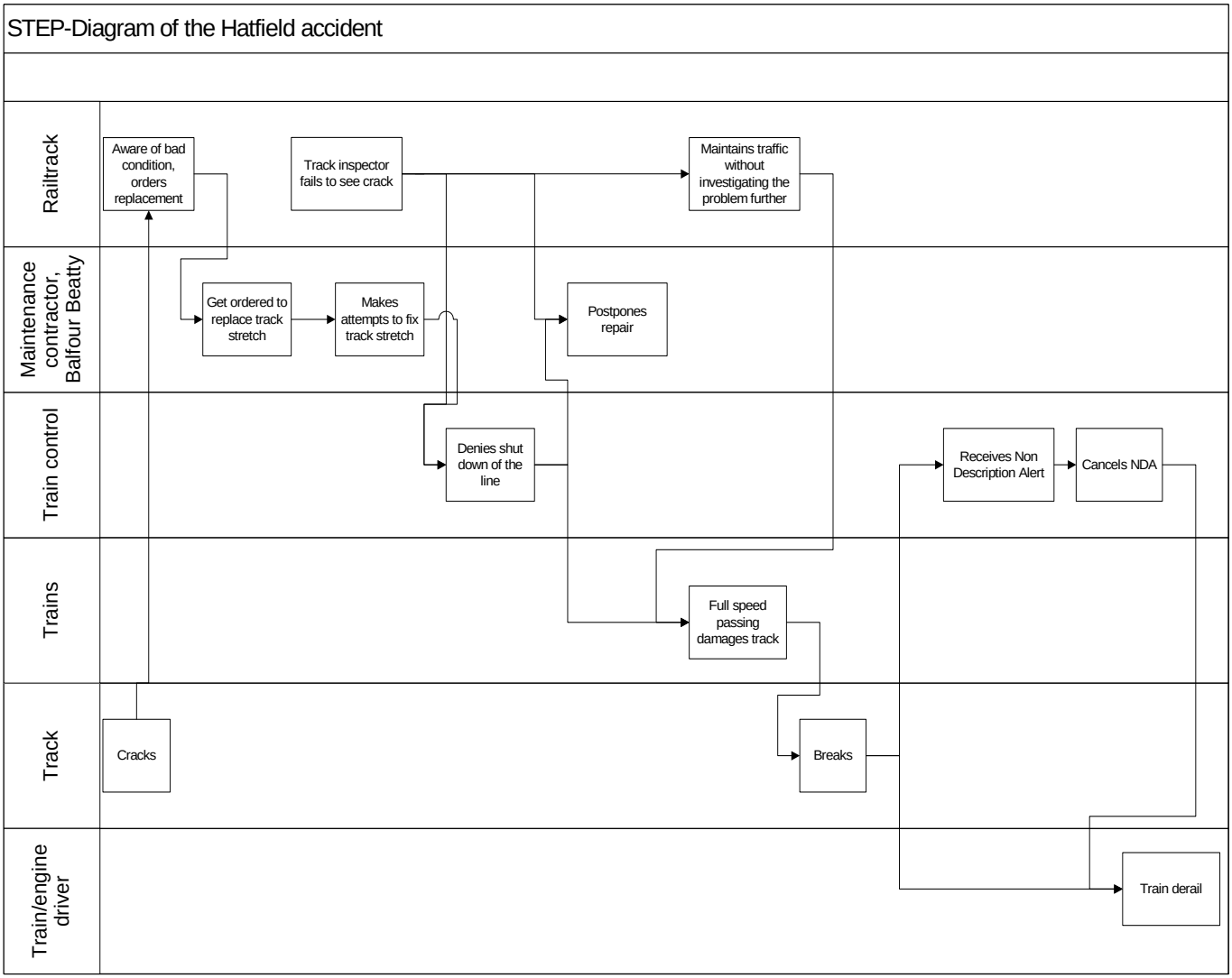
The maintenance contractor Balfour Beatty was under a high level of pressure to meet competitive demands of cost-cutting. As a contractor the maintenance personnel did not feel any ownership to the track, or personal responsibility for the state of the track, in the sense that those formerly responsible for the track had had. This may have contributed to the fact they did not express clearly how urgent the re-railing was to Railtrack, and that the job was not sufficiently prioritized.

The track was most likely broken by an earlier train than the 12.10 Train from Kings Cross to Leeds, which was the one that derailed. A Non Description Alert, which is an automatic detection system, sounded with an alarm in the Control Centre four times before the derailment. Since this alarm sounded almost constantly in the control centre this warning was neglected and cancelled.

As a consequence of the accident the infrastructure operator Railtrack imposed speed reductions on all stretches of track with similar characteristics as Hatfield throughout the system. These speed reductions led to delays and public dissatisfaction with rail as a manner of transport, and a change in public opinion and loss of reputation. This fact also led to major economic losses.

Some key questions to be discussed could be:

- Is this a case probable to occur again in other countries?
- Who was to blame for the derailment and the events that followed it?
- What connection does it have with privatisation or deregulation?



S9b. Train enters track section that is or should have been reserved for work on track

The following factors/events may contribute to this scenario:

- Planning failures
- Failure in the notification process (errors or ambiguities in traffic circulars / written orders, failure to distribute, failure to read traffic circulars / written orders)
- Track work cannot be completed on schedule and there is a failure in notification about the delay
- Inadequate measures to block the section reserved for work or measures not carried out (e.g. red flags, short-circuiting rails, blocking at the Rail Traffic Control Centre)
- Failures related to coordination of multiple work activities
- Misunderstanding / communication errors

S9c. Too high speed in conjunction with track work

Several factors/events may contribute to a train passing a location with work on track at too high speed:

- Inadequate judgment of the need for speed restrictions when planning the work
- Failure in the notification process (errors or ambiguities in traffic circulars / written orders, failure to distribute, failure to read traffic circulars / written orders)
- Failure to put up signpost with speed restriction (not put up, incorrect location, poor visibility)
- Failure related to installing ATP beacon (track coils) with reduced speed signature (not installed, incorrect signature, incorrect location)
- Train driver inattention (fails to note signpost with temporary speed restriction)

S9d. Road vehicle enters track section not reserved for work on track

The following factors/events may contribute to this scenario:

- Planning failures
- Failure in the notification process (errors or ambiguities in traffic circulars / written orders, failure to distribute, failure to read traffic circulars / written orders)
- Misunderstanding in communication between vehicle driver and site safety man
- Vehicle driver not familiar with safety rules and procedures
- Failure related to coordination of multiple work activities

S9e. Incidents related to work on overhead equipment (electric power supply)

Examples of incidents:

- Failure to shut down power supply before work starts, too early reconnection of power supply
- Inadequate grounding
- Machinery operating in too close proximity to overhead equipment / power supply
- Incidents related to diesel trains passing section where work is carried out on overhead equipment

Examples of contributing events:

- Planning and notification failures
- Misunderstanding, communication failures
- Failure of Rail Traffic Controller to keep track of events (inadequate situation awareness)

APPENDIX B: PREPARATIONS FOR SCENARIO ANALYSIS AND GUIDELINES TO FACILITATE THE GROUP PROCESS

PREPARATIONS FOR THE GROUP WORK IN THE SCENARIO ANALYSIS

The analysis group should aim at completing analysis of one scenario in approximately 1/2 work day, see Table below. The first scenario may take longer to complete, depending on the participants' knowledge and availability of information and key personnel. Subsequent scenarios will be completed in shorter time, because certain topics will already have been thoroughly discussed.

