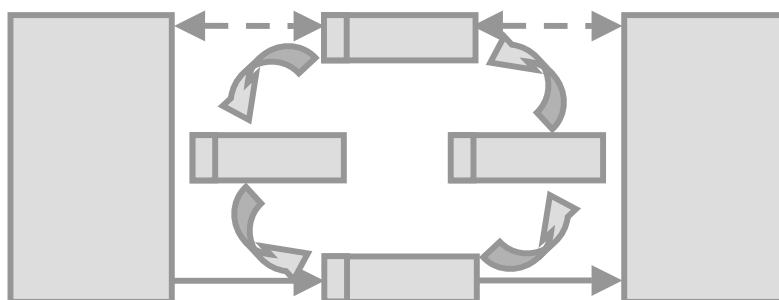


# Safety Management in European Railway Companies



Commentary on the Implementation  
of the European Directive on Railway Safety in the Community

Final Version  
January 2005

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## Foreword

The European Directive on safety on the Community's railways (2004/49/EC, referred to below as the Safety Directive) demands as a condition of operation for both railway undertakings and infrastructure managers evidence that a safety management system (SMS) is introduced and approved by the relevant national safety authority. Adoption of the Safety Directive in national law must take place within two years of the Directive coming into force, i.e. by the middle of 2006. That means that an SMS will become a legal requirement within the foreseeable future.

This paper sets out how we envisage an SMS that meets the requirements of the railways and the Safety Directive. We aim in that way to assist the implementation of the Safety Directive and the introduction of practicable and effective SMS.

This paper is divided into two parts: in the first part a short introduction to the subject is followed by our deliberations on the functions, requirements and components of an SMS, and goes on to provide guidance and suggestions for the introduction and organisational integration of the SMS, in each case illustrated by practical examples. Then follows a fundamental discussion of the subjects of management systems and safety for railways in combination. And excerpts from the Safety Directive are given. The second part, the Appendix, contains an SMS manual based on a real, practised system.

The results of our discussions are presented as a stimulus for the promotion of a common understanding of the development, introduction and maintenance of a value-adding SMS at railway companies.

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Berlin, Vienna, Bern, July 2004

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## Glossary

Appendix	the appendix of this paper
Annex III	(Roman numerals) the annexes of the Safety Directive
BS	British Standard
CEN	Comité Européen de Normalisation
CIP	Continuous improvement process
CSI	Common safety indicators
CSM	Common safety methods
CST	Common safety targets
DIN	Deutsches Institut für Normung e. V. (German Standards Institute)
EASA	European Aviation Safety Agency
EC	European Community
EFQM	European Foundation for Quality Management
EMAS	Environmental Management and Audit Scheme
Employees	All management and staff of a company
EMS	Environmental management system
EN	European standard
EQA	European Quality Award
ERA	European Railway Agency
EU	European Union
IM	Infrastructure manager
IMS	Integrated Management Systems
INSAG	International Nuclear Safety Advisory Group of the IAEA
ISO	International Standardisation Organisation
MEM	Minimum endogenous mortality (risk acceptability criterion according to EN 50126)
MNBQA	Malcom Baldrige National Quality Award
OHSMS	Occupational Health and Safety Management System
PDCA	Plan, Do, Check, Act – the management control loop

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QM/QMS	Quality management/Quality management system
Railway	Any RU or IM
RAMS	Reliability, Availability, Maintenance, Safety
RU	Railway undertaking
SMS	Safety management system
TQM	Total quality management
TSI	Technical Specifications for Interoperability

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## Bibliography

Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on Safety on the Community's Railways.

Regulation (EC) No. 881/2004 of the European Parliament and of the Council of 29 April 2004 Establishing a European Railway Agency.

Directive 91/440/EEC of the European Parliament and of the Council of 29 July 1991 on the Development of the Community's Railways.

Explanation by the Commission of the Proposal for a Directive on Safety on the Community's Railways of 23 January 2002, Document 2002/0022 (COD).

ISO 8402:1995: Qualitätsmanagement – Begriffe. Beuth Verlag, Berlin, 1995.

ISO 9000:2000 ff: Normenreihe Qualitätsmanagement. Beuth Verlag, Berlin, 2000.

ISO 14001:1996: Umweltmanagement. Beuth Verlag, Berlin, 1996-1999.

EN 50126: Bahnanwendungen, Spezifikation und Nachweis der Zuverlässigkeit, Verfügbarkeit, Instandhaltbarkeit und Sicherheit. Beuth Verlag, Berlin, 1999.

Dörner, D. (1992): Die Logik des Misslingens. Rowohlt, Reinbek.

Herczeg, M (2003): Sicherheitskritische Mensch-Maschine-Systeme: Rahmenbedingungen für sicherheitsgerichtetes Handeln. Paper presented at the annual Nuclear Technology Convention 2003, specialist session on "Safety Management – Status and Recent Developments", 20 - 22 May 2003, Berlin.

Hinzen, A. (1996): Der Einfluß des menschlichen Fehlers auf die Sicherheit der Eisenbahn. ETR, Vol. 45, Issue 10, pp. 623-630.

International Railway Safety Conference (2003), Proceedings, Paris, 25-28 November 2003.

IAEA (Ed.), (1999): Management of Operational Safety in Nuclear Power Plants. INSAG Report 13.

Ipsen, K. (1998): Die „Zuverlässigkeit“ im Sinne des Atomgesetzes. Energiewirtschaftliche Tagesfragen, Vol. 48, Issue 11, pp. 725-730.

Jorden, U. (2003): Das Sicherheitsmanagement der deutschen Betreiber – Wo stehen wir, wohin geht der weitere Weg? Paper presented at the annual Nuclear Technology Convention 2003, specialist session on "Safety Management – Status and Recent Developments", 20 - 22 May 2003, Berlin.

Kuhlmann, A. (1995): Einführung in die Sicherheitswissenschaft. 2nd Edition, Verlag TÜV Rheinland, Köln.

Ludwig, B. (2001): Management komplexer Systeme. Der Umgang mit Komplexität bei unvollkommener Information: Methoden, Prinzipien, Potenziale. Edition Sigma, VDI-Reihe Technik – Gesellschaft – Natur, Vol. 4, Berlin.

Ludwig, B. (2004): Vorstudie zur Einführung eines Sicherheitsmanagementsystems (SMS) bei der Deutschen Bahn AG, unpublished.

Schröder, F. (2003): Examining Deutsche Bahn AG's Attempts to set up a Safety Culture. Re-Engineering Risk Assessment & Safety Culture Conference, London.

---

Suckale, M. (2002): Taschenbuch der Eisenbahn-Gesetze. 13th Edition, Hestra, Darmstadt.

According to Wiedemann, R. et al.: VC Human Factor Konzept. Pub. Vereinigung Cockpit e. V., continually updated without indication of year, quoted from Herczeg (2003)

Zimolong, B. (1990): Fehler und Zuverlässigkeit. In: Hoyos, C., Zimolong, B.: Ingenieurpsychologie, Schriftenreihe Enzyklopädie der Psychologie, Hogrefe, Göttingen, pp. 313-345.

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# 1 Introduction

## 1.1 What is the Intention of the Safety Directive?

The European railway industry has been undergoing a process of restructuring since the European Directive on the development of railway undertakings in the Community of 1991 (91/440/EC) in order to create a free market. From the point of view of the EU, this required a separation between infrastructure managers (IMs), who provide the infrastructure, and railway undertakings (RUs), who provide a transport service which operates on the infrastructure. The Commission's explanation of the reasoning behind the Safety Directive (2004/49/EC) states on the subject of that separation that *"the main concern of the safety experts" was that "as a consequence, the control of safety of the overall railway system, which encompasses both areas, could suffer from misunderstandings and a lack of transparency. In the restructured industry, total and undivided responsibility for safety will no longer be held by a single legal entity or company. That requires a clear distinction between the operational responsibilities of the infrastructure managers and the railway undertakings on the one hand, and the regulatory and supervisory functions of the safety authorities of the Member States on the other"*.

### Origins

Following the deregulation of goods traffic, the Safety Directive is intended to *"complement the legal framework for a standardised European railway system; it is part of a package of further proposals, in particular relating to amendment of the Interoperability Directive and the establishment of a European Railway Agency."*

The Safety Directive itself is intended to ensure the development and improvement of railway safety in the European Community by, among other things, *"defining common principles for safety management and regulating and monitoring railway safety"*. The Safety Directive *"encompasses safety requirements for the overall system which also relate to the safe management of infrastructure and transport services and the interaction between railway undertakings and infrastructure managers."*

### Subject

**The EU envisages the following fundamental problem areas in the development of safe railways in Europe:**

- Harmonisation of the legal framework in the area of safety and of the content of safety regulations,
- Remaining obstacles to progress in the creation of a free market,
- Transparency and availability of information in the area of safety, and
- Investigation of serious accidents.

## 1.2 Institutions

The Member States must set up national safety authorities. In respect of the safety management system (SMS), the safety authorities will be able to carry out all necessary inspections and investigations and will have access to all relevant documents and to the equipment and installations of the IMs and RUs. In addition, they

### National safety authorities

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will actively exchange information and opinions in order to harmonise their decision-making criteria.

**ERA** The European Railway Agency (ERA) will support the national safety authorities in the performance of their duties. Its creation was set down in Regulation (EC) No. 881/2004 on the Establishment of a European Railway Agency. The ERA is also responsible for development of the Common Safety Targets (CSTs) and Common Safety Methods (CSMs) and functions arising from the Interoperability Directive.

**Investigating bodies** Furthermore, in each Member State an organisationally, legally and functionally independent permanent body will be set up to investigate accidents and incidents. The investigating body will inform the ERA of its conclusions and the national safety authority of its recommendations. The Member States bear the responsibility for implementation of the safety recommendations. The national safety authority concerned will inform the investigating body of the action taken and planned.

### 1.3 Essential Content of the Safety Directive

**Responsibility of Member States** Article 4 of the Safety Directive charges the EU Member States with the responsibility for the maintenance and continuous improvement of railway safety, taking account among other things of technical and scientific advances. The Member States transfer the liability, and therefore the responsibility, for safe operation of the railway system and for limitation of the associated risks to the IMs and RUs. To that end, they are required to introduce SMS.

**CST, CSM, CSI** This requires the development of CSTs. The assessment of the extent to which those targets have been achieved is facilitated by Common Safety Indicators (CSIs) and performed according to the CSMs. The latter two are similarly yet to be developed. The CSTs define minimum targets for safety levels in the Member States. They are expressed in the form of criteria for the acceptability of individual and social risks. The CSTs are developed according to a method specified in the Safety Directive. The CSIs are defined according to Article 5 and Annex I of the Safety Directive.

**SMS** The SMS to be introduced is defined in Article 9 and Annex III of the Safety Directive. An SMS must meet the requirements and include the components that are specified in Annex III. It must ensure the control of all risks that are associated with the activities of the IMs or RUs, including maintenance work and procurement of materials as well as the subcontracting of services. The IM's SMS must also take account of the consequences of different RUs operating on its network and guarantee that all RUs can operate in accordance with the safety requirements of the Technical Specifications for Interoperability (TSI), the national safety regulations and the requirements of their safety certification. Furthermore, it must co-ordinate its emergency procedures with all RUs that use its infrastructure. All IMs and RUs must submit an annual report to the safety authority providing specified details.

**Safety Management System** means  
*"the organisation and arrangements established by an infrastructure manager or a railway undertaking to ensure the safe management of its operations."*

Definition in Safety Directive, Article 3 i)

**Evidence of SMS** Both IMs and RUs must provide evidence of an SMS in order to obtain an operating licence. RUs require a safety certificate, IMs safety authorisation, both of which incorporate a requirement for approval of the SMS.

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## 1.4 Personal Responsibility of Management

The European railway companies, and particularly their senior management, have a duty, and therefore a personal responsibility, to ensure safe operation. A suitable SMS as a management and monitoring tool for maintaining and improving safety performance is a fundamental aid to carrying out that responsibility within the company.

**SMS as a management and monitoring tool**

In order to avoid personal and corporate liability in the event of accidents, senior managers will have to demonstrate and if necessary prove that they have done everything required of them, and in particular complied with all legal requirements and standards. A suitable SMS simplifies the provision of evidence.

**Avoidance of personal liability**

## 2 Statement on Functions and Elements of the SMS as per Safety Directive

The sections that follow deal with the understanding and possible interpretations of Article 9 and Annex III of the Safety Directive. The core functions of the SMS are detailed in Article 9, while Annex III specifies the requirements in the first section and in the second section lists the essential components that the SMS must include as a minimum requirement. The full text of all Articles of the Safety Directive to which this paper relates is reproduced in chapter 5.

**Core functions, requirements, components of SMS**

### 2.1 Core Functions of the Safety Management System

The function of the SMS is to achieve the CSTs, to comply with the safety requirements of the TSI and the national safety regulations, to control the risks arising from all areas of railway operation and to maintain the system thinking, i.e. co-operation between IMs and RUs, that is so important for safety in normal operation and in emergencies.

All railway companies today have a safety management that is intended to ensure safe operation, safe maintenance, necessary advances and control of risks. For interoperability in railway transport, however, mutual recognition of this safety management is necessary. In order to simplify that, it is necessary to agree upon the elements that all those involved consider to be the essential safety requirements, which guarantee a generally acceptable level of safety, and finally which are to be tested by the approval procedure. Implementation of the requirements and essential components specified in Annex III should facilitate such unification and harmonisation. For each company, therefore, the task consists of bringing its existing safety arrangements and safety-related processes into line with those requirements and components. As however, the latter are only defined in terms of keywords, it is necessary to consider questions of interpretation, design scope and practical possibilities for implementation. Therefore, the sections that follow provide suggestions for interpretation and classification of existing elements of existing SMS that are considered to be fundamental. That includes among other things the issue of provision of adequate resources which is not mentioned in Annex III. However, each company will have to decide for itself on the individual design and implementation of the SMS as dictated by its technical equipment and its operational requirements, though guidance can be found in Section 3 below and the Appendix of this paper.

**Present status of safety management**

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## 2.2 Requirements Placed on the Safety Management System

Annex III details five fundamental requirements for the SMS.

Requirement 1: *"The safety management system must be documented in all relevant parts"*.

### Relevant parts of the SMS

This requirement is a basic necessity for a functioning SMS. Without documentation, no auditing or improvement is possible. The relevant parts include among other things basic functions, processes, instructions and responsibilities.

### Safety Management Manual

A suitable means of providing documentation is by producing and continuously maintaining a Safety Management Manual. The Appendix of this paper is an example of such a manual based on practised SMS. It can be used as the basis for creating an individualised manual incorporating the relevant company-specific particularities.

Requirement 2: *"The safety management system ... shall in particular describe the distribution of responsibilities within the organisation of the infrastructure manager or the railway undertaking."*

### Defining areas of responsibility

The distribution of responsibilities within the organisation is one of the central components of an SMS. This requires a legally safe organisational structure. The practical definition of areas of responsibility and their allocation to specific functions and the employees associated with them within a procedural structure is a prerequisite of safe operation.

### Delegation of safety tasks

The senior management of the company is responsible for the safety of operation. In larger corporations with significant division of tasks, the management will have to delegate transferable corporate duties arising from its safety responsibilities. Delegation involves the selection of employees suitable for the function, tasks and type of responsibility, a written contract with a precise definition of the area of responsibility, the regular monitoring by a superior of performance of the tasks and immediate intervention by the superior if those tasks are not being properly performed. Such delegation does not, however, absolve the company management of its fundamental responsibility for safety.

### Management manual

It is useful to document the distribution of responsibilities and definitions of areas of responsibility, i.e. the organisational structure and the description of the processes, in an organisation or management manual. The manual in the Appendix deals with this topic in Section 2.2.

Requirement 3: *"It shall show how control by the management on different levels is secured"*.

### Performance of safety responsibilities

Securing management control supplements the distribution of responsibilities. Not only must the safety responsibilities be set down and transferred, their performance must also be monitored. Continuous monitoring of managers by their relevant superiors is equally necessary.

### Safety manager

In all processes that are part of the delivery of operation under normal and degraded operational conditions, the guaranteeing of safety will be coverable by the line-management and emergency structures. However, there are tasks that require the function of a safety manager (safety co-ordinator, railway safety manager, Eisenbahnbetriebsleiter, safety director, ...) and demand resources beyond those necessary for day-to-day business. Depending on the extent of the tasks and size of the corporate unit, the deployment of subordinate safety managers may be required

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who may also simultaneously perform line-management functions. The safety manager may for organisational purposes be provided with a staff such as is described in Section 3.3 of the manual in the Appendix.

Requirement 4: It should describe *"how staff and their representatives on all levels are involved."*

The involvement of staff is of decisive importance in matters of safety in particular. The SMS should also serve as a means of improving the safety culture. That is only possible with the support and acceptance of all employees. To that end staff must be informed and involved across hierarchical levels and project boundaries. The fact that many safety-related processes extend across multiple levels and functional areas can be utilised in that regard. Procedures for involving staff can thus be documented alongside process descriptions in the management manual.

**Effect on the safety culture**

Staff representatives should be involved in committees and groups that develop operational processes that affect staff. A similar demand is included in Section 3.2. b) and c) of the manual in the Appendix.

**Staff representative**

Requirement 5: It should describe *"how continuous improvement of the safety management system is ensured."*

There are plenty of examples in other management systems for continuous improvement of the SMS, as detailed in chapter 4. In this area, every company can make use of synergetic effects with existing processes and systems. Continuous improvement of the SMS, and therefore of safety performance, can be achieved by a suitable safety management process. This topic is discussed in detail in Section 3.1.8 and Section 4 of the manual in the Appendix.

**Continuous improvement**

## **2.3 Essential Elements of the Safety Management System**

Annex III 2 sets out in paragraphs a) to j) the ten essential components that an SMS must incorporate at the very least. The expositions below present possibilities for ways in which the existing elements of railway safety management that are considered important can be matched up with those components. That necessary involves an interpretation of the regulatory scope of each component.

*"(a) a safety policy approved by the organisation's chief executive and communicated to all staff;"*

It is a characteristic of management systems to create such a policy to reflect the commitment of the company management and the direction in which the management system concerned is aimed. A safety policy can be made up of three components: the vision, the mission and a code of principles. It should be in harmony with the general corporate policy, based on legal and social requirements, communicated to the staff by the company management and followed by all. The company's safety strategy, which is formulated and implemented with the aid of the other components of the SMS, must be derivable from it. An example of the structure of the safety policy is provided in Section 9.2 of the manual in the Appendix.

**Safety Policy**

*"(b) qualitative and quantitative targets of the organisation for the maintenance and enhancement of safety, and plans and procedures for reaching these targets;"*

In contrast with the CSTs at national level, which are discussed in chapter 4.7, this refers to company-related targets which, however, will also be based on the CSTs. Since the ERA has five years to develop the first proposal for CSTs but the imple-

**Connection with CSTs**

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### **Examples of guiding principles of the safety policy**

#### **Vision:**

- Safety requires a lasting safety culture.
- Safety is continuously improved.
- For the benefit of our customers and employees, our aim is to develop and improve.
- We aim to always be the safest railway company in Europe.

#### **Mission:**

- Through safety, we are recognised partners in the marketplace and have a future.
- Safety is part of our corporate aims.
- Safety management is inextricably linked with the quality standards of the service we provide.

#### **Code of principles:**

- Every employee feels jointly responsible for safety.
- We collectively develop, think and practice safety.
- I am personally responsible for safety.
- Safety is created collectively.
- Safety is a duty of management.
- We aim to increase safety by continuously learning and improving.
- We set ourselves clearly formulated, measurable targets and monitor their achievement.

mentation of the Safety Directive in national law must take place within two years, it makes sense for the companies to initially base their targets on national regulations and risk acceptability criteria. This will also be in keeping with Article 7 (3) of the Safety Directive because that first proposal is based "*on an examination of existing targets and safety performance in the Member States*". The deductions and deliberations in respect of qualitative and quantitative CSTs can also be transferred to the company-related targets.

#### **Possible qualitative targets**

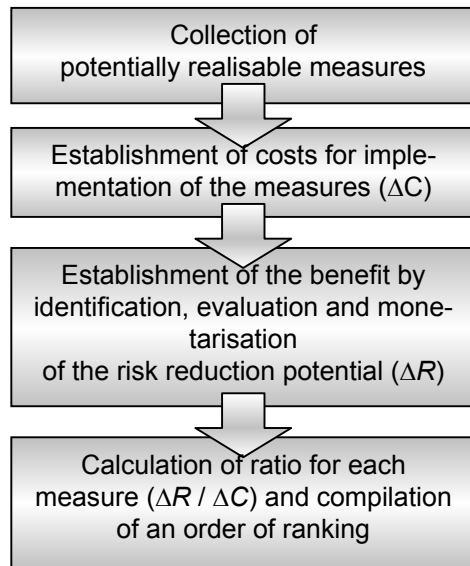
- To ensure safe operation, e.g. by adoption of the fail-safe principle
- To implement proactive measures for risk reduction where necessary for ethical, social, legal or economic reasons
- To use suitable methods applied in other safety-critical industries, e.g. suitability tests for selection of staff

#### **Possible quantitative targets**

- Numerically quantifiable individually and socially acceptable existing risks at various system levels, e.g. reduction of shunting accidents by 8.5% annually.
- Subsystem dependent risk acceptability criteria, e.g. as per EN 50126
- Safety performance of other modes of transport, e.g. fewer deaths per passenger kilometre or passenger hour

But it is not only targets which are demanded; plans and procedures by which they

## Safety measures



are to be attained are also required. The two together are an essential component of the corporate safety strategy. Plans and procedures may take the form of safety programmes which not only detail measures for improving safety and, therefore, for achieving targets, but also describe the procedures by which the measures are proposed, selected, prioritised, implemented and compliance with them and implementation of them monitored in keeping with the demands of a continuous improvement process. Selection and prioritisation of the measures should be made on the basis of "*reasonable judgement*" with the aid of a cost-benefit analysis and thus be guided by the yardsticks of economic viability, customer needs and social demands. A detailed

example of a selection procedure is provided in Section 8.3 of the manual in the Appendix.

*"(c) procedures to meet existing, new and altered technical and operational standards or other prescriptive conditions as laid down*

- *in TSIs, or*
- *in national safety rules referred to in Article 8 and Annex II, or*
- *in other relevant rules, or*
- *in authority decisions,*

*and procedures to assure compliance with the standards and other prescriptive conditions throughout the life-cycle of equipment and operations;*

Compliance with the rules for normal and degraded operation and for transitional conditions in the process of returning to normal operation is the key component of continuous control of the risks that exist in railway operation. That is because, in

## Continuous risk control

### The "safety goggles"

- What obstacles in the work process could prevent safe and reliable achievement of my target?
  - Could I be injured?
  - Could others be injured?
  - Could property be damaged?
- What have I learned from the process?
- What has improved?

conjunction with the relevant job and process instructions below the statutory level, it enables safe operation. This requires that the company makes sure that rules are set down for all safety-related processes and operations, that there is comprehensive documentation, and that there are specifically targeted procedures for the control of documents and data. Everybody must have access to the documents that are relevant to them. Once again, there are synergetic effects with other management systems that can be utilised here.

In order to be able to ensure compliance with new or amended standards, regulations and legislation, the company must make certain that documents and company regulations are constantly updated. To do so, procedures have to be put in place which register the licensing situation, amendments and new introductions both internally and externally.

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<b>User-related regulations</b>	<p>In addition to being complete and up to date, the rules and regulations must be correct, user-related and capable of being carried out. This relates to the second part of this component, the assurance of compliance throughout the life cycle of equipment and operations. User-related in this context means formulated in clearly understandable language and relevant in terms of content to the user and his/her tasks. Practice-proven methods should be incorporated in the regulations, while new regulations should be tested out in practice before being brought into force. Capable of being carried out means that the regulations should be formulated in such a way that they are in keeping with reality so that the company can provide the resources necessary for compliance. Those resources must then actually be made available. In addition to monitoring compliance, the procedures must therefore also be able to check and establish whether standards and regulations are at all possible to adhere to or require revision and adaptation. Those requirements are decisive to motivating the staff to adhere to the regulations, an important interface within the safety culture. Communication of the regulations and the work of committees are presented in Sections 10.6 and 3.2 paragraphs b) and c) of the manual in the Appendix.</p>
<b>Measurement system, proactive risk control</b>	<p>All in all, systematic documentation of all risks is required, in other words of all critical activities and technologies for the implementation of this component of the SMS which can potentially have serious consequences if they are not properly performed or do not function correctly. The critical areas of the risk landscape and the action required at all levels of management can be identified by means of consistent quantitative assessment of safety, and monitoring and control using appropriate key figures and quickly highlighted by an early warning system with suitable indicators. Such a measurement system is described in more detail in Section 6 of the manual in the Appendix.</p>
<b>Maintenance</b>	<p>The compliance with standards, requirements and regulations also includes the process of maintenance, which is not explicitly mentioned in Annex III. If a company meets the standards and requirements over the entire life cycle of equipment and operations, as demanded by the Safety Directive, then the specifications of the manufacturer and the company's own maintenance rules are included. Also covered is the question of subcontractors. In that connection, procedures for monitoring compliance with regulations on the part of subcontractors must be laid down.</p> <p><i>"(d) procedures and methods for carrying out risk evaluation and implementing risk control measures whenever a change of the operating conditions or new material imposes new risks on the infrastructure or on operations;"</i></p>
<b>Risk control</b>	<p>Whereas paragraph c) refers to the control of risks in the course of ongoing operation, this component relates to the control of risks in the event of changes in operating conditions or the introduction of new equipment. To that end a company must tackle the subjects of risk analysis and change management. Risk evaluation must be preceded by intensive discussion of risk acceptability criteria such as is already demanded in connection with the CSTs. Risk control also requires the systematic documentation of relevant potential risks in order to be able to assess and quantify changes. This must take place across all levels and divisions that affect the process or the equipment concerned so that all elements of the risks are known. A risk-control procedure is set out in Section 8 of the manual in the Appendix.</p>
<b>Risk assessment</b>	<p>Risk assessment procedures should ensure that the data and operation scenarios on which different risk analyses and appraisals are based are identical or comparable in each case. To that end it is useful to set up an interdepartmental co-ordination unit. Every company should draw up a set of criteria for the necessity and extent of risk assessments in order, on the one hand, to guarantee the necessary level of safety and, on the other, to avoid unnecessary expenditure.</p>

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A particularly suitable method of risk assessment, including for the acceptance and approval of new or modified equipment or operating procedures, is the demonstration of at least equivalent safety. This shows that the acceptable risk level is the same as or even below that which existed with the previous technology or procedures. This is dealt with in chapter 4.7.

**Proof of equivalent safety**

The procedures for carrying out risk assessments should include methods of identifying non-apparent risk changes in the course of changes to operating conditions or the introduction of new equipment. The possibility of changes to risks as a result of changes of an organisational nature or alterations in the general social conditions should also be taken into account.

**Non-apparent risk changes**

*"(e) provision of programmes for training of staff and systems to ensure that the staff's competence is maintained and tasks carried out accordingly;"*

Since the operation of railways is still largely an activity carried out and controlled by people despite the increasing use of technology, special attention has to be paid to the initial and continuing training of staff in matters of safety. The subject of safety plays a particular role in the area of human resources because the retention of skilled staff or of skills and knowledge in the face of staff turnover in safety-related functions is of particular importance to railway operators.

**The human resource**

Training programmes must be prefaced by a requirement for future staff to be tested for psychological suitability and physiological fitness for the job in question. Both initial training and subsequent in-service training for maintaining and improving qualification levels should aim to engender an awareness of safety. In the railway industry, as in other businesses, the individual carries a social responsibility with regard to safety. This must be reflected in the content of training courses, testing methods and examination content, documentation, etc. Training should also highlight the effect of function-specific safety on overall safety. In order to ensure that jobs are carried out in a manner in keeping with the specified qualification level, there is also the possibility of incorporating safety aspects in the targets agreed with employees. Such content can be delivered, for example, by training on simulators or by computer based training (CBT).