Table 5: Approximate duration of steps in the Scenario Analysis

Activities of the SafeCulture method	**Approximate Duration**
Selection of a realistic scenario and Construction of scenarios	1 hrs.
Description and development of the scenario	1 to 2 hr.
Identification of safety challenges and Analysis of decisions	1 hrs.

FACILITATION OF THE GROUP PROCESS

The SAFECULTURE analysis gathers personnel from different fields of expertise. Yet, in order to fully utilize the knowledge and experience of each participant, the group process must be facilitated. The SAFECULTURE leader or participants should have Human Factors background enabling her/him to facilitate group processes.

Introductory information

The participants of the analysis should receive some relevant information before attending the analysis. This could be a short introduction to SafeCulture, purpose of the specific analysis, background of other participants and a short description of relevant scenarios, when a scenario analysis is performed.

The physical layout of the room

Considerations concerning the physical layout of the room for the SafeCulture analysis should be done. Key elements to facilitate the group process are:

- **Size of the room:** The room should accommodate 8-12 persons and sufficient space and equipment for graphical presentation concerning the events during scenarios.
- **Equipment:** The room should have all necessary equipment such as “flip over”, yellow “post-it” notes, overhead or projector present and functioning before the analysis starts.
- **Workplace:** The room should accommodate space for participants to bring supporting additional information and documentation (laptop PC’s, books, etc)
- **Seating:** All participants should have good visual and audible overview of the graphical presentations from their seats.
- **Room Climate:** The room should have possibilities for air condition and good lighting conditions.
- **Drink/Food:** Cold drinks, Coffee and fruit should be available during the meeting, since the group process and discussions are very demanding.

The facilitation of the group process can be divided into three general activities:

(a) Briefing,
(b) The SAFECULTURE Analysis, and
(c) Debriefing.

Each phase presents issues to be observed on by the SAFECULTURE leader.

Briefing

The initialization of the scenario analysis introduces the structure and content of the group process. The SAFECULTURE leader informs on critical factors essential for a successful outcome. Important elements concerning the Briefing are:

- **Introduction:** SAFECULTURE leader welcomes the participants, and outlines the background and main focus for the analysis.
- **Presentation:** Each participant and the SAFECULTURE leader should provide a short presentation of themselves including name, background and role during the SAFECULTURE analysis.
- **Setting Rules:** The SAFECULTURE leader outlines rules of interaction and dialogue during the analysis, emphasizing the need for a structured, open, non-judgemental and explorative approach.
- **Setting the Agenda:** The SAFECULTURE leader provides an overview of the time schedule for the analysis and the relevant issues to be focused on, in which the participants agree upon.
- **Questions:** Inviting participants to ask questions or to comment on matters concerning the structure or content of the SAFECULTURE analysis.
- **Analysis Initialization:** SAFECULTURE leader clearly marks when the briefing ends and the scenario analysis starts.

The SAFECULTURE Analysis

The SAFECULTURE analysis aims to facilitate the sharing and combination of the participant's knowledge. Important elements in order to maximize the joint effort of the participants are:

- **Dialogue:** SAFECULTURE leader should facilitate a non-judgemental exploration of participant knowledge by 'active questioning' aiming to uncover premises and assumptions underlying the statements made.
- **Second Stories:** SAFECULTURE leader should push for detailed descriptions of chains of events with focus on contextual characteristics and how problems actually are solved and interpreted in comparable everyday situations by the operators.
- **Involvement:** SAFECULTURE leader should facilitate engagement of all participants, ensuring an even and reasonable amount of participation in the process. No participant should dominate excessively or be exceedingly passive.
- **Joint Focus:** SAFECULTURE leader should facilitate the combination of knowledge by translating the individual statements and experiences into phrases useful for all participants, and allowing joint group focus.
- **Summary:** The SAFECULTURE leader should provide clear and useful summaries of themes and findings during analysis that all participants can understand and respond to.
- **Maintain Rules:** If necessary, the SAFECULTURE leader should remind the group of the rules of interaction and dialogue stated during the briefing.
- **Maintain Focus:** If necessary, SAFECULTURE leader should remind the group of their aim and focus of the SAFECULTURE, limiting efforts to relevant issues.
- **Conflict Resolution:** SAFECULTURE leader should facilitate conflict resolution between participants in case of withstanding disagreement inhibiting group performance.

Debriefing

At the end stages of the SAFECULTURE analysis, the SAFECULTURE leader should provide a smooth closure. Important elements concerning the closure and debriefing of the SAFECULTURE analysis are:

- **Preparing Termination:** SAFECULTURE leader should announce the termination of the analysis in advance (10-15 min) in order for the participants to prepare for final conclusions.
- **Final Conclusions:** SAFECULTURE leader should present summaries of main conclusions and findings, allowing participants to comment.
- **Closing the Session:** SAFECULTURE leader clearly marks when analysis is closed before moving to evaluations and verbal debriefing.
- **Q&A and Evaluation:** Participants should be allowed to comment on the analysis in terms of experienced value the analysis, group functioning, the SAFECULTURE leader, and so forth.
- **Contact:** The participants should the informed on how to contact SAFECULTURE leader for further comments etc. after the closing of the current SAFECULTURE session.
- **Orientation:** SAFECULTURE leader shortly describes the procedures further in terms of how the information is handled, and how participants may get access to the final report.

The main challenge is to create a productive and effective group process, allowing each participant to contribute with their knowledge to the joint exploration of the system in focus. This is done by establishing joint focus and rules of interaction, and flexibly applying these during the analysis. The ending stages of the SAFECULTURE analysis should provide a smooth closure leaving major issues resolved and summarised, enabling the participants to agree on

the statements. The SAFECULTURE analysis ends by all participants knowing the outcome and follow-up procedures.