**Engendering safety awareness**

The monitoring of staff qualification levels and job performance can be carried out as part of the normal staff appraisal process and must be documented. Training course levels and training quality can be evaluated by an analysis of test results.

Finally on this point, there should be SMS training courses for staff who are specifically involved in the implementation of the SMS, e.g. by virtue of being responsible for safety-related processes or by their position as safety manager.

**SMS training courses**

*"(f) arrangements for the provision of sufficient information within the organisation and, where appropriate, between organisations operating on the same infrastructure;"*

The furtherance of safe behaviour must be preceded by a recognition of the necessity of safety-related measures and regulations. That requires the organised communication of information within the company so as to ensure that all necessary safety-related information is available when required, is documented and is complete. Important factors in that regard are controlled reporting channels for safety-related incidents in the course of operating activities, e.g. GSM-R radio links, for passing on information from systematic risk documentation or from the early warning system and standardised language rules throughout the company. The use of communication processes in existing management systems offers recommends itself in that connection.

**Controlled reporting channels**

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**Consultation  
process between  
companies**

A decisive factor in the controlled flow of information between companies is an organised consultation process between the IM and the RUs that use its infrastructure. In some countries there is already a legal obligation for co-ordination between companies. Beyond that, inter-company committees and working parties are in any event effective means of consultation and co-ordination.

**Information  
duties**

The responsibilities for providing and obtaining information must be clarified in accordance with the contractual relationship between IM and RU. The IM, however, must of its own accord pass on all necessary technical or operational information to all RUs concerned. A RU must inform the IM directly and the latter must then pass on the information to all other RUs concerned. Between companies as well, the documented exchange of safety-related information via defined interfaces with clear escalation channels is absolutely essential. The information must be formulated in such a way that the companies can implement it within their own operating procedures.

*"(g) procedures and formats for how safety information is to be documented and designation of procedures for configuration control of vital safety information;"*

**Harmonisation  
of formats**

There is a fundamental need for harmonisation in this area, particularly with regard to formats, which should take account of proven documentation processes in existing management systems. Once again two aspects are involved: safety information of internal significance only, and safety information that affects processes between companies. In the latter case, harmonisation is of decisive importance. For internal company documentation it is important to recognise the absolute necessity of defining duties and responsibilities for identification and retention in terms of location and duration. Retention periods that are not specified by law, e.g. for audit records, should be harmonised at European level.

**Document and  
data control**

Document and data control procedures must be defined and can be based on existing management systems. Documents and records must be filed or electronically stored in such a way that they are permanently available and contribute to maintaining and improving performance and can enable the prompt initiation of corrective action.

**Particular duties  
of IM**

In the case of processes involving several companies each of which generates information that requires storage, the IM should ensure the comprehensibility of language and content and the capability of documentation. The use of standardised formats, e.g. for instructions or accident records, must be aimed at. Other examples include the approval of rolling stock following repairs or maintenance and the work and communication logs of the station inspector. RUs that operate on more than one network should not be confronted by a variety of different formats.

*"(h) procedures to ensure that accidents, incidents, near misses and other dangerous occurrences are reported, investigated and analysed and that necessary preventive measures are taken;"*

**Reactive  
risk control**

The reporting and investigation of accidents, faults, near misses and other dangerous events is an element of safety management that is already extensively subject to statutory and regulatory control. In addition, however, every company should look into possibilities for promoting the reporting of faults and near misses, including in cases where employees have made mistakes or failed to follow correct procedures.

**Co-operation  
with other  
companies**

Sharing experiences with other railway companies is a sensible supplement to a company's internal strategy planning. The investigation and assessment of acci-

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dents involving more than one RU should be carried out jointly in keeping with the overall system approach, provided the legal situation allows it.

In order to obtain usable data for documentation, a company must be able to provide adequate investigation capacity, while taking account of the need to make a distinction between "trivial" accidents and events involving more deep-rooted, inherent system faults. The analysis of accident causes which may follow also requires personnel and possibly technical capacities. It is precisely that analysis, however, which is indispensable for the improvement of safety performance.

**Adequate investigation capacity**

The investigation of all events is important for the identification of trends or systematic faults. Suitable methods include, for example, the regular analysis of accident statistics or the systematic examination of journey progress records. Another tool is the root-cause analysis within the framework of directed workshops for documenting the insights and needs of employees not directly involved in the event and subsequent development of plans of action. Accident investigation is also an important topic in the manual in the Appendix.

**Investigation methods**

The result of practical event cause analyses or the analysis of the accident and other event-related databases are necessary preventative measures. They may take the effect of immediate action or longer-term planned strategies. Immediate action in this case does not refer to damage reduction or limitation at the accident site but rather to action which demands implementation without delay supported by provision of the necessary resources. There should be procedures in place which promote the individual responsibility of staff in the initiation of such action. Longer-term planned strategies can be incorporated in the safety programme. In any event experts must be available for the process of developing and implementing the strategies in order to prevent both unnecessary measures and the omission of necessary action.

**Preventative measures**

Insights obtained from the process of cause analysis should be made available in a form suitable for inclusion in training strategies. They should be dealt with openly as far as legal constraints allow and staff should be actively involved in the problem-solving process.

**Incorporation in training strategies**

*"(i) provision of plans for action and alerts and information in case of emergency, agreed upon with the appropriate public authorities;"*

Due to legal requirements, railways already have emergency management systems with the appropriate action, alarm and information plans. It is important that those plans are regularly checked and updated. With regard to the interaction between emergency management and SMS, a decision has to be made either to define the interfaces or to incorporate emergency management within the SMS from a functional point of view.

**Relationship of emergency management to SMS**

The SMS can provide for crisis management as an escalation of emergency management by which decisions can be made quickly and independently of line management responsibilities with the aim of protecting the company against additional financial losses or damage to its image.

**Crisis management**

*"(j) provisions for recurrent internal auditing of the safety management system."*

Regular internal checks serve to continuously improve the SMS and its procedures. The system audits check not only the existence of necessary and required procedures and processes but also their application and effectiveness. Internal audits should be carried out by internal and external auditors independent of the organisa-

**Effectiveness of procedures**

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tional unit being audited. The use of existing management systems as a basis is an obvious approach.

### **3 Introduction and Organisation of a Safety Management System**

#### **Guide to introduction and model for procedural and structural organisation**

The introduction of an SMS will be particular to each individual company. Two possibilities are proposed in this section and illustrated by practical guidance. The first involves the complete introduction of the system within a finite period of time, the advantages of which are to be seen in establishment in time for enactment of the Safety Directive in national law, the all-encompassing view of the overall system, and the utilisation of existing management systems as a basis. This holistic approach is based on the descriptions of safety and management systems in the Appendix of this paper. The second approach is based on a longer-term, incremental introduction of the building blocks of the system and takes account of the fact that not all the necessary resources for complete introduction may be available. This section concludes by presenting a model for suitable procedural and structural organisation of safety systems.

#### **3.1 Holistic Approach to Introduction**

##### **Sequence and aim of introduction**

Introducing an SMS into a railway company is initially a matter of examining, adapting and improving the existing safety-related processes. Process evaluation is one of the main areas of emphasis in the initial stages of introducing an SMS in order to establish to what extent the existing rules meet the requirements or require adaptation. It is essential that the management system is embedded in the corporation and that it is continuously improved over the years. In practice, it is a case of systematically identifying faults so that they can be avoided in the future, bringing about extensive and rigorous exchange of knowledge and information within the company, communicating necessary skills and insights and achieving a thorough knowledge and mastery of safety-related processes in the company.

##### **Framework as guide**

A framework for the overall introduction of an SMS in a railway company is outlined below. That framework is intended to serve as a guide and simplify the implementation of an individual SMS. It details important aspects to be taken into account when introducing the system which then have to be practically refined, extended and adapted to the individual circumstances of the particular company. The procedure for introduction should be distinguished from the subsequent process model which contains the sequence layout described later on for the SMS introduced, thus so to speak represents the aim of the efforts.

##### **3.1.1 General Strategy**

##### **Introduction project and medium-term planning**

It is a general principle with management systems that they have to be introduced, maintained and continuously improved. Only the introduction of the SMS is a once-only project which can be dealt with using project management methods; maintenance and improvement are continuing processes that are reliant on the involvement and support of employees at all levels. For that reason it is sensible – and this applies even more so to the restructured railway operating companies with their many additional interfaces – to develop a medium-term vision of the general strategy as well as an introduction model, particularly in order to include the con-

tinuing development of the safety culture within the organisation in the deliberations. At the same time, it can take account of the other formal milestones by which the SMS must be guided, i.e. enactment of the Safety Directive in national law, creation of the ERA, development of the CSMs and CSTs.

Starting from the basis of the ongoing safety measures and, if applicable, existing management systems, a safety campaign can be developed, for example. A pilot project at an early stage underlines the importance of the project for the corporation. Experience gained in the course of the pilot project can be used to adapt the procedure in the subsequent implementation process.

**Safety campaign,  
pilot project**

Because of the transferability to SMS of many aspects of other management systems, it is basically possible to either

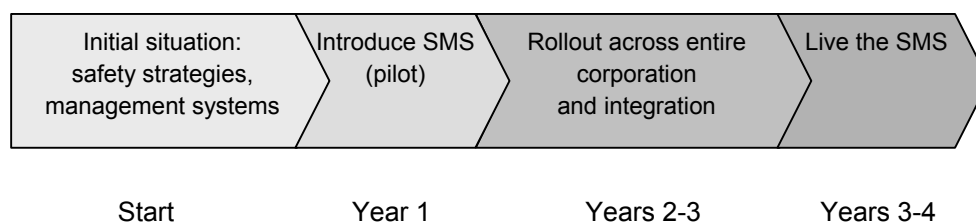
- construct an SMS as a separate system, or
- merge the SMS with existing management systems – as a higher-level, subordinate or overlapping system.

**Merging with  
other  
Management  
Systems**

When doing so it is important to avoid barriers and unproductive competition between organisational units within a corporation. Experience of management systems provides pointers as to areas likely to require the greatest concentration of efforts when introducing an SMS as per the Safety Directive, which will differ in their level of complexity from case to case. The expectation that regulations exist does not mean that no additional efforts will be required; conversely, the expectation that extensive work will be required does not mean that no regulations exist.

Subsequently, the piloted SMS can be rolled out to the remaining sections of the business and the system integrated in day-to-day operations. Internal comparisons with the previously established SMS can accompany and complement that process, and later on external comparisons and exchanges of experiences with other railways and, if necessary, with businesses in other safety-related industries can be carried out as further support. The aim is for the overall system to become a living part of the everyday thinking actions of all employees and for safety to occupy a position of high importance. Safety should then also become a subject for marketing.

**Integration in  
day-to-day  
activities**



### 3.1.2 Project Management

Before actually starting the process of introduction it is necessary to draw up a project outline for submission to senior management. The aim of this is not only to explain the basic components of the project such as aims, procedures and required resources, but also to make senior management aware of the introduction of the SMS and gain their support. It is helpful if the necessity of the project can be demonstrated by safety performance indicators such as accident figures or type and number of instructions from the safety authorities or by statutory requirements.

**Project outline**

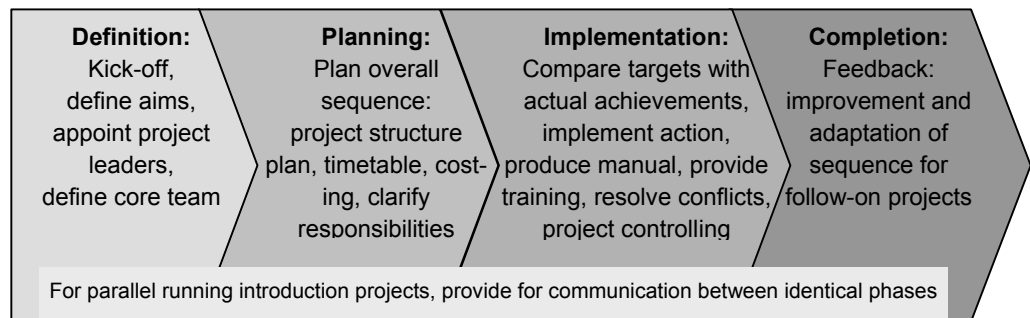
The introduction project should match the known phase models for project management in which the content modules subsequently described can be integrated.

**Project  
management  
phase models**

Optimisation and continuing development of the SMS and its individual processes is the job of the SMS itself and takes place once it is introduced.

### Project aim and completion

It is important to define the aim of the introduction project so that it is possible to determine when it has been completed. The point of completion can be set as the achievement of certification or the presentation of a management manual, for example. It makes sense to fix that point by definition because the transition from completion of the introduction process to continuing development of the living system is fluid within the context of the continuous improvement process (CIP).



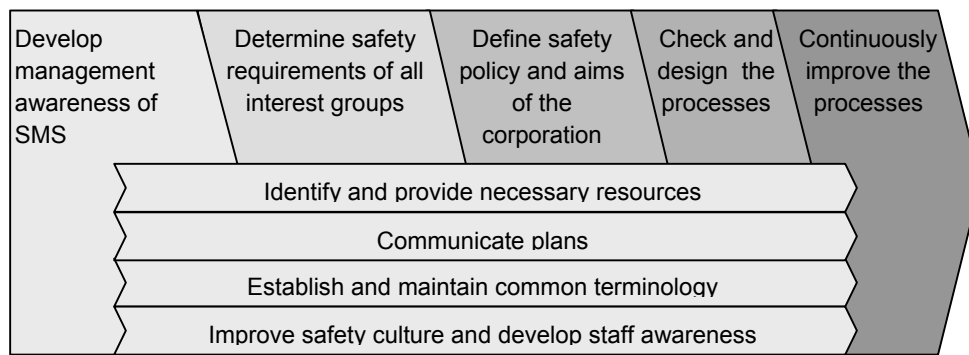
### 3.1.3 Procedure for Introduction Project

The explanations and recommendations as to procedure that follow take the existing safety strategies in railway operating companies as their starting point. With regard to the sequence, the reader is referred to the project management phase models described above. Depending on the implementing company's own estimation, various different modules may serve as the starting point for introduction, such as the CIP for example. It is advisable in any event to take account of internal experience gained from previous management system introduction projects. The safety management manual should be written over the course of the introduction project as documentation of the SMS and should continue to be refined and regularly updated after completion of the introduction project. The manual in the Appendix can be used as the basis for individually adapted versions.

Existing processes and regulations should be taken account of but not necessarily adopted in every case; instead they should be measured up against efficacy criteria, i.e. assessed as to their effectiveness. The extent to which processes are transferable between organisational units must be considered on a case to case basis.

#### Action areas for introducing the SMS

- Definition of criteria for identifying which tasks and processes are safety-related.
- Checking and improving compliance with company regulations. In the face of a multiplicity of licensed RUs, this is particularly important for the IMs.
- Checking possibilities for replacing existing technologies with new ones.
- Checking or establishing feedback systems (lessons learned), company suggestions systems or ideas management systems.
- Development or checking of the set of indicators for checking the effectiveness of the SMS processes and the other safety-related processes so as to be able to identify diminishing safety performance, the background to weaknesses, and to define suitable corrective action. The common safety indicators (CSIs) as per Annex I of the Safety Directive can be used as a starting point.



### 3.1.4 Developing Management Awareness of the SMS

Effective embedding of the SMS in the corporation requires that it does not remain an alien entity within the organisation and does not lead to additional bureaucracy, because as a consequence of its process-related nature, it is always the staff at all levels of the operation that ultimately determine the success of the system.

Developing awareness on the part of the most senior management levels should ensure that they actively represent and communicate their formal responsibility within the company, even if the executive responsibility is delegated. The established management systems recognise this as an important point because this sets an example for all levels of management and permeates through to all employees. Where an SMS is concerned, this is all the more important because an exemplary safety culture starts from the very top. In practice, therefore, in addition to universal development of awareness among the most senior managers, it also makes sense for all management personnel who are in charge of staff with safety-related jobs to be technically qualified.

**Responsibility**

For SMS in railway operating companies, this takes on extra significance because railway operation even without SMS is traditionally one of the safest technical system processes. Deliberate efforts at persuasion should therefore emphasise the necessity and benefits of introducing an SMS beyond the statutory demands and support, explain and promote the European initiative on SMS.

**Motivation**

The same indicators of safety performance proposed for promoting project awareness can again be used as means of developing management awareness. Equally suitable are the costs and consequential costs of accidents and damage to the company's image in the event of diminishing safety performance. It is also conceivable to make corporate managers aware of their personal responsibility for the safe condition of rolling stock and installations and for safe operation of the business.

**Examples of awareness development**

### 3.1.5 Determining Safety Requirements of all Interest Groups

The financial success of businesses today increasingly demands a knowledge of the interests of the environment in which they operate, and above all the interests of the public, the customers and the owners (shareholders). This can form the basis for identifying development potential, influences on corporate aims and main focal points for business operations.

The Safety Directive is an example of explicitly expressed and systematically observed safety interests. It expresses the social interest in technical and operational safety compatibility between the European railways due to the creation of the single market.

**Social interest in safety compatibility**

**Benefit** Safety as a product feature of railway transport is assumed as a fundamental prerequisite rather than, for example, being explicitly demanded by customers. For that reason, railway companies should systematically ascertain the safety demands of their interest groups and take them into account by means of appropriate improvement processes. The identification of demands and expectations is also of significance to the extent that such knowledge can now be more positively employed for the benefit of the railway, for example by integrating customers and suppliers in the safety culture or to reduce accidents at level crossings.

**Information collection methods** Safety requirements can be ascertained in practice by methods such as customer surveys, discussion forums with shareholders and safety authorities, staff surveys or analysis of safety performance ratings presented in the media.

### 3.1.6 Defining Safety Policy and Aims of the Corporation

**Basis for action** The policies and aims of a business make the actions and character of the company

#### Safety policy

**Vision** The strategic aim that the organisation wishes to achieve with regard to safety in the long term.

**Mission** Embeds safety within the concept of "railway operation" as the purpose of the organisation.

**Code** Describes by means of a set of principles which serve as imperative guides to action the values according to which the corporation operates.

comprehensible to those within it and outside it. This requirement on the part of the Safety Directive can, for example, expressed in terms of a code or principles, a vision and a mission statement from which the strategic aims, the development course and the values of a corporation should be derivable. This can also formally demonstrate the management support. The knowledge gained from identifying the requirements of the interest groups and the adoption of the CSTs support the definition of the safety targets.

#### Setting an example

A close link with the safety culture is essential to a functioning safety management system. Achievement of the specified requirements is simplified if the safety policy is entrenched in all employees and safety-orientated behaviour is promoted. It is helpful if regular checks of the safety levels are the joint responsibility of all managers, i.e. safety management is understood as the duty of all management staff. A personal undertaking to that effect included in the performance and target agreements for managers can be useful in that connection.

#### Preliminary considerations for safety targets

- Systematic identification of requirements of interest groups
- Selection of safety targets within the framework of overall corporate aims
- Transparent procedure for target agreement
- Targets should be challenging but achievable
- Targets should be quantifiable and tied to a deadline
- Utilise operational experience to formulate realistic targets

**Communication** The involvement of all employees can be ensured by a universal communication strategy for implementing the safety policy at all levels of hierarchy through which employees can also express their views. Periodical employee information such as company magazines that report on the activities and achievements of safety management are a suitable means. It is sensible to highlight the successes of continuous improvement and to place them at the centre of efforts in order to counter the impression that everything is already safe and nothing needs improving.

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### 3.1.7 Check and design the processes

The company introducing the system must itself answer the questions as to whether it is familiar with all its own safety-related processes (possibly including those over and above the legal requirements), in how much detail it wishes to describe those processes, which processes have already been described, whether they are known to the relevant staff, to what extent they are observed, etc.

**Safety-related processes**

The subject of the SMS are the processes within the company that are relevant to technical and operational safety. Those are, firstly, the safety-related added-value processes and, secondly, the controlling processes and procedures of the SMS itself that serve the purpose of achieving the specified safety targets. It is the function of the SMS processes to ensure that the business processes run safely. Those SMS procedures must also ensure that, where applicable, other safety-related processes are identified and become the subject of the SMS, if they are not already. That also involves the SMS processes ensuring that systems keep pace with technical and scientific progress and comply with the recognised technical rules.

**Functions of SMS processes**

In order to define all processes, both the safety-related business processes and the SMS-specific processes must be documented and the persons responsible specified in each case. Beyond that, it is important for the assessment of process performance that methods of determining the actual effectiveness and efficiency of each individual process exist. Such a measurement system is one of the factors that determine the success of the SMS.

**Measurement system for efficiency and effectiveness**

The business processes in railway operating companies are already described by comprehensive sets of rules and regulations that should be checked for completeness and up-to-dateness. The main focus of attention can then be placed on the SMS processes themselves and other areas of action in the course of introduction with interfaces with the monitoring and improvement process.

The introduction project will be able to build on the fact that there are already extensive safety strategies in place at all railway companies. In terms of content, therefore, it is a case of checking, adding to and linking all existing processes to a self-contained system, and in terms of form and structure, of adapting the existing system to the requirements of the Safety Directive.

**Adaptation to the Safety Directive**

#### **Example key questions relating to the SMS processes**

- What does the existing safety management consist of? In this connection, the internal company regulations, safety reports, internal weakness analyses and interviews with those responsible for safety should be analysed.
- Which requirements of Annex III of the Safety Directive are already met to what extent by the present safety strategies?
- Which of the requirements demanded of the SMS are already met to what extent by the existing management systems (e.g. EMS, QMS, health and safety, fire safety, hazardous materials and emergency management)?
- To what extent is there potential within the company for integration between the existing management systems, the existing safety strategies and the SMS being aimed at? At this point, circumstances at the company such as obstructive departmental imperatives should be taken into account in the assessment to a realistic degree.

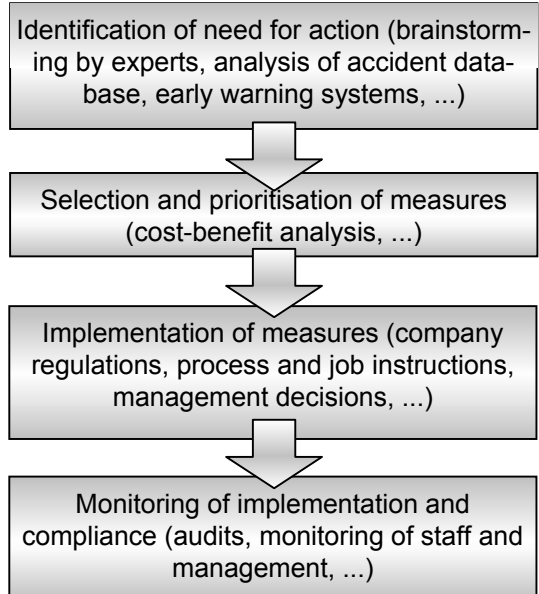
Essential elements of SMS as per Annex III of Safety Directive	Expectation that regulations	
	already exist	are less likely to exist
a) Safety policy and code of principles		•
b) Targets		•
c) Procedures for compliance with legally required and other standards	✓	
d) Procedures for risk management	✓	
e) Training programmes	✓	
f) Information flow within the organisation and between organisations which use the same infrastructure		•
g) Procedures and formats for documentation of safety information		•
h) Reporting systems for accidents, faults, near misses, etc.	✓	
i) Action, alarm and information plans in consultation with authorities	✓	
j) Internal audits of the SMS		•

### 3.1.8 Continuously improve the processes

#### Combined improvement of safety performance and SMS processes

The improvement of the SMS should be distinguished in terms of context from improving safety performance; nevertheless, improving the SMS processes alone without simultaneously focussing on safety performance does not serve a useful purpose.

The CIP thus incorporates the assessment of the SMS and the overall safety performance including the implementation of measures arising from the assessment and comparison with the specified safety targets, and thus completes the management circle. The assessment of the SMS is the result of regular internal checks of the SMS (also demanded by the Safety Directive) and a process to that effect should be set up. Where applicable, consultation with the national safety authority is useful and helpful in that connection.



#### Learning company, self-assessment

It is advisable to rigorously involve all employees in a collective learning process (learning company). This can be supported by self-assessment processes by which organisational units rate themselves in terms of level of safety development and potential for improvement.

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An important component of the improvement process is the analysis of feedback from the interest groups as a means of internal benchmarking. In addition to making a comparison with other railways, it is also advisable to compare the safety performance of other modes of transport or the safety procedures employed in other safety-critical industries. Active benchmarking against entirely different sectors of industry can provide usable results both for the SMS and the company's own safety performance, as well as for marketing and corporate image.

## Benchmarking

### Basic framework for CIP

- Analysis and evaluation of current situation in order to identify areas in need of improvement
  - Assessment of SMS processes and safety performance
  - Incorporation of feedback from customers, staff and other interested parties, as well as from audits and assessments of other management systems
  - Incorporation of systematic feedback of experience based on events that have occurred
- Definition of improvement targets for the areas identified
- Search for possible solutions for achieving those targets
- Assessment of those solutions and selection from among them
- Implementation of the chosen solution
- Measurement, verification, analysis and assessment of the results of implementation in order to determine whether the targets have been achieved
- Where applicable, incorporation of the changes into the regulations

### 3.1.9 Accompanying Measures

In order that the safety targets can be reached, resources in the form of personnel and equipment are necessary. The resources required must be ascertained and made available, both for all phases of introduction and for the subsequent maintenance of the system. This point is not explicitly mentioned in the Safety Directive. However, it is of central importance to the economics of railway companies because the present restructuring is being accompanied by a significant reduction in staffing levels and therefore also affects questions of safety. In order to obtain acceptance from the workforce for the introduction and maintenance of the SMS, it is sensible to work with internal resources as far as possible. External assistance should only be brought in for expertise that is unavailable within the company and is only occasionally required.

## Identifying and providing necessary resources

Establishing the required resources includes, in personnel terms, not only determining the general suitability of staff but also the question of specialist qualifications. The latter involves ascertaining the training requirements of specialist staff and of management with regard to communicating of the overall picture to the workforce. Increasing economic pressure, the raising of company performance levels and the speed of the business processes can, against the background of shrinking staffing levels, turn previously safely performed operations into operations rated as safety-critical, and straightforward operations into complex ones; this should be taken into account when producing training materials and providing training courses. The training materials for a station inspector, for example, who is given a position in the signalling control centre after reorganisation cannot be the same as before even for fault situations when the fallback level has to be used.

## Staff training requirements

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**Communicating plans**

As a result of the reorganisation required, employees' familiar surroundings may change and cause adaptation reactions due to change of location, new superiors or colleagues, or having to take on new, additional duties. Great importance should therefore be placed on active communication of the introduction of the SMS within the company. That includes prompt and open communication about the project and ongoing reporting of progress during the introduction phase and of continuing developments after introduction. Communication should extend to all interest groups and be actively pursued. It is advisable to involve the public and to exchange experiences with companies who are currently going through a similar process or have already done so.

**Terminology – maintaining a common understanding of terms**

Safety is also dependent on reciprocal and – when time is limited – rapid communication and mutual understanding. To that extent, it is absolutely essential that introduction of the SMS is accompanied by the adoption or reinforcement of measures for a common understanding of terms. Such measures can contribute to the avoidance of loss of knowledge in the railway system in view of the multiplicity of meanings of the term safety on the one hand, and the changes in the areas of personnel and organisation on the other. Much that characterised the railway community in the past was based on experience that within the context of a self-recruited and long-serving staff could be passed from senior colleagues to their juniors. To the extent that direct entry at senior levels and staff turnover are increasing in railway companies while older employees are retiring, there is insufficient time for knowledge to be passed on, and as a result it is lost.

**Improving safety culture**

The safety culture is the sum total of all safety-related behaviour modes within a corporation, both internally and externally. At the same time, it is an indicator of the quality and suitability of the SMS. Therefore, a distinction should be made between the formal adoption of safety thinking in the corporate policy and the incorporation of the idea in the corporate culture.