EXAMPLE OF "INVITATION TO A WORKSHOP TO ASSESS AND DEVELOP SAFETY CULTURE AT INTERFACES"

Introduction

As legislation is introduced to ensure the interoperability of railway systems across Europe, the issue of safety culture has become a subject of considerable interest to the rail industry. This interest is partly due to the recognition that organisational culture has a direct impact on safety, and that the different cultures that exist in organisations will be increasingly required to interface with each other.

UIC has sanctioned a project, Safety Culture at Interfaces – SCAI, in order to develop a toolkit that can be used by the railway industry to predict where cultural interface issues may arise, and to counteract any attendant detrimental effects on safety.

The toolkit has benefited from the input of the European railway industry in three ways.

- First, we have a Steering Committee of representatives from BV, IRISH RAIL, JBV, MÁV, PRORAIL, RSSB (RAIL SAFETY AND STANDARDS BOARD, UK), NETWORK RAIL, SNCB, UIC, ZSR and ÖBB who have provided valuable input and advice on the development of the toolkit.
- Secondly, we have convened two workshops where industry representatives took part in practical applications to test the toolkit.
- Thirdly, we have performed several in-depth pilot "try-outs" across Europe together with railway undertakings to further refine the toolkit.

Purpose and Scope of the workshop

The purpose of the workshop is to give you the benefit of discovering problematic issues arising at interfaces proactively, and contribute to finding solutions. When considering the development of a new interface with an organisation from a different culture, this might give you a clearer idea of the potential safety impact and how to deal with it.

The use of the method should be related to an actual interface issue of interest. The tool could also be used to consider a number of hypothetical but realistic cultural interface scenarios for the particular company, and to develop strategies for dealing with them.

What is a Scenario

The scenario could be based on known accidents or incidents. It could be also be made up by the Railway Undertaking based on future challenges or known problems. The scenarios should be selected on the basis of the following criteria:

- The scenarios should be realistic. The involved parties should feel that they really might occur.
- The scenarios should have a potential of major losses.
- The involved parties should be uncomfortable with their knowledge about the existing status.

The Scenario Analysis addresses alternative sequences, i.e. "what could have happened if ".
Seven scenarios have been outlined in the attached method toolkit (See Appendix A) to help to start the scenario analysis. The scenarios are:

- S1: Initiating emergency stop of train
- S2: Approach to level crossing
- S3: Events before and after SPAD (Signal Passed at Danger)
- S4: Detection of errors in track routing
- S5: Depart station
- S6: Assisting a failed train as a result of traction power
- S7: Accident and incident response to a major train accident
- S8: Accident because of differences in Infrastructure
- S9: Scenarios related to Maintenance (the Hatfield accident, work on track)

Each workshop will consist of two main activities:

- **Assessment and development of safety culture** by using a questionnaire. This should be done in two steps. First each participant will complete the questionnaire on their own, and then subsequently in a group.

Around 20 questions will be discussed. Discussion of the questionnaire and related cultural issues should take less than one day.

- **Discussion of important Scenarios** selected by the participants. Two to four scenarios will be elaborated. The Scenario analysis should be done in a group setting. Discussion of the Scenarios should take one day. A scenario is a description of an interface between two cultures where there may arise safety problems. The toolkit encourages users to consider the 'safety critical functions' that people carry out, and that might be threatened by the nature of the interface between two different ways of working. Discussion of the scenarios and related (cultural) issues should take less than one day.

Scope/Effort

We expect that any company participating in the workshop will provide participants from their staff. The participating staff should be available to spend between 3 to 4 days to make it successful:

- ½-1 day will be used in preparation by the company participants,
- 2 days will be used in the workshop and
- ½-1 day will be used to follow up the activities.

Workshop Participants

The participants in the workshop should be personnel with some experience regarding safety culture at interfaces.

The participants involved are dependent on the interface to be explored. If the interface is related to cross border traffic, the participants could be:

- Line management involved in the issues (to ensure commitment to any solutions generated)
- Two train drivers, to bring experience to the analysis and two drivers instead of one to support each other's experience.
- An External observer, Consultant; Human Factors Specialist (to facilitate the process)
- Relevant actors cross borders/cross Interfaces – such as Train Control, a Train driver from "other" culture or participants from another co-operating firm such as an Outsourcer.

Participants are in advance advised to bring appropriate examples and case studies to the workshop. Not all attendees will have this knowledge, but should have some familiarity and interest in the subject of safety culture and the possible challenges that might arise as rail organisations across Europe increasingly interface with each other.

Form and Content of the Workshop

The workshop will be a mix of group work and plenary discussions. Work will be done in 50-55 minute sessions, interrupted by short breaks of 5 to 10 minutes.

The number of participants may vary from 5-10, dependent on participation cross interfaces. It is suggested that a meeting room is provided, supporting good group processes.

In group work - the groups should consist of 4-6 persons.

Proposed AGENDA – Workshop/Application of the method:

Time Schedule	Main themes Day 1-
9:00 - 9:30	1.1. Introduction - Scope of project. Safety Culture - Working definitions and Work to be done in this workshop. Presentation of the main case and tangible differences at interfaces.
9:30- 11:30	1.2. Description Safety Culture questionnaire and Discussion of Questionnaire - Filling out the questionnaire and discussing it in own Organisation. Identifying issues scoring "low" or important issues that should be resolved or explored.
	Lunch from 11:30 to 12:30 (Or other appropriate time)
12:30- 14:30	1.3. Discussion of Questionnaire between organisations. Comparison of issues where safety culture between organisations are very different and could create problems
14:30- ca.16:30	1.4. Identifying issues and agree on actions cross interfaces – (Identify challenges that could delay or stop the agreed actions).