**Safety-orientated behaviour**

The basis for safety-orientated behaviour on the part of operational staff is formed by the individual's professional competence, experience of the job and commitment to professional ethics; this means that initial and continuing training occupies an important position both with regard to practical mastery of processes under normal operational circumstances and the identification and assessment of situations in abnormal circumstances. Furthermore, an understanding of the overall system promotes responsible behaviour in a global context. A knowledge of the different divisions of the company is an advantage for staff in safety-critical positions. In addition, selection criteria that help to identify applicants with a greater awareness of risks should be adopted when appointing new staff in order to increase overall safety. Managers must be appropriately trained.

**Elements of a safety culture to be aimed at**

- Managers who set an example and send out a clear message
- Specification of clear individual safety targets which are not simply based on laws and regulations
- Clear allocation of responsibilities and corresponding authority for safety-critical duties
- Regular publication of safety performance data
- Recognition of staff performance and rewarding of achievement

The fundamentally high probability of human error in complex technical systems makes it significant to railway companies because, on the one hand, it accounts for a large proportion of the causes of accidents, and on the other, because behaviour-related strategies for its reduction can achieve considerable success at a relatively

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small financial cost. The safety culture should also be continually developed alongside the SMS introduction projects and beyond.

#### **Qualitative indicators of a good safety culture**

- Safety performance can only be delivered if staff
  - are job-orientated and motivated in their actions
  - take personal responsibility for their actions and are supported by safety specialists
  - are adequately qualified in order to be able to actively contribute to the continuing development of safe operational processes, and
  - have the authority to act independently and make decisions in the event of changes in operational processes.
- Staff know who is responsible for safety.
- Staff affected are involved in the production of new process instructions.
- Regulations
  - are not a means of finding who is to blame.
  - are the basis for safety.
  - are sufficiently practically based to be complied with.
- Safety is continually advanced by systematically looking for potential hazards and assessing potential risks – and not just after accidents.
- Near misses are used to learn lessons.
- Safety targets are continually proactively pursued.

#### **Factors determining the success of an SMS**

- Improving safety performance
- Personally setting an example
- Specifying individual safety targets
- Communicating personal commitment on the part of management
- Allocating responsibility and appropriate authority for safety-critical tasks and defining interfaces
- Involving staff in system development
- Promoting constructive criticism and development of alternative ideas
- Recognising staff performance and rewarding achievement
- Making the benefit to an individual of his/her own work perceptible
- Making regulations up-to-date, correct, complete, user-related and possible to carry out
- Emphasising learning and preventing/improving
- Regularly publishing safety performance figures
- Avoiding barriers and unproductive competition between the organisational units within a corporation

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### 3.2 Incremental Approach to Introduction

With a view to limiting the cost of the necessary available resources, the SMS can also be introduced in stages over a longer period. The basis for that would be the adaptation described previously of the existing safety strategies to the requirements and elements of Annex III taking account of the core functions.

#### Individual projects for adaptation to the Safety Directive

This procedure is based on the view that the existing safety management structure can already be classed as a system and it is therefore possible to start immediately with the process of continuous improvement. Individual measures are adapted by way of a separate project in each case.

### 3.3 Procedural and Structural Organisation for Improving Safety Performance

After completion of the introduction process, the system continues to be advanced by the organisational structure. The SMS works as an independent systematic process which is based on an existing or adapted organisational structure for guaranteeing operational safety.

#### Focus on safety

Because of the difference between the SMS and other management systems, i.e. that the targets aimed at and some of the methods used are specified within a legally binding framework, the core processes such as train operation, shunting or servicing and maintenance must be viewed with a very clear focus on safety.

#### Extended Process Model

Reaching the corporate targets includes, among other things, an adequate safety level. To that end, the company must develop and maintain a lasting safety culture with the aim of maintaining and improving safety performance. An effective tool in that quest is a living SMS.

#### Extension of classic process model by addition of safety component

The diagram shows a possible model for the processes required. The essential factor is the addition of the safety component to all elements of the classic process model (control loop with dark grey arrows); the effect of safety on the processes is illustrated for the essential core processes of train operation, shunting and provision of equipment (control loop with light grey arrows) in the detail box (magnifying glass) below the process model. The classic control loop ensures that the safety control loops cannot be viewed in isolation but rather have to be seen in the overall context of their connection with one another.

#### Defining targets with those responsible for processes

Since safety cannot be produced but only guaranteed, the SMS counteracts the reduction of safety levels in a compensatory fashion. The output of the SMS is therefore not safety per se or a safe train journey but the guaranteed provision of the specified safety level.

Arising from the SMS, safety targets for the core processes and strategies for reaching those targets are defined in consultation with those responsible for the processes. They should be broken down by those responsible for the processes into detailed targets, implemented with an appropriate key figures system and controlled in keeping with a management system. The results from the process review are the basis for adjustments to safety targets and strategies which must be defined by the safety organisation in agreement with those responsible for the processes.

Appropriate consideration should be given to the expectations and demands of the interest groups. The interest groups include not only customers, shareholders, employees, suppliers and national safety authorities but also the EU, the ERA and the public. And they all have specific expectations of safety. Not only does the SMS provide outcomes for the interest groups, there is also feedback in the form of satisfaction surveys which creates a reciprocal relationship.

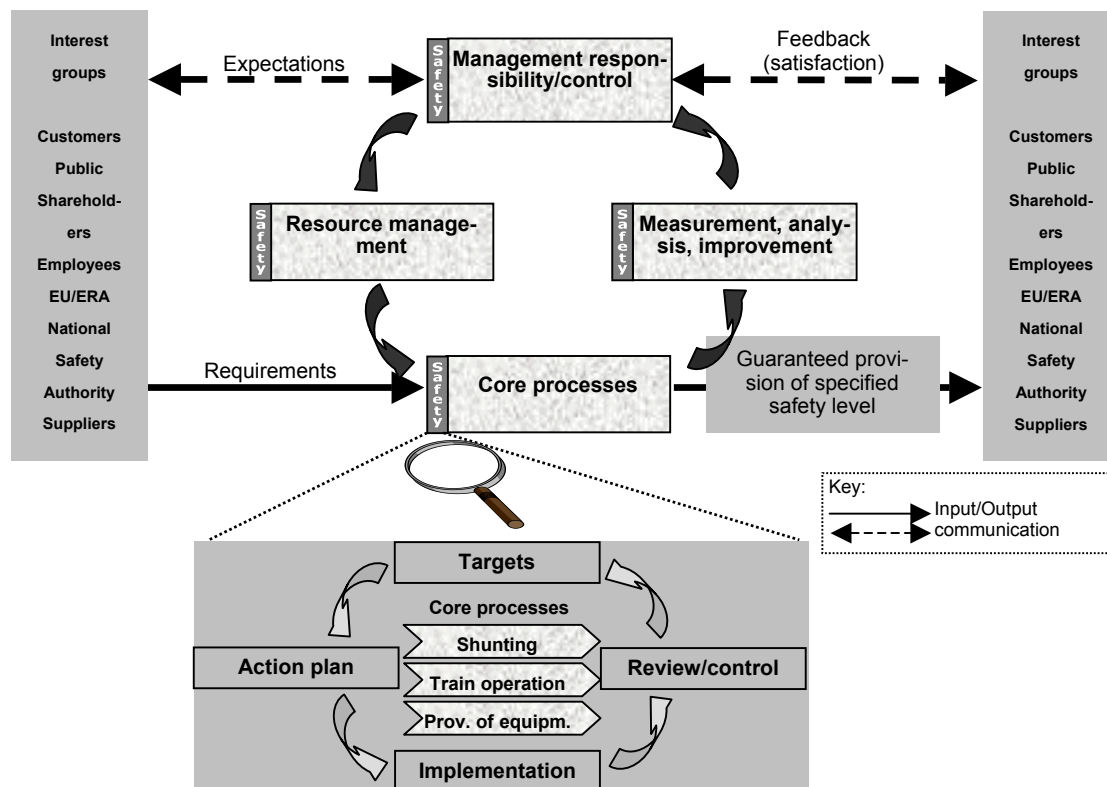
## Requirements of interest groups

A particular role in relation to the expectations placed on railway safety performance is played by the public. The reaction of the public to accidents is generally more sensitive than with other modes of transport and the level of risk expected is generally approaching zero. That expectation is not only unrealistic, it also represents an enormous challenge to the SMS and risk communication. That is because it means the SMS must be so well set up and must be communicated along with its aims, measures and results in such a way that it is not placed into question in its present form by individual out-of-the-ordinary events that might be perceived by the public as setbacks.

## Special Features of the SMS

Since CSTs and CSMs are specified by the EU, a company cannot set its safety targets and the means of achieving them purely according to its own judgement, it must also take account of those specifications. In areas where the safety performance is relatively low in comparison with other railways, specifically targeted improvement strategies must be implemented.

## Dependence on CSTs



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## Interaction between Structural and Procedural Organisation

In order to be able to define operational processes and put them into functional interaction with one another, it must be possible to locate them within an existing structural organisation. The shaping of the interrelationship between structural and procedural organisation should be guided by the overall company aims and the responsibilities arising from them.

## Requirements Placed on Structural Organisation

The SMS-specific structural organisation must ensure that the responsibility legally imposed by the relevant national railway legislation is practised (legally safe organisation). At the same time, it must be compatible with the existing structural organisation for producing added value at the company.

## Link with Operational Organisation

<b>Support function</b>	The guaranteeing of operational safety by means of an SMS is not a core operational process of a railway company. The purpose of running a railway company is not to produce safety but to provide safe transport services economically. The SMS should be organised so as to be dependent in terms of content on the operational core functions. Its supporting and safeguarding functions should be interwoven with the processes and structural organisation in such a way that it can work within the company as its quality characteristic. The SMS performs a support function. It has no functionally independent outcome; instead it produces a certain quality on the part of the core process and should not be designed as something independent.
<b>Use of resources</b>	The result of that is that the SMS structural organisation should almost entirely – apart from a few managers and specialists – make use of the available personnel resources of railway operation, as far as is possible. The SMS functions for ensuring safety, which are part of the procedural organisation, are performed in combination with operational functions by the same personnel by such staff as are expressly made use of by the SMS as part of the SMS structural organisation on the basis of their function in safety-related positions.
<b>Safety-related functions</b>	<p>For the sake of clarity, it must be emphasised once again at this point that the safety-related functions in the overall planning and production process must be identified by the SMS. Such functions include</p> <ul style="list-style-type: none"><li>• Selection and training of staff</li><li>• Construction and planning of installations, rolling stock and systems</li><li>• Materials procurement and quality checking</li><li>• Rolling-stock and track maintenance</li><li>• Rolling-stock provision</li><li>• Instruction and regulation management</li><li>• Emergency contingency and security</li></ul>
<b>Limits</b>	Compliance with legal safety requirements takes precedence over the economic considerations of designing an SMS structural organisation. Thus wherever the interests of safety demand specially qualified persons or post-holders who are as independent as possible of operational areas, the SMS must be granted its own staff.

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## Internal Structure of Structural Organisation

As far as SMS management is concerned, the construction, introduction and maintenance of the SMS demand specialist expertise as well as management and leadership skills commensurate with the size and complexity of a railway company. Therefore, expert and sound management of the SMS by a safety manager should be provided for. In small companies, that position can be taken on by the senior management. In large companies, a full-time post of safety manager for the SMS should be created within the senior management, supported by specialists as required.

### Management

A safety manager cannot be satisfied with simply checking that the SMS is functioning but rather must at least have the possibility of making proposals as to how the targets are to be met.

### Safety manager

In order to ensure appropriate levels of safety and safety performance, the safety manager must even have powers of design that have an effect beyond the mere process model and the systematology of the SMS. The safety manager will thus particularly have to deal with the organisation, the target achievement plan, the resources, and even the core processes and have an effect on them. Consequently, it is also necessary to define safety targets for the individual core processes and to agree them with those responsible for the processes and the management. The same applies to the measures by which those targets are to be achieved. Depending on the organisational integration and the definition of the function of safety manager at each individual railway, and on the associated authorities and areas of responsibility, the following models are conceivable.

### Design scope

If the safety manager is a staff position, powers of proposal and involvement as well as duties of notification will suffice. That means that the safety manager makes proposals for safety targets, advises on the selection of the safety-promoting strategies to be pursued and must draw attention to safety-critical deficiencies.

### Powers of proposal and involvement

If, however, the safety manager as well as the company management has joint responsibility for success, i.e. the guaranteeing of a certain level of safety performance or the prevention or reduction of specific risks, he/she will have to be invested with powers of design because responsibility can only ever be taken on in conjunction with the appropriate degree of authority. Beyond that, the safety manager must be systematically involved in certain elements of the core processes. That relates to provision of resources by initial and continuing training, compliance with regulations, information, documentation and accident investigation. With regard to the CSTs and CSMs the safety manager must also be able to issue the persons responsible for the relevant core processes with specifications for process-related safety targets and methods to be applied. Furthermore, he/she must have the possibility of checking whether the safety targets have been achieved – or can still be achieved by means of corrective action. In view of the safety manager's personal responsibility for success, he/she must also have the fundamental, unrestricted power to intervene with all employees with safety-related duties in order to be able to directly and immediately rectify non-compliance with the safe process sequence or condition.

### Joint responsibility

As experts responsible for safety-related areas of responsibility assigned to them, the specialists manage the staff entrusted with SMS functions in those areas. They may also perform general system functions such as system maintenance, system documentation, system communication and system audits.