	1.5 Based on differences, Identify Scenarios that could be explored day 2.

Time Schedule	**Main themes Day 2**
9:00-9:30	2.1. Introduction – summary from Day 1.
9:30- 11:30	2.2 Description of Scenarios. How to describe scenarios/ Techniques and Method Discussion of relevant Scenarios - (Group and Plenary Discussions) -Result: Relevant examples of Cross border scenarios regarding train traffic and relevant Interface problems.
	Lunch from 11:30 to 12:30 (Or other appropriate time)
12:30 – 14:30	2.3 Discussion of Scenarios and Discussions of relevant Interface problems - Cases from the participants. (Group & Plenary Discussions) Result: Relevant examples of Interface problems and challenges related to safety culture at interfaces and proposed solutions.
14:30- 16:00	2.4 Discussions of solutions and actions to avoid problems at interface. How to solve problems cross borders, actions within a company and cross border – how to implement the actions.
16:00 – ca.16:30	Wrapping up/summarising session

APPENDIX C: SAFETY CRITICAL FUNCTIONS

SCF-1: SCFs related to normal operation
The situation is that all technical systems are functioning. The infrastructure is also without any (apparent) deficiency, and the trains are within their schedules. We will assume that the line is either single or double track, and that the line is equipped with a complete signalling system. Six primary safety critical functions are evident in this situation:

- 1.1 Ensuring that a train do not enter a section which is occupied by another train.
- 1.2 Identify and take proper action if a train enters a section which is occupied, or reserved for another train.
- 1.3 Identify any "system" change that takes the system to a degenerated operation mode
- 1.4 Ensure the safety of passengers at stations
- 1.5 Safe operation of level crossings
- 1.6 Avoid excessive speed

SCF-2: SCFs related to ordinary traffic disturbances
The situation is similar to section 0. The situation now is that trains are delayed, cancelled etc. Hence it is required to change the scheduled crossings. A new SCF is thus:

- 2.1 Safe change of crossing

Note that change of crossing is usually not a problem. However, on lines without a complete signalling system (controlled by train messages) the change of crossings is important. For example on train message (single track) lines in Norway, the locomotive driver shall verify that the passing train has arrived before he enters the next block, even if the train dispatcher has indicated "green". Thus, when the scheduled crossing is changed, the procedure needs to be altered as well.

SCF-3: SCFs related to technical failures in signalling system/Central Train Control (CTC) system
Relevant SCFs in these situations are:

- 3.1 Diagnose system in order to reveal which functions are trustful in the new degenerated state.
- 3.2 Allow trains to enter sections that could not be confirmed free from other trains
- 3.3 Issue relevant traffic circular when e.g. level crossing is defective
- 3.4 For rolling stock; comply with orders given by traffic circular, radio messages etc.

SCF-4: SCFs related to degenerated infrastructure
When the infrastructure is degenerated, or threatened by extreme weather conditions it would be necessary to impose traffic restrictions. Further repair or maintenance activities must be conducted. Relevant SCFs in this situation are:

- 4.1 Issue relevant traffic circular (speed restrictions, signal out of order due to maintenance etc)
- 4.2 Comply with instructions in traffic circular

SCF-5: SCFs related to work on the track
When maintenance is conducted on the track, special safety arrangements are necessary. The most important SCFs are:

- 5.1 Issue relevant traffic circular
- 5.2 Comply with instructions in traffic circular
- 5.3 Put up signpost with reduced speed information
- 5.4 Install track coils with reduced speed signature
- 5.5 Comply with traffic circulars, signposts etc
- 5.6 Timely and accurate notification and dissemination of information in contingency situations

SCF-6: SCFs related to deficiency on rolling stock
When there are problems with the rolling stock, it is important that this is detected, and relevant actors are informed. Relevant SCFs are:

- 6.1 Detect deficiency (by train crew, or by infrastructure systems like hot-boxes, stroke detectors)
- 6.2 Timely and accurate notification and dissemination of information in contingency situations
- 6.3 Take appropriate action (e.g. stop the train when necessary, and take the train to the nearest station with speed restrictions)
- 6.4 Fetching defect train
- 6.5 Emergency preparedness in case of accidents

SCF-7: SCFs related to cross border activity

- 7.1 Ensuring that rolling stock is compatible for cross border traffic
- 7.2 Ensuring that rolling stock is maintained adequately
- 7.3 Ensuring that train crew is qualified and trained for cross border traffic
- 7.4 Ensuring that technical systems are reset/configured when passing the border
- 7.5 Ensuring that dangerous freight is handled properly in relation to cross border traffic

APPENDIX D: TABLE 2: CHECKLIST-2 TO IDENTIFY SAFETY CHALLENGES RELATED TO COLLABORATION AND COMMUNICATION AT INTERFACES

	Risk Influencing factor Major Differences	Safety Challenges related to collaboration and communication at interfaces	Examples of Actions (agreed between participants)
1: Operating conditions/ Environment	**1.1 Language** Different Language being used	Misunderstanding between Train Driver and Traffic control	*Examples are: "Common Language training of Traffic Control Centre (TC) and Train Driver (TD) with Common set of phrases being used across interfaces." " Repetition of key information between TC and TD to ensure common understanding.)"*
	1.2 Regulations Different practice and underlying assumptions	Fundamental differences in rules and regulations	
	1.3 Climate/Nature Differences in Climate (more/less) snow on the tracks	Experiences longer braking distances?	
	Differences in Geography (Curvature and gradient different)	Differences related to use of ATC?	
	1.4 Authorities Different organisational structure	Difficult to establish co-operation cross borders	
	Different routines and/or time schedule being followed by authorities	Cross border solutions difficult to establish	
	1.5 Risk and Risk treatment – Different philosophy		
	1.6 Public opinion		
2: Infrastructure and Rolling Stock	**Risk Influencing factor** **Major Differences**	**Safety Challenges related to collaboration and communication at interfaces**	**Actions (agreed between participants)**
	2.1 Communication equipment Different frequencies being used and different routines used when communication with Train Control.	Important messages could be missed	
	2.2 Rolling Stock		
	2.3 Tracks Different technical standards cross interfaces		
	2.4 Signalling systems Different use of signalling system		
	2.5 Power Lines/ Voltage		

	Risk Influencing factor Major Differences	Safety Challenges related to collaboration and communication at interfaces	Actions (agreed between participants)
3: Organisation	**3.1 Structure** Different organisational structures, differences in responsibility between co-operating companies.	Unclear responsibility, commitment and co-operation difficult because of differences. Key issues may be not addressed.	
	3.2 Goals and Strategies Different Goals and strategies related to safety. Different definitions, terms and "mental models" are being used.	Communication and agreement is difficult because of different terminology and mind-set.	