### Specialists

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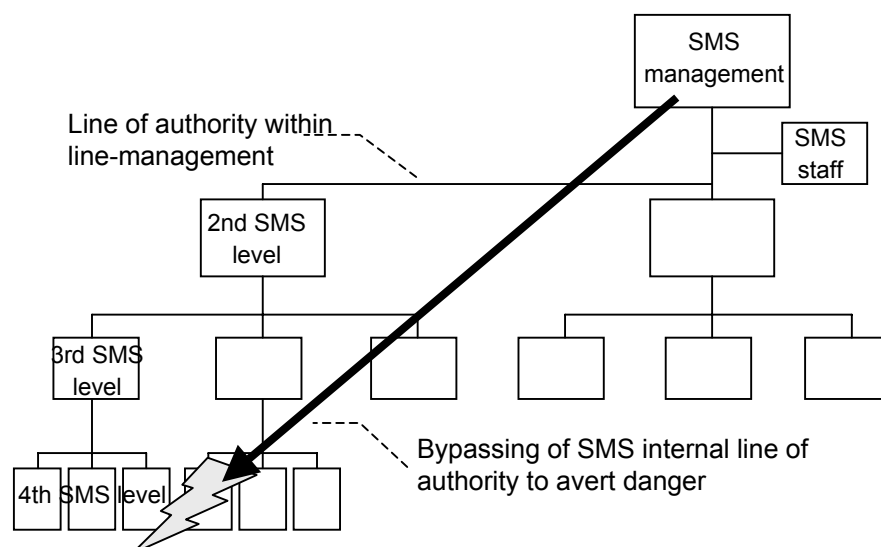
All those functions can be defined as staff functions assigned to the safety manager. However, they can also be set up as central, group or interdisciplinary functions. If those functions have to be taken on by operational staff in small companies, it is imperative that a loss of quality by the SMS functions is avoided.

**Employees** The staff who perform SMS and safety-related functions and the resources allocated to them are incorporated in the SMS structural organisation by the process descriptions and the process sequences.

**Lines of authority** The Safety Directive details the core functions of the SMS in Article 9. However, it does not make any mention of lines of authority or powers of intervention. It merely directs expectations at the effectiveness and function of the SMS which are imperative. For example, compliance with standards and guaranteeing of standards conformity are demanded, as are programmes, precautions and procedures. The Safety Directive therefore offers no grounds for diverging from the normal and proven tools of corporate or business organisation where the organisation of the SMS is concerned. In order to guarantee safe railway operation, clear allocation of responsibilities and duties is required. In that connection,

- lines of authority alongside line-management functions and
- lines of authority for the safety manager direct to staff in safety-related areas must be defined.

**Intervention powers** Powers of intervention with staff must be set down by the senior management as otherwise intervention will clash with the operational organisation of the business. As a fundamental principle, the safety manager and his/her staff must be able to issue direct instructions to all staff in order to be able to perform their allotted functions. To avoid conflicts and contradictions, however, as a basic rule only the SMS staff assigned to the particular operational function or organisational level concerned should intervene with the units in their area of responsibility. A universal right or obligation for any SMS staff member to rectify any safety deficiency apparent to him/her by issuing instructions or for the SMS management itself to issue direct instructions to any operational employee whatsoever should be reserved for the aversion of immediate serious dangers. This closes the loop with the safety culture, which also demands intervention.



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## 4 Safety and Management

This chapter presents fundamental deliberations on the relationship of safety, management systems and SMS which can help RUs and IMs clarify questions and offer ideas prior to project planning and introduction.

### 4.1 What is Safety?

Safety is a complex general term in everyday use without a clearly circumscribed meaning. It relates to individual personal and social perceptions, conventions and standards which are subject to constant change. On the one hand, safety designates a complex feature of conditions and processes, and on the other, activities which may be expressed through social or political action, technical precautions or statutory regulations.

#### Safety in General

The various different perceptions are generally linked by the following alternative terms which delineate the wide scope of the term and collectively illustrate what is understood by safety. Security, protection, certainty, reliability, but also self-confidence, trust, skilfulness and not least availability, surety, foreseeability, predictability and durability. Long-standing developments such as environmental damage, depletion of resources or health hazards due to all-pervading use of technology make the increasing spatial and temporal dimension of the perception of safety evident.

##### Definitions of safety:

EN ISO 8402: *"Condition in which the risk of personal injury or damage to property is limited to an acceptable level."*

EN 50126: *"The non-existence of an unacceptable risk of harm."*

#### Scope of term

Numerous definitions use the terms danger and risk in particular to make the full scope of the term safety comprehensible. Risk is used to quantify the level of possible danger. This paper makes recourse to the international standard EN ISO 8402 which defines terms used in quality management.

#### Risk

We speak of a calculated risk in actions and decisions when not all information relevant to the decision is available – which is most often the case. For example, possible reductions in safety levels resulting from a technical application may be accepted if the benefits of the application are sufficiently great. Risk in this case is defined as measurable uncertainty the detailing of which represents an estimate of future likelihood. Risks relate to future possibilities, whereas safety refers to an assessment of a present situation.

The question of the acceptability of risks, in other words which risks are seen as acceptable for the individual, for groups or for society as a whole, cannot be objectively answered. The CSTs which railways have to develop serve equally as risk acceptability criteria. With regard to the actual acceptance of a risk, however, the following general tendencies are known. The accepted risk is higher

#### Acceptance and acceptability

- if a risk is taken voluntarily
- if the person believes he/she is in control of the risk

- if individual small accidents are more common than catastrophic accidents with large numbers of casualties
- if the consequences are immediate rather than delayed.

The example of tunnel safety illustrates the third point. In this case a comparatively small likelihood of accidents and fires is coupled with extensive expenditure on safety measures. This contrasts with other places where the probability of accidents is greater but the safety expenditure is lower.

## Safety and Technology

**Types of risk** In technical activities, the following types of risk can be distinguished:

- Operating/operational safety: this relates to damage occurring in the course of normal operation and intended use of the technical system. Possible examples are accidents at level crossings which are characterised by unauthorised crossing by other traffic. (Example: accident in 2003 between bus and express train at Siofok on Lake Balaton (Hungary) at a level crossing protected by stop-signal lights.)
- Failure risk/technical safety: this relates to damage occurring as a result of technical defects (e.g. ICE accident at Eschede in 1998 caused by defective tyre).
- Misuse risk/public safety: this covers damage caused by improper use of the technical system with criminal intent (example: setting off the alarm when there is no emergency).

## Safety requirements

Therefore, the safety requirements that generally result are to the effect that technical or organisational means should be used to minimise the operational and failure risk to a reasonable degree and to exclude the possibility of improper use with criminal intent including external intervention. Railways generally use the term security to refer to protection against improper use, whereas protection against technical and operational risks – which may include health and safety at work – is referred to as safety and is the subject of the SMS.

Probability of errors for tasks in nuclear power stations (Zimolong 1990)	HEP – Human Error Probability	Means: number of errors per 1000 opportunities
Error		
Incorrectly reading an analogue display	0,003	3
Incorrectly reading graphs	0,01	10
Failure to notice a fault indicator	0,003	3
Moving a control in the wrong direction under high stress	0,5	500
Failure to properly close a valve	0,005	5
Failure to use a check-list	0,01	10
Failure to work through a check-list in the correct order	0,5	500

**Human error** Another important aspect of safety is the generally high probability of human error in the execution of a task. Humans have the fundamental capability to correct errors and therefore to negate the consequences of actions. Nevertheless, erroneous actions which have wide-ranging effects and whose deficiencies are outside manageable limits and the consequences of which cannot, therefore, be cancelled out,

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remain a problem area. The lack of reliability of human beings can thus fundamentally undermine the safety of complex systems (human failure) so that it is imperative that it is supplemented by suitable organisational measures such as represented by the SMS.

Minimum safety requirements that technical systems have to meet are generally specified by law. In addition, safety is afforded a position of major importance among technicians and engineers for reasons of professional ethics, a situation to which professional associations also contribute.

## **Safety and the Railways**

Safety measures in the railway industry are fundamentally aimed at ensuring the following. The railway infrastructure, the rolling stock and the equipment and installations must first of all be safely constructed, which is ensured on the part of the manufacturers by means compliance with up-to-date technical standards, and by national licensing authorities. In the subsequent course of their life cycles, railway infrastructure, rolling stock and installations and equipment must then be kept in a safe operational condition by appropriate maintenance. Furthermore, personnel and organisational measures must be taken to ensure that they are safely operated. That includes not only internal health and safety measures, technical safety and operation per se, but also operation within a complex environment where there are interfaces with other modes of transport and types of traffic such as pedestrians and motorists.

Those requirements are defined in a similar form throughout the Member States in national railway legislation and regulations, compliance with which is ensured by established company-specific rules that have grown up since the earliest days of the national railways.

## **4.2 What are Management Systems?**

Management relates to the entirety of the actions of a business that are aimed at the best possible degree of achievement of the company targets and of the interest groups associated with it. To that end, the internal structures and processes have to be co-ordinated with the environment in which the business exists.

Management systems are formal guidance systems for shaping, steering and developing corporations and organisations. They are used to reinforce the ability to learn, respond and adapt, and thus help companies to be prepared for possible changes, particularly in a complex environment.

**Management  
concepts, models  
and systems**

The basis is formed by management concepts such as Total Quality Management (TQM). The well-known international standards ISO 9001:2000 and ISO 14001:1996 define models for the implementation of management concepts relating to quality and the environment respectively. The application and adaptation of those implementation aids to a specific company then produces a company-specific management system.

There are numerous well-known management systems, some of which have been established for many years. They are based on common principles and procedures. Management systems have a company-wide strategic and operational co-ordination function. Common to all modern management systems is a process-orientated approach. Complex processes may be subdivided into sub-processes for which responsibilities are clearly allocated in each case.

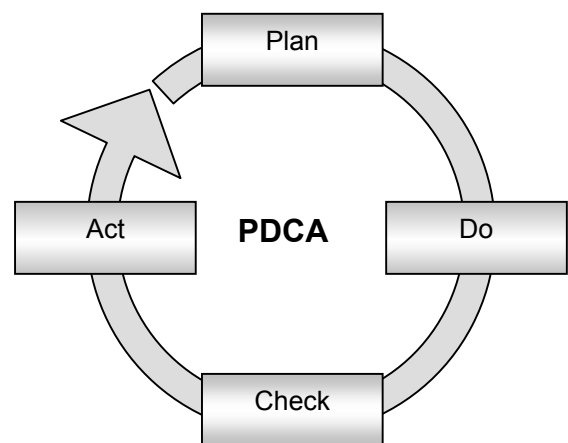
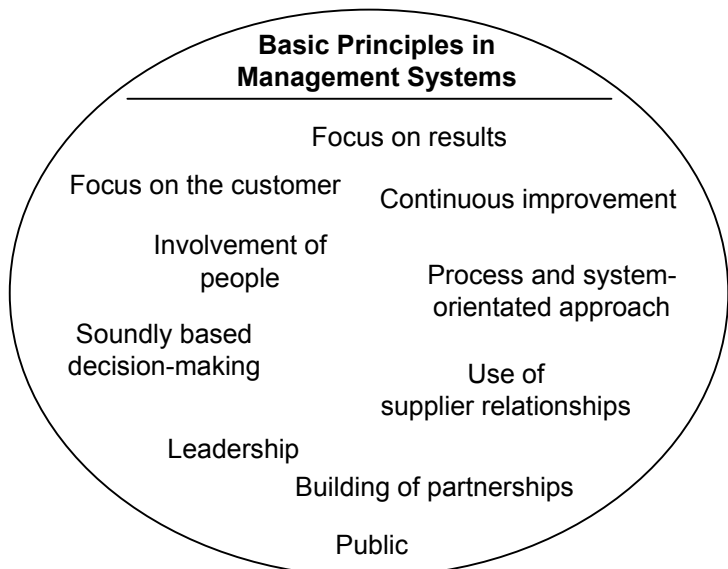
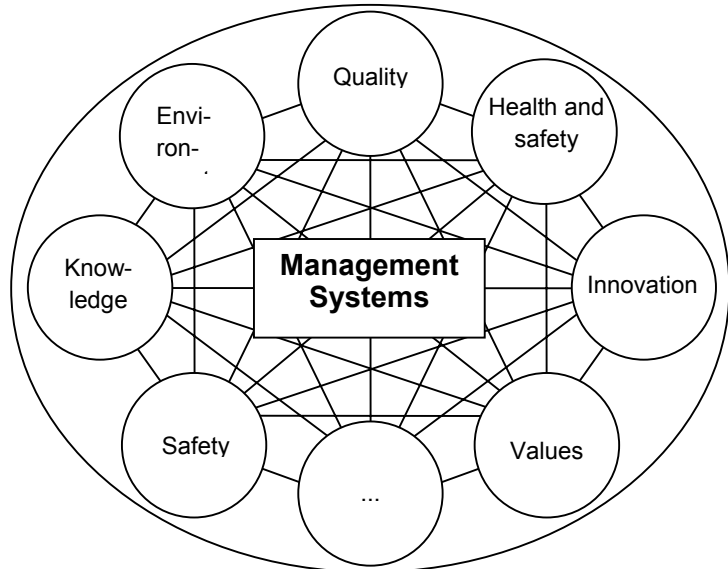
The difficulty for management systems consists in each case of the procurement, processing and analysis of relevant information as the basis for action and decision-making.

Management systems contain descriptions and documentation of the business processes and their mutual interfaces.

Process indicators perform a monitoring function which enables control and optimisation of process performance. This is where the concept of control by management activities that is typical of management systems finds expression.

### Management control loop

Management activities consist of planned, targeted and verifiable action. This is expressed in cyclic phase concepts which are based on the PDCA cycle. In its classic form it consists of the phases **plan**, **do**, **check** and **act**, and can be found in many variations. The point here is that a company should first of all be clear as to the outcomes it wishes to achieve. In order to deliver those outcomes, procedures are planned and then systematically put into practice. This is followed by a specifically targeted evaluation phase which permits conclusions to be drawn as to whether the measures originally planned were suitable in terms of their implementation or effectiveness for achieving the set targets. This incorporates a learning process and, based on it, an improvement process. At that point, the closed control loop starts again from the beginning by virtue of the fact that procedures are im-



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proved and/or targets are adjusted or new targets introduced on the basis of external influences from the environment in which the organisation operates.

The PDCA cycle illustrates the principle of constant or continuous improvement (CIP), one of the basic principles of quality. Other principles and characteristics of quality management are nowadays familiar components of management system standards. They are easy to grasp but by no means simple to put into practice.