4 : Safety culture at Interfaces	**Risk Influencing factor** **Major Differences**	**Safety Challenges related to collaboration and communication at interfaces**	**Actions (agreed between participants)**
	4.1 Reporting culture Differences in reporting	It is difficult to understand and learn from Incidents and accidents	
	4.2 A just culture Differences in Blame could make open and honest co-operation difficult	Blame is an issue and is passing around cross interfaces	
	4.3 Learning culture Differences in approach – single loop learning vs double loop learning	Root causes is not found – fundamental issues are not resolved	

5: Rules, procedures and practice	**Risk Influencing factor** **Major Differences**	**Safety Challenges related to collaboration and communication at interfaces**	**Actions (agreed between participants)**
	5.1 Work practice When stopping a train different "gestures" are being used	Misunderstandings leading to accidents	
	5.2 Contingency plans Contingency plans is different when crossing borders	Misunderstandings	
	5.3 Rule books		
6: Individual and Team	**Risk Influencing factor** **Major Differences**	**Safety Challenges related to collaboration and communication at interfaces**	**Actions (agreed between participants)**
	6.1 Competence Different requirements – different basic training	Different mind-set and different basic assumptions	
	6.2 Communication Differences in who is contacted when a problem is encountered	Less experienced personnel could be involved – less safe solutions being chosen	

APPENDIX E: The Track to Safety Culture Questionnaire

The aim with this questionnaire* is to help you and your organisation to develop an understanding of how to manage and improve safety culture at interfaces between rail companies.

Recently safety culture has been of great interest in various industries. There has been put a lot of effort in developing HSE systems that include safety culture as the industry has seen the important connections between **excellent safety culture** and **work safety and efficiency –** ref Itho, Andersen (2003).

Safety culture is a difficult concept. We feel it is necessary to define Safety culture clearly and to exemplify what is considered an excellent safety culture. When talking about safety culture at interfaces we would like to introduce the following definition:

> ***Safety culture at interfaces focuses on characteristic interaction patterns, i.e. how people collaborate and communicate at interfaces.***

With an increased demand for transport across Europe, safety culture cross interfaces and borders are of high importance in railway undertakings. Competition could increase as a consequence of deregulation and outsourcing. This creates new challenges for co-operation and communication across organisational borders as well as across national borders.

The aim of SafeCulture is to improve safety by improving safety culture. This is being done through evaluations and discussions of key areas related to safety culture at interfaces.

The Track to Safety Culture consists of different questions that are organised in four different areas, all of high importance to challenges of safety culture at interfaces. The method consists of 21 questions to be assessed through five levels of safety culture. Three key levels of safety culture are described. The idea is to evaluate your organisation at each question, and then place it within one of the safety culture levels in the range from 1 to 5. *The Track to Safety Culture questionnaire* is illustrated in **Figure-1**.

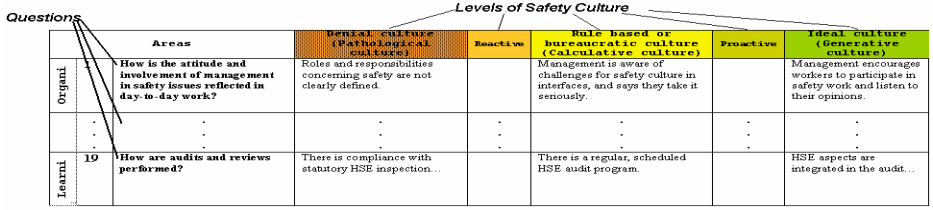


Figure 1: The Track to Safety Culture Questionnaire

*Our toolkit is developed to suit the railway industry. In the process of developing *The Track to Safety Culture* we have been inspired by Shell's *Hearts & Minds* program. Shell has used the program for several years with excellent results. In addition we have used research from Hudson and Westrum.

Four important areas affecting safety culture at interfaces

Figure-2 gives an illustration of the structure of this questionnaire. It suggests that four central areas will affect safety culture at interfaces. The questions are structured in the suggested areas. A description of the different areas is given below:

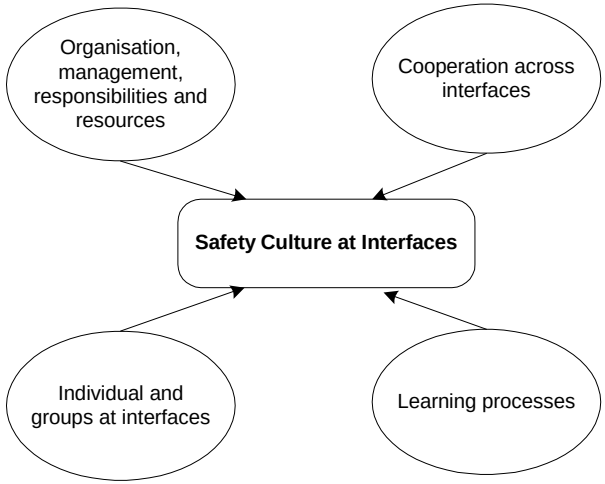


Figure 2: Four important areas affecting safety culture at interfaces.

Organisation, management, responsibilities and resources:

These are the formal parts of the organisation that affect how work is done and thus safety culture. The questions cover communication and prioritisation of safety and how these issues will affect the level of safety culture.

Co-operation cross interfaces

Deals with co-operation cross interfaces. Interfaces are seen as meeting points, both between different companies and between different countries.

Learning processes

Competency training and knowledge affect the attitude towards safety. The organisation as a whole can also learn through experience feedback and reporting.

Individual and groups at interfaces

How individuals interact and their attitude towards competing organisations will affect safety culture at interfaces.

Five different safety cultures

As shown in Figure-1 five levels of safety cultures are given of which only three are described for each question (This classification of safety culture has its origin in Westrum's description of different organisational safety cultures – Westrum (-92)).

Descriptions of the different perspectives on safety culture are given below. This is done to facilitate the use and understanding of the toolkit:

1. Denial culture – Pathological culture: The organisation is ruled by a desire to preserve status quo: denial of signals, punish whistle blowers, attack reputation of HSE scientists, avoid reporting recording, and "out of sight – out of mind" attitude. There are no feedback systems in the organisation.

2. Reactive culture – This culture is recognised by the attitude that *safety is important, and we do a lot every time an accident occurs.* The organisation only works with safety after an accident occurs. After a while safety work disintegrates and in order to get safety back, a new accident has to occur.

3. Calculative culture – a bureaucratic, purely rule based culture: The organisation is using rules, stays within normal wisdom, downplays the implications, implements only limited scope of repair and remedial actions.

4. Proactive culture – This culture is recognised by the attitude that *we work on problems that we still find*. Here, the organisation tries to map challenges and risks with the aim to identify potential hazards and accidents. The culture reflects on rules.

5. Generative culture – the learning culture: The organisation is concerned both with fundamental rules but also with goals, values and continuously learning. It welcomes and encourages danger signals, disseminates, sees wider implications, and is positive to system changes. There is a higher order feedback system – hence a learning organisation.

In Figure 3, the levels of the different safety cultures are illustrated.