#### **Principles and characteristics of management systems**

- A firmly established corporate purpose with regard to continuous improvement of products and services
- Continual search for the causes of problems in order to constantly and continuously improve (CIP) all production and service systems and all other activities within the corporation
- Modern methods of initial and continuing training directly at the place of work and specific to the job
- Modern management methods which help people to do their jobs better
- Promotion of effective, two-way communication and other means or removing the atmosphere of fear throughout the entire corporation
- Removal of demarcation lines between different areas of the business
- Removal of all obstacles to management and staff being proud of their work
- Rigorous training programme and encouragement of self-improvement on the part of every individual
- Lasting commitment of the most senior management to continuous improvement of quality and productivity

### **4.3 Safety Management Systems**

The idea of safety as a fundamental human principle has almost always occupied an important position in the operation of technical systems. There is a long tradition of safety precautions; it is just that the associated regulations, process instructions and activities were not labelled as an SMS. Consider, for example, the development of safety systems for motor vehicles as illustrated by passive safety systems such as airbags or active safety systems such as ESP which keep the vehicle controllable in dangerous situations. These are examples of the continual development of safety features without there being an SMS. Even in such complex technologies as nuclear energy generation with sophisticated safety arrangements and highly developed safety systems, the establishment of SMS is a development that is only now taking place.

**Long tradition  
of safety**

#### **Features in Common with Other Management Systems**

Safety management should be understood as the sum total of all activities and actions necessary to ensure safety. Important features of an SMS are always, as with established management systems, the process-orientated approach and adoption of the PDCA principle. Fundamental aspects of established management systems can be transferred to the area of safety management because, firstly, all management systems touch on aspects of safety and, secondly, the process-orientated approach

**Based on  
established  
management  
systems**

is a key feature common to all of them; the management principles can equally be transferred to SMS. The essential components of an SMS detailed in the Safety Directive can basically be placed in that category as well. For that reason, it makes sense for an SMS to be based on the established management systems and use to be made of the similarity of content and the lessons they offer.

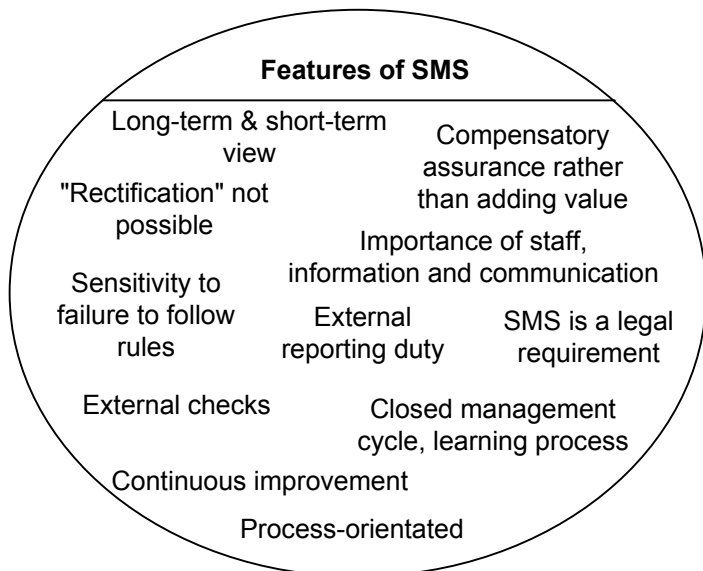
### Special Features of Safety Management Systems

#### Long-term and short-term view

Like the term safety, the term also SMS has many sides. Interpretations of it range from a broad, general long-term view – for example the development of safety reserves or, in a narrower sense, accident prevention management – to emergency measures in the event of acute risks and emergency management with a specific short-term perspective.

#### Compensatory guarantee

Just like quality, safety is a feature of a product or process. And just as quality cannot be imposed on a product but has to be built into it, safety has to be provided in parallel with a process. A decisive difference between quality and safety is that quality can be produced, i.e. manufactured, and therefore represents added value. A hazard as a threat to safety, by contrast, always diminishes safety levels and therefore reduces value. So if safety cannot be produced but only guaranteed or maintained, an SMS must consequently ensure that that level does not drop and that loss of value does not occur; to that extent, safety must be provided proactively as pre-emptive action. The SMS only has a productive effect where



an already diminished safety level is raised again; otherwise it has a compensatory effect by preventing a lowering of safety levels. Consequently, unlike quality which involves a productive process along the value added chain, safety involves a safeguarding process along the process chain, in other words continual management of the residual risk. In that regard, safety has features in common with environmental management, although environment is not a feature of a product or process and environment in the literal sense cannot be subject to a management process, but only to a protective and possible compensatory process.

#### No rectification possible

The condition of safety is just as difficult to measure directly as that of quality or health, or the level of environmental protection. Although all of those features are directly determined by a large number of individual influences, they tend to present as not directly controllable due to the complexity and inaccessibility of the factors that affect them. Quality can generally be directly improved within limits after the event by rectification – though usually at considerable cost; this is not normally the case with safety and explains why anticipatory actions are required.

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Safety is difficult to perceive; in some cases it can only be identified with great effort and expense and in some cases not at all. An indication of the difficulty with the perception of safety are the problems in defining the concept of safety – what is safe? At the same time, interest groups assume the existence of safety; or at least its existence is not explicitly acknowledged. By contrast, safety deficiencies in accidents or other undesirable occurrences are very clearly perceived and criticised.

**Safety is assumed**

The control of indirectly determinable conditions is based on exerting an influence on accessible aspects. For management systems, those are process descriptions, definitions of responsibilities and other regulations by which the behaviour of individual staff can be influenced. In the case of the SMS, the relevance to safety of the processes increases the responsibility of the individual employee in comparison with other management systems. As a result, the importance of the flow of information within the company and of communication between organisational units and between staff simultaneously takes on greater significance than in other management systems. All employees at all levels of the company then have a decisive role to play.

**Importance of staff, information and communication**

Because of the greater importance of all active staff where safety is concerned, safety is more sensitive to the failure to follow rules than, for example, quality. This comes to the fore particularly where complex technical systems are concerned, in other words in situations where it is not easy to create a clear mental picture of a danger. When safety regulations are ignored, injury or damage do not generally directly result by any means. The immediate result of failure to observe safety regulations is initially simply that the restrictions of the safety regulations are removed and the individual can act more freely. However, this can prove to be deceptively dangerous. The positive consequences of the disregarding of safety regulations lead to an increasing tendency to ignore them. And that increases the likelihood that something will actually happen.

**Sensitivity to failure to follow rules**

The guaranteeing of safety is achieved by safety systems, in other words by means of devices and arrangements designed to satisfy safety-related requirements. An SMS is an active, process-orientated, non-technical safety system. The aim is to use efficient regulations to make possible future eventualities more easily predictable and therefore controllable, to limit, as it were, the element of surprise. In that way the residual risk is reduced.

Another difference between SMS and all other management systems is the legal requirement to show that it has been introduced. Quality management systems (QMS) by contrast are introduced by managers due to market pressures or the realisation that they offer an economic advantage. This applies equally to environmental management systems (EMS), although they do have to take account of legal environmental protection requirements as well. Similarly in the case of health and safety at work, there are statutory regulations to be observed but the introduction of management systems is not obligatory. SMS are accordingly set up on the basis of the legally required minimum safety standards in keeping with the perception of corporate and social responsibility.

**SMS is a legal requirement**

In contrast with the certification of other management systems, the approval of an SMS is a case of licensing by the state. By virtue of the company's external reporting duty, an interface with the relevant national safety authority is created. That means that in contrast with other management systems the SMS is not circumscribed by the railway company for which it was created. As with the system for road vehicle licensing, approval and testing could be subcontracted to accredited private organisations.

**External reporting duty**

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<b>External audits</b>	As opposed to internal audits, which as in other management systems serve the purpose of continuous improvement of the system, external audits, i.e. audits, examinations and inspections of the SMS by the national safety authority, can potentially have serious consequences because the identification of inadequacies not only threatens the loss of business from customers due to the lack of a certificate, but also the imposition of conditions even extending to the loss of the operating licence.
<b>Closed management cycle, learning process</b>	Of particular importance for an SMS is the closed management cycle, i.e. the implementation and subsequent monitoring of measures that have been planned on the basis of defined targets. In particular, the learning process takes on greater significance than in other management systems because recurring events arising from the same causes are unacceptable due to the nature and potential seriousness of the damage, and can lead to criminal and civil action against the management.

### **Functions of Safety Management Systems**

<b>Maintaining and improving safety</b>	The SMS must at least maintain the previously attained level of technical and operational safety. Statement (30) of the Safety Directive, however, states that <i>"In line with technical and scientific progress, safety should be further improved, when reasonably practicable and taking into account the competitiveness of the rail transport mode"</i> .
<b>Accident prevention</b>	The aim of the Safety Directive is to prevent serious accidents and preventatively reduce the consequences of accidents. That requires permanent efforts on the part of the railway companies. An understanding of the fundamental causes of undesirable occurrences and ultimately of accidents and the progression of them is a prerequisite for the ability of SMS processes to identify deficiencies in procedures and to implement improvements.
<b>Identification of danger</b>	Efforts should be aimed at preventing or at least detecting increases in the level of danger and thus halting its subsequent progression from possible risk to present danger. Early warning systems offer suitable means but demand a knowledge of the safety-related processes. Proper documentation of those processes is helpful so that the knowledge does not exist in the person of a particular individual but is generally accessible. In consequence, that means that someone has to take on responsibility for internal communication of the relevant information within the company, which also includes checking the extent to which the information is actually known.
<b>Quantification of safety performance</b>	The functions of an SMS also include indicating the level of safety achieved. This must be done in such a way that the progression of the safety level over time can be examined. That safety performance can on the one hand be represented by certain quantitative indicators such as accident figures; however, it can also be characterised by features that can be assessed by the use of qualitative indicators such as rough "traffic light" ratings.
<b>Safety culture</b>	A long term corporate task is the development of the safety culture which is reflected and influenced by an SMS. An overall grasp of safety, which has a cultural as well as a technical aspect and affects the success of the company in the long term, must be promoted by an SMS.

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## Procedures

Generally recognised procedures for introducing an SMS do not yet exist. The requirements placed on a sound SMS can be derived from a variety of international regulations and recommendations in addition to the Safety Directive.

Of particular significance are the standards ISO 9000 ff, "Quality Management Systems", ISO 14001, "Environmental Management Systems" and general guides on the subject of process management. Studies by the IAEA (International Atomic Energy Authority) on safety culture and safety management may also be referred to. In particular, the standard ISO 9004:2000 provides guidance for organisations wishing to go beyond the requirements of ISO 9001 in their efforts to continuously improve performance.

The guide to introducing an SMS in Section 3.1 provides a basis for the procedure to be adopted. It is important for an SMS – as it is for the established management systems – that it is not seen as a one-off project but as a continuing process that relies on the involvement and support of all employees; an SMS must be a living part of everyday thought and action.

**Guide to  
introduction in  
Section 3.1**

### Potential of safety management systems

- Efficient and transparent processes guarantee safe operation
- Image improvement from delivering a safe service improves market position
- Motivation of employees is increased
- Safety-related interaction between production and its environment is detected at an early stage
- Safety-related effects of innovations and production facilities are identified sooner
- Practical safety-related consequences of new services are estimated
- Safety-orientated alternatives are highlighted
- Safety-related trends are detected
- Social safety demands are identified sooner and more easily
- The acceptance of safety-related technology and products is increased
- Completely comprehensive delegation of responsibilities is enabled
- Safety-related knowledge is developed, preserved and utilised along the chain of research, development, production and application.

## 4.4 Relationship between Safety Management Systems and Other Management Systems

The question as to the relationship between an SMS and other management systems arises from two viewpoints. If a railway company already has a management system, there is the question not only of demarcation but also of interfaces between the existing and the new management system. Every company must answer those questions for itself and the conclusions will depend on its individual view of safety. This question is also of interest because European and non-European railway companies have already started to introduce an SMS based on EMS or QMS. This is more of a unifying than a divisive aspect.

**Potential basis  
for SMS**

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**Examples of management system standards**

- Quality: e.g. ISO 9001:2000, EFQM, ISO/TS 16949:2002
- Environment: e.g. EMAS and ISO 14001:1996
- Health and safety at work: e.g. OHSAS 18001:1999 (British Standard compatible with ISO 14001:1996), OHSMS (Occupational Health and Safety Management System – ISO 18000) is under discussion
- Safety for railway applications: e.g. EN 50126:1999 (RAMS – Reliability, Availability, Maintenance, Safety, compatible with ISO 9000)
- Hygiene: e.g. HACCP (Hazard Analysis of Critical Control Points)
- Social aspects: e.g. SA 8000 (Social Accountability)

In any event, the requirements placed on the SMS by the Safety Directive must be met. For that reason it is advisable to take account of the established existing structures in companies. To that extent, use of the structural and procedural organisation of existing management systems as a basis is conceivable and worthy of consideration (see also Section 3.3). With regard to content and structure, all management systems offer pointers for the SMS as the all touch on aspects of safety and generally contain similar elements. In addition, different specific aspects of individual management systems are of relevance to SMS so that no single system is preferable as a basis in terms of content, while all process-orientated management systems are suitable as starting points. Whether an established management system is selected as the basis for an SMS, and if so which one, must be decided according to the individual situation of the company concerned. However, because of the similarity of content and the level of experience that exists – and also because of the amount of experience in the areas of standardisation and certification – environmental and quality management systems lend themselves to use as the basis for an SMS.

**Variety of management systems**

Management systems today have a wider focus on areas such as occupational health and safety, social aspects, hygiene, information security, risk, innovation and knowledge. They are concerned with guaranteeing safety at work, handling risks or data protection, and with managing the future of the company (longevity). Social aspects relate to topics such as worker participation, sexual equality, or ethics and morality in the workplace. Not all areas benefit from published standards.

**Integrated management systems**

Frequently, several management systems are set up within a company and are combined for the sake of efficiency and avoidance of duplication; they are then referred to as integrated management systems, though the nature of the combinations varies from industry to industry. As a rule, combinations between quality, environment and safety at work are formed, though occupational health plays an

**Examples of synergetic effects in integrated management systems**

- Avoidance of duplication of work
- Identification of contradictions in compliance with regulations
- Avoidance of overlaps in regulations and allocation of responsibilities
- Avoidance of conflicts by means of defined communication processes between systems
- Avoidance of isolated solutions
- Direction of aims and processes at an overall optimum

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increasingly important role. Integration is aimed at harmonising the various management systems and utilising synergetic effects.