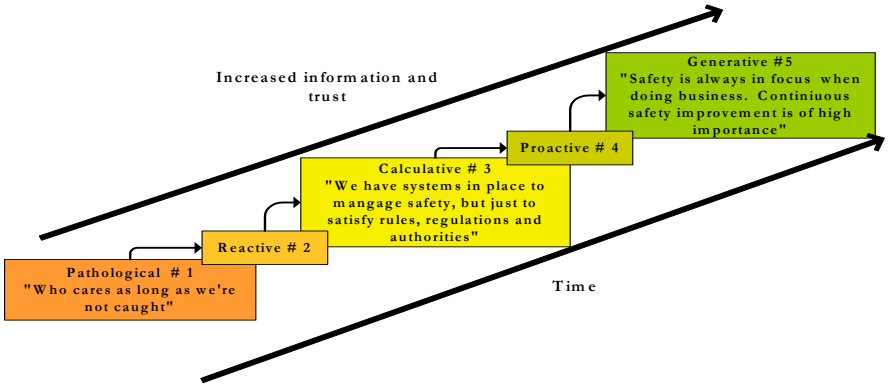


Figure 3: Relation between the different safety cultures

How to use The Track to Safety Culture

When driving cross interfaces (and borders) the rules and their practice can vary in many ways. With increased traffic and interfaces it could be important to go beyond the purely "rule based" culture described in "3-Calculative" to the learning culture in "5-Generative culture" where rules still is important – but must be understood in their local context.

The Track to Safety Culture can be used to evaluate safety culture and to develop safety culture. The setting could be between individuals within an organisation or between organisations meeting at interfaces.

When using this questionnaire to develop safety culture, it should be used in a workshop between people where you want to improve safety culture. Every participant should prepare in advance by going through the questionnaire. Individual actions and improvements should be noted and prioritised.

The department/organisation should discuss the result in a group meeting, trying to establish a common profile and agree on areas to be improved.

This questionnaire could be used cross interfaces/cross border by comparing the result in a workshop between different organisations meeting at interfaces. Differences should be highlighted and prioritised together. This could aid in establishing common understanding and common action-plans across borders. Areas where there is different understanding and practice could be used as a basis for further discussions and explorations in a Scenario-workshop (witch could be the next step in improving safety culture cross interfaces).

In filling out the questionnaire - choose the alternative best suited to your organization. We suggest the following procedure:

- Read the question and try to make a brief evaluation of your organization.
- If consider your organization to perform well start reading the rightmost alternative (if you consider it to perform badly, start left).
- Mark the best-fitting alternative for your organization. If you consider the performance to lie in between the sketched alternatives, that is, in the columns called 'Reactive' or 'Proactive', then choose one of these.
- All the questions have to be answered. Mark only one answer for each question.

Those who participate in a workshop or discussion using this tool as a foundation, have to be honest with the answers given, in order to give an accurate picture of their organisation. This will enrich the discussions and thereby contribute to an increased safety culture at interfaces in European railway industry.

Good luck!

Areas			Denial culture (Pathological culture) #1	Reactive #2	Rule based or bureaucratic culture (Calculative culture) #3	Proactive #4	Ideal culture (Generative culture) #5
Organisation, management, responsibilities and resources	1	**How is the attitude and involvement of management in safety issues reflected in day-to-day work?**	Roles and responsibilities concerning safety at interfaces are not clearly defined. Management sees safety problems as unavoidable. If accidents or incidents occur, management find out who is to blame, often individuals and competitive or collaborating organisations, and get rid of them or blame them. Financial and punctuality targets are more important than safety targets.		Management are aware of challenges for safety culture at interfaces, and says they take it seriously. It is a view that all accidents could be prevented if people only do what they are told. Follow-up is limited to demands of rules and regulations, but beyond that no effort is made to encourage further work to improve safety culture at interfaces.		Management are encouraging workers to participate in safety work and listen to their opinions. Focus is on good processes to continuously improve safety culture at interfaces. Safety conferences are arranged; workers and stakeholders cross interfaces are welcome to participate and discuss safety issues. There is a double-loop learning in which outcomes of discussions are applied through the organisations.
	2	**Who causes accidents in the eyes of management?**	Individuals are blamed, and it is believed that accidents are a part of the job. Those directly involved in accidents are held responsible for them. It is a tendency to blame other organisations cross interfaces.		Faulty machinery, poor maintenance and people are seen as causes of incidents. There are attempts to reduce exposure to hazards. Collaborating partners are still easy to blame if accidents occur.		A just culture has been achieved. Management accepts responsibility when assessing what they could have done to remove underlying causes. They take a broad view of safety; looking at the overall interaction of systems, people and co-operating organisations across borders.
	3	**How is safety prioritised when it competes with other concerns in the organisation, like profitability and punctuality?**	Making money and establishing high punctuality are the most important concerns. Some times the traffic rules are not followed and speed limits are exceeded if necessary to keep up with the schedules. The important issue at the end of the day is to avoid extra costs.		There is no clear policy on how safety and punctuality are balanced, especially related to interfaces. Officially safety are of high priority, but hard to manage in practical situations.		Risk are identified and treated in a systematic and open manner, open to review. Safety is seen as a competitive advantage and a source of "Best-practice" shared cross interfaces. A safety policy is derived from the overall business strategy, is clearly defined and agreed upon by collaborating organisations. The policy includes concerns for other organisational units, contractors and partners.
	4	**How precise and transparent are the contracts between operators and contractors?**	Safety problems are entirely the responsibility of contractors. Personal contacts, deriving from previous single-company-organisation, serve as a basis for co-operation at interfaces. This implies diffuse responsibilities, which in return leads to disclaiming of responsibility.		When initiating collaboration across interfaces contractors have to meet extensive pre-qualification requirements, based on questionnaires and statistics. Safety standards are lowered if no contractor meets the requirements. Routines are communicated to contractors and the initiating organisation demands contractors to comply with these.		No compromises are made for contractor safety capability. There is a formal service level agreement, which ensures acceptable level of safety performance. Solutions to safety problems are found in co-operation with contractors across interfaces. The organisation takes into account that several contractors are involved and compensations are made to use more effort on contractual matters, establish clear responsibility at interfaces and define service levels in an objective way. Focus is on high risk contracts.

		Areas	Denial culture (Pathological culture) #1	Reactive #2	Rule based or bureaucratic culture (Calculative culture) #3	Proactive #4	Ideal culture (Generative culture) #5
Organisation, management, responsibilities and resources	5	**Is management interested in communicating safety issues related to interfaces with the workforce?**	Management hardly focuses on communicating safety issues related to interfaces. The only communication of safety issues that exists is management telling workers not to cause problems. There is no communication or collaboration cross interfaces.		Management shares information with workers, but not more than what is required by rules and regulation. They show limited interests in safety issues and there is a one-way communication concerning safety issues at interfaces in the organisation.		There is frequent and clear two-way communication about safety issues related to interfaces, in which management receive more input and information than they actually provide. Everybody knows when there is an incident; they are discussed cross interfaces and lessons are learned.
	6	**How do the organisations adapt to new interfaces and co-operation across borders?**	The organisation has not changed even if new interfaces and new "markets" have been established. The "old" organisation is being used. There is unwillingness to make organisational changes or adjustments.		There is a bureaucratic organisational structure, which is managed by rules and with few adjustments. Discussions concerning organisational evolution are almost negligible.		Overall goals, visions and values guide the organisation. Continuous research to identify best practice is done. There is a systematic development cross interfaces based on multinational project teams and good co-opting processes where the workers are actively participating. There are face to face meetings to create common understanding and confidence.
	7	**How are rules and regulations used at interfaces?**	The companies make safety procedures when required by authorities. Rules are used by management to keep a retreat open, and in that way disclaim responsibility when accidents occur. Rules are not always used to increase safety, but also used politically.		There are many safety procedures, serving as 'barriers' to prevent incidents. The stringency of the rules is at the minimum required by authorities. Procedures are adjusted or "bent" to enable quick fixes or do the job faster. Common rules are established.		Rules are used as a basis to develop procedures. Procedures are seen as an opportunity to improve the safety level at interfaces and they are continuously refined in order to make them more practical. Common procedures are used cross interfaces. Procedures are translated and retranslated. Rules are developed in cooperation with authorities cross interfaces.
	8	**How is emergency situations planned for at interfaces?**	There are emergency procedures which are seen as sufficient. There are few resources allocated for training or updating of emergency procedures. No efforts have been made to make or test useful emergency procedures for cross border traffic.		Accidents are examined and plans are made for unplanned situations. Emergency training is performed according to authority requirements. Efforts have been made to introduce standard emergency procedures in the company and cross interfaces.		New potential situations are constantly searched and planned for. Standardized emergency procedures are implemented throughout the company and in cooperation cross interfaces and among the railway industry. Procedures are tested at defined intervals.
	9	**How is Benchmarking, trends and statistics used at interfaces?**	There is compliance with the authorities' safety reporting requirements, but little more than that. Benchmarking is performed on financial data and production within the national railway community. Benchmarking across borders based on safety statistics and trends does not exist. Benchmarking is done locally.		Managers display some data publicly throughout the organisation. There is a focus on current problems that can be measured objectively and summarised using numbers. Data is not widely shared across interfaces.		Systematic risk assessment is performed. Benchmarking of relevant safety data is performed in relation to companies within the rail industry and across national borders. There is a common goal to establish "best practice" throughout the industry, which is actively used by all actors.

Areas			Denial culture (Pathological culture) #1	Reactive #2	Rule based or bureaucratic culture (Calculative culture) #3	Proactive #4	Ideal culture (Generative culture) #5
Individual and group	10	**How do individual attitudes towards competing organisations affect safety work at interfaces?**	New entrants are seen as intruders and are regarded negatively. Blame is moved across interface.		Existing rules are seen as defences against new entrants.		The view is that new entrants will increase the market and increase the use of railway. New entrants will enrich the competence and safety level of European railways.
	11	**Do management and labour unions co-operate and work towards the same safety goals?**	Safety is regarded as a political tool in the struggle between the labour unions and management. Safety is used as a means to achieve other benefits than safety. There is no co-operation across interfaces.		Management and unions co-operate on the most critical issues. Safety communication with management is limited and based on requirements from authorities. Labour unions in different collaborating organisations know about work performed by the others, but no co-operation exists.		There is good co-operation between management and labour unions on a wide range of safety issues. They work together to achieve a higher level of safety. Conflicts are used pro-actively to explore and exploit differences. Labour unions are cooperating across interfaces.
Co-operation across interfaces	12	**Is there willingness to co-operate with stakeholders across national borders?**	Fear of giving away company secrets makes the organisation reluctant to co-operate across borders. It is feared that co-operation could lead to increased competition and reduced market shares. New entrants to the market are considered a threat.		The organisation co-operates but only to a limited extent. Necessary information is given to authorities, but only minimum requirement. No further contribution.		There is close co-operation both with authorities and private companies cross borders. There is openness about incidents and risks and the company willingly shares information and best practice cross interfaces. The long-term goal is to improve safety and to benefit the industry as a whole. Benchmarking is taken place across the industry.
	13	**Have arrangements been made to co-operate at interfaces?**	Co-operation at management level is seen as sufficient. There is little communication with other stakeholders. On an organisational level, co-operation at interfaces is seen as a problem.		Meetings are arranged to satisfy regulation demands. These however, do not imply workers' participation and they are not anticipated to attend.		There is a high level of co-operation both between different levels in a company and between workers of the same profession and occupation. They all co-operate to reach a common goal – high level of safety. Safety is an issue in both formal and informal meetings and gatherings. There are no grey areas of responsibility.
	14	**How do the company co-operate with authorities?**	The organisation is reluctant to information sharing and co-operation toward authorities – and is sharing only what is necessary.		Information sharing across interfaces is restricted. The organisations deliver information inquired by authorities, but there is no contribution beyond that. Authorities don't cooperate closely with the industry or cross-borders.		There is a close co-operation between the organisation and authorities. The organisation shows initiative and is actively engaged in the process of developing rules and regulations. Feedback is given both ways.

Areas			Denial culture (Pathological culture) #1	Reactive #2	Rule based or bureaucratic culture (Calculative culture) #3	Proactive #4	Ideal culture (Generative culture) #5
Cooperation across interfaces	15	**What is the attitude in the organisation towards standardisation across borders?**	Cross border traffic must adjust equipment, language and routines to each country. If someone wants to compete with a railway undertaking in our country, they have to adjust to our infrastructure, routines and to learn our language.		The long-term goal is to adapt to standards. Standards are enforced via rules and regulation. There is a focus on cross-border training to learn to adapt to other countries.		International standard bodies, suppliers and railway undertakings are working through a concern to standardise rules, regulation, infrastructure and command language. An international rule book is established, and differences are known. Language standardisation is welcomed in the railway industry.
	16	**How is company structure adapted to manage cultural differences?** **Evaluate this question for how this is handled:** **A)within an organisation and** **B) Between organisations.**	The organisational structure is not adjusted. A laissez-faire attitude is characteristic and cultural differences are ignored and not exploited.		Cultural differences are paid some attention, and some measures are taken. Definition and discussion of culture is regarded as important.		Cultural differences are seen as an advantage as well as a challenge. Good collaborating processes and reflection across borders are methods used to handle differences proactively. Cross-cultural teams are established to solve problems. Organisation structure is adapted to be responsive to each "culture". Management is moved across cultures. Knowledge of different cultures is rewarded.
Learning processes	17	**How are skills upgrading and competency training ensured in the organisation?**	Few or insufficient resources are set aside to ensure continuous upgrading of employee skills and competence. This implies that there are no competency training programs in the organisation covering interfaces.		The organisation has plans for safety training and skills improvement as required by authorities. No effort is made to meet potential demands for courses from employees. Employees are keen to show that they have attended all the necessary courses to gain safety knowledge. Training related to working cross interfaces is established.		There is a continuous process to improve skills and competence among employees. Workers desire knowledge and understand the need for continuous training. Training involves technical and co-operation training cross interfaces. The workers knowledge is tested periodically and is rewarded. Management makes an effort to get workers to participate, and they exert to get common training and educational programs throughout the industry and cross borders.
	18	**How are incident and accident reporting, investigation and analysis performed?** **Evaluate how this is done both at:** **A) Domestic and** **B) International level.**	Many incidents are not reported. Organisations do investigations on their own, but only after a serious accident. It is common that investigations blame individuals and organisations cross borders. Analyses do not consider human factors nor go beyond legal requirements. It is regarded as a threat to be reported in an incident. The priority is to protect the company and its profits.		There are incident investigations procedures producing lots of data and action items, but opportunities to address the real issues are often missed. Follow-up concentrates on training and procedural solutions. The organisations read other rail companies' reports according to regulations but there is no collaboration cross interfaces.		There is a good understanding of how accidents happen. Information from a wide range of incidents identifies safety issues. There is cooperation on investigations and they are carried out in groups with participants from several organisations. Important interface issues are proposed to central authorities to ensure continuous safety improvement. There is a "just" culture.

Areas			Denial culture (Pathological culture)	Reactive	Rule based or bureaucratic culture (Calculative culture)	Proactive	Ideal culture (Generative culture)
Learning processes	19	**How is experience feedback used in the organisation?**	Many accidents are not reported. A database of serious accident reports exists but it is incomplete and not considered being useful. The system does not have open access and SHE personnel fill out reports.		There is a database with detailed descriptions of near accidents and accidents, which is used internally. Efforts are made to use it actively, but it is not yet fully established as a useful tool.		The company's own and other companies' experiences are actively used to continuously improve our own safety performance as well as the industry as a whole. Interfaces are seen as an important learning arena. Simulators are used as a training tool to gain experiences cross interfaces and create understanding.
	20	**How is commitment to procedures and rules in the organisation?**	If necessary, rules are broken to keep up with required timetables. Procedures are seen as limiting people's activities in order to avoid lawsuits or harm to assets. When travelling cross border, there is lack of reflections on other countries' procedures and rules.		Traffic and safety procedures are followed. They are seen as barriers to prevent incidents at interfaces. There are no ongoing processes to improve procedures. The organisation has tried to introduce standard procedures throughout the company and to collaborating partners, but workers do not see them as standards yet.		Procedures are seen as an opportunity to improve safety level at interfaces and they are continuously refined for efficiency through feedback. Employees are actively involved in development in order to ensure high level of commitment. Efforts are made to promote the need for standardisation of procedures across the industry and cross interfaces.
	21	**How are audits and reviews performed?**	There is compliance with statutory safety inspection requirements. When audits are carried out, it is to satisfy authorities. Co-operation and relation with other companies are not considered. Safety audits take place mainly after major accidents.		There is a regular, scheduled safety audit program. It concentrates on known high hazard areas. Managers are happy to audit others, but being audited is less welcome. Audits are structured in terms of management systems. The scope is limited to organizational borders.		Safety aspects are integrated in the audit system that runs smoothly with good follow-up and continuous informal searching for non-obvious problems. Audits focus on behaviours as well as systems, and go beyond organizational borders and consider operation cross interfaces. Sharing experience across organisational boundaries is seen as highly positive for the industry as a whole.
	22	**Your input or suggestions:** **"What issues are missing and should be discussed?"**					

	SCORE CARD	1	2	3	4	5	
	Description of Dimension	**Denial**	**Reactive**	**Rulebased**	**Proactive**	**Ideal**	
1	Attitude and involvement of management in safety issues.						
2	Who causes accidents in the eyes of management?						
3	Prioritization of safety in competition with other concerns.						
4	Contract transparency and clarity.						
5	Interest in communication of safety issues.						
6	Adaptation to new interfaces and co-operation across borders.						
7	Rules and regulations.						
8	Emergency planning.						
9	How are Benchmarking, trends and statistics used?						
10	Individual attitudes towards competing organisations.						
11	Co-operation between management and labour unions.						
12	Willingness to co-operate with stakeholders across national borders.						
13	Have there been made arrangements to co-operate at interfaces?						
14	Co-operation with authorities.						
15	Attitude towards standardisation across borders.						
16	How is company structure adapted to manage cultural differences?						
	A: Within an organisation:						
	B: Between organisations:						
17	Ensuring competency training and skills upgrading.						
18	Performance of incident and accident reporting:						
	A: Domestic:						
	B: International:						
19	How is experience feedback used in the organisation?						
20	How is commitment to procedures and rules in the organisation?						
21	How are audits and reviews performed?						
	Total ticks per column: **a**						
	Weighting factor: **b**	1	2	3	4	5	
	Number of ticks per column (a) x Weighting factor (b) Sum total weighted scores: **Total = (a) x (b)**						**Sum =**
Calculate average Safety Culture Score: Total (∑ (a x b))/23 =					**/23 =**		

How to use The Track to Safety Culture Score Card

The process and discussions of safety culture are of greatest importance when using this tool. The method can serve as a means to gain awareness of safety culture, and thereby contributing to improvements. This effect is regarded as more valuable than a final score without an obvious intrinsic value.

Nevertheless, some might find it interesting to use this tool as a comparative basis. Therefore a score card has been made.

We suggest the following procedure:

- Put a tick in one of the columns for each question
- Sum up the number ticks for each column in the row named **a**.
- In the next row, **b**, you find a weighting factor, one for each column corresponding to the levels of safety culture.
- Multiply the number of ticks for each column with the corresponding weighting factor (**a** x **b**).
- Sum up the total weighted scores (In the field containing Sum=).
- Calculate the average Safety Culture score by dividing the total weighted scores, ∑, with 23(the number of questions).