The question as to which management system is preferable as a basis for SMS would appear to be of secondary importance in view of the development towards increasing integration of international standards which relate to one another in various ways.

In particular, it is evident that the succeeding revisions of the ISO quality and environmental standards increasingly make reference to one another, and that efforts are made to ensure that other standards are compatible with them. The revision of ISO 14001 expected in 2004 is intended to offer greater compatibility with ISO 9001:2000. In addition, working parties at the ISO at technical committee level are generally occupied with improving compatibility between management systems and the merging of management systems into a single system.

### **Compatibility of management systems**

On the basis of the structural requirements published to date in the Safety Directive and the required certified proof of SMS existence on the one hand, and the existing extensive safety strategies at railway companies on the other, as previously mentioned the certified management systems for quality and environment are particularly suited to use as a template for an SMS or for integration of the safety strategies, taking account of the particularities of SMS.

A comparison of the requirements of the Safety Directive with those of ISO 9001:2000 and ISO 14001:1996 reveals which of the requirements for SMS offer potential for integration based on fundamentally similar requirements for QMS or EMS; in other words they are demanded in equal measure with relation to quality or environmental considerations, due to which solutions or at least starting points should exist where there are existing management systems within the company.

### **QMS and EMS**

Differing interpretations of safety alter the relationship of the SMS to other management systems if, for example,

- safety is seen as a quality feature of the service provided by a railway, or
- safety is seen as an extension of health and safety at work, or
- safety is viewed as similar to environmental protection because of the preventative and compensatory nature of the activities.

Despite the note on the definition of safety in EN ISO 8402 to the effect that safety is one of the aspects of quality, a differentiated view is necessary even if a wider

#### **Compatibility and integration of standards**

- ISO 14001:1996 makes reference to ISO 9001:1994: overlaps and parallels with ISO 9001:1994 are set out in tabular form
- ISO 9000:2000 makes reference both to ISO 14001:1996 and to excellence models (EFQM-EQA/Europe, MBNQA/USA and Deming Prize/Japan).
- ISO 19011:2002-12 common guide for quality management and/or environmental management system audits replaces ISO 14010–14012:1996 and ISO 10011:1992.
- Technical Specification ISO/TS 16949:2002, "Quality management systems – Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organisations" replaces previous industry standards such as QS 9000 and VDA 6.1.

interpretation of the concept of quality is adopted. Thus the subject of safety takes on a more all-embracing character than that of quality in businesses such as railway companies where the product is not a physical object but a service, and one which is delivered by the use of complex technology whose technical components are subject to production-related quality management.

Essential elements of SMS as per Annex III of Safety Directive	Fundamentally similar requirements exist	
	in ISO 9001 (QMS)	in ISO 14001 (EMS)
a) Safety policy and code of principles	•	•
b) Aims	•	•
c) Procedures for compliance with legally required and other standards		•
d) Procedures for risk management		
e) Training programmes	•	•
f) Information flow within the organisation and between organisations which use the same infrastructure	•	•
g) Procedures and formats for documentation of safety information	•	•
h) Reporting systems for accidents, faults, near misses, etc.	•	•
i) Action, alarm and information plans in consultation with authorities		No consultation with authorities
j) Internal checks of the SMS	•	•

#### 4.5 Relationship between Safety Culture and Safety Management Systems

##### The concept of safety culture

Railways have always been special in terms of cohesion and the feeling of belonging; it is not by chance that the term "railwayman" has particular connotations; to work for the railways – not in a particular country but in any country – is something special. That is something that must once again be brought to the fore as part of a unique corporate and safety culture. Practical aspects are the prevention of the loss of expertise due to reductions in staff and greater staff turnover, increasing the willingness to take on responsibility and promoting the feeling of belonging. In the process, the safety culture and the SMS will each affect the other.

The concept of a safety culture, which is not mentioned at any point in the Safety Directive, is still relatively new. It was first defined by the IAEA in 1986 in the aftermath of the accident at the nuclear power station in Chernobyl. According to that definition, a safety culture is the entirety of the characteristics and attitudes of organisations and individuals which afford matters of safety the degree of attention commensurate with their outstanding importance. The aim of a safety culture is to improve safety through self-discipline to a level beyond that required by law. This must be instilled in inherent to the thoughts and actions of staff at all levels of the organisation.

A safety culture is the combination of values, standards and principles of acceptable behaviour. That refers to the individual social capabilities of all members of the corporation. They find expression in common modes of behaviour that are typical of a corporation. The safety culture is part of the company culture, which is of particular importance for a business such as a railway that operates a complex technical system in order to provide its services.

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**Important factors affecting the operational safety of airlines (*Vereinigung Cockpit e. V.*)**

- Deficiencies in the safety culture evident to all involved
- Conflicts between management and worker levels
- Poor morale
- Inadequate monitoring and inspection
- Turning a blind eye to rule-breaking as group norm
- Distorted perception of risks
- Perceived negligence and lack of vigilance on the part of management
- Low motivation and pride in work (lack of work ethic)
- "Macho" culture which encourages the taking of risks
- Naive belief that no negative consequences will result
- Low self-esteem
- Learned helplessness
- Perceived licence to break rules
- Contradictory or apparently pointless rules
- Age and gender: young men have a greater tendency to break rules

Safe operation means reliable technology and operational management. Factors which indicate a lack of safety culture can be observed as attendant features of many accident and near-miss situations. Insights from the airline industry would appear entirely transferable to other technically based services such railways.

The safety culture is always the present expression of the current common modes of behaviour, which is determined both by the attitudes of the active persons and the structure. The structural aspect of the safety culture encompasses the safety arrangements made by the company that are set down in the SMS. For shaping and guaranteeing safety in parallel with the processes which produce the service provided, the personal responsibility of the individual members of staff, in which the safety culture is also evident, is of particular importance. The guaranteeing of process safety is supported by the fact that they are defined in terms of sequence and responsibility and are regularly checked by means, for example, of process key figures, acknowledged transfers, double-checking principle, clearances and audits.

**SMS as structural aspect of safety culture**

The decisive factor, however, is that safety cannot be maintained simply by regulations and checks because it centres around human beings. That means that employees must fundamentally first be given the capability to identify and avoid unsafe situations. They must therefore have the possibility

- to identify non-compliance with specifications
- to take action and report events
- to have the certainty that those events will be looked into
- to take personal responsibility in order not to have to circumvent regulations
- to act autonomously in emergency situations.

- In addition the possibility for co-operation based on trust must exist, in other words those who act according to the points listed above must not suffer any disadvantages as a result.
- Any advantages of bypassing safety regulations must be eliminated.

The safety culture is called upon in particular when complex technical systems have to be controlled by human beings so that not only the reliability of the technology but also that of the human operators takes on major significance. When technical systems fail, human reliability is the decisive safety resource.

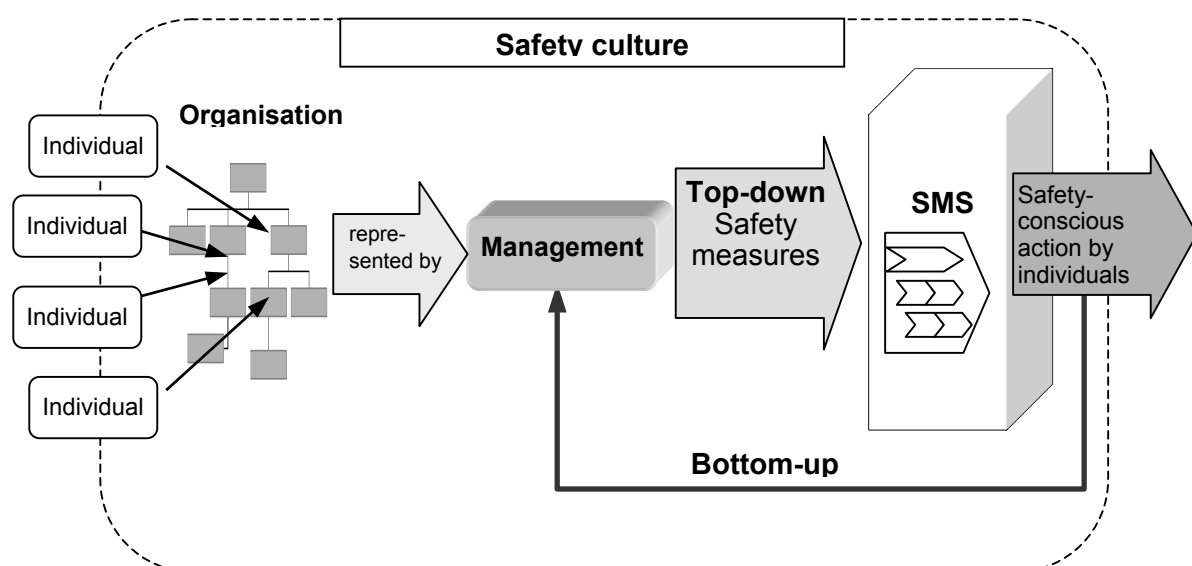
#### **SMS: organisational maintenance of reliability**

Human reliability is generally limited, even in the case of actions that are performed automatically on the basis of well-trained skills. It drops further, firstly if actions are based on the processing of rules, and even further if actions can only be based on human knowledge due to lack of experience; secondly, reliability diminishes if unfavourable circumstances such as unexpected events and situations mean that the same actions are performed under stress. The SMS represents an organisational means of maintaining and improving reliability which, by means of feedback from personnel who are the embodiment of the SMS, i.e. have to put it into practice, contributes to the development of the safety culture, which in turn has a positive effect on reliability.

The German Federal Constitutional Court characterises reliability as an indeterminate legal concept which has always been used in economy management legislation. It has to be redefined in practical terms for each new set of circumstances in order to constitute a measure for the best possible prevention of risk and aversion of danger. Thus the German Federal Administrative Court defines the practical meaning of reliability in relation to the operation of nuclear power stations, for example.

#### **Requirements placed on members of a corporation**

In addition to the safety-orientated performance requirements such as the identification of situations in which there is a greater danger, therefore, there are requirements placed on the individuals that make up an organisation. The tolerance or even acceptance of risky behaviour by the group and particularly by superiors, i.e. institutionally or socially tolerated willingness to take risks within an organisation, reduces the individual perception of risk and therefore increases the willingness of the individual and ultimately of the entire organisation to take risks. Perception of risk is further dulled if accidents rarely occur. And even after witnessing an acci-



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dent, safety-related changes in behaviour are only temporary among people not personally involved.

When introducing an SMS it is important to avoid creating just another dissociated management system among many others. It is equally important on the basis of experience of dealing with safety regulations not to merely create formal organisational elements that are of little effect or even deliberately subverted.

An important requirement for the SMS that arises immediately from the management system aspect but is equally important in connection with the safety culture is the existence of clearly defined responsibilities. Ambiguous allocation of decision-making authorities prevents the assumption of responsibility and reduces safety by promoting organisationally easier or more economically orientated but possibly less safety-orientated decisions.

**Practical definition of reliability for the purposes of nuclear energy legislation**

According to the definition of the German Federal Administrative Court in relation to the operation of nuclear power stations for the purposes of the German Atomic Energy Act, a person is unreliable if he/she reveals basic deficiencies or weaknesses

- as a holder of a position of responsibility or
- in the organisation of the business or
- in the initial and continuing training of the operative personnel

and those deficiencies constitute an increased level of risk. (Ipsen 1998)

#### **4.6 Economic Aspects of Safety Strategies**

Safety is an essential characteristic of the railway industry. Railway operation in accordance with the statutory requirements and the technical regulations is safe. The legal requirements generally include an obligation on the part of the railway companies to work towards an improvement of safety levels by the development and use of new technologies and techniques. In keeping with that legal practice, Article 4 of the Safety Directive requires the Member States to generally maintain the safety of railways and to continuously improve it *"where reasonably practicable"*.

##### **Continuous Improvement of Railway Safety where Reasonably Practicable**

This qualified statement requires interpretation to the extent that a decision has to be reached according to what is reasonably practicable rather than from a strictly financial viewpoint. Social demands and customer needs also play an important role. The Member States will fulfil this requirement at legislative level. In so doing, they must take account of developments in Community legislation and technical and scientific progress, while mainly giving priority to the prevention of serious accidents.

Since, however, railway safety cannot simply be controlled at government level but is essentially ensured at operational level, the obligation of continuous improvement is passed on to the railway companies by way of the SMS.

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**Excerpt from Article 4*****Development and improvement of railway safety***

- (1) *Member States shall ensure that railway safety is generally maintained and, where reasonably practicable, continuously improved, taking into consideration the development of Community legislation and technical and scientific progress and giving priority to the prevention of serious accidents.*

**Implementation by the Railway Companies**

**Safety measures** There are already regulations in place in most European countries which ensure that the railway industry is required to adapt to technological progress in order to increase safety levels. In future this will be supported by the requirement specified in the Safety Directive as part of the SMS that every company sets targets for maintaining and improving safety and demonstrates the existence of procedures and plans for achieving those targets.

The proposals for the measures can be developed on the basis of a wide variety of methods, such as accident analysis, for example, or surveys among safety co-ordinators. They will have to correspond with the company's own corporate targets and with the CSTs at government level. The number of measures that can actually be implemented within a particular period of time will, however, be limited as every company can only provide a certain budget for the implementation of safety strategies.

**Selection procedures**

From all the potentially realisable proposals, the company must therefore make a selection. In that process, the aspects of reasonable practicability cited above – economic viability, customer needs and social demands – are also determinants for the railway companies. In addition to the financial condition of an affordable safety level which does not threaten the existence of the company, social aspects, market needs and the benefits of image enhancement resulting from safety will thus be taken into account in selecting suitable measures. Beyond that there may be measures that are in the public interest, the financing of which is beyond the means of the company and which are paid for by the Member State concerned.

**4.7 Common Safety Targets**

Article 7 of the Safety Directive deals with the development, adoption and revision of the CSTs. They are intended to define the safety levels *"that must at least be reached by different parts of the railway system and by the system as a whole in each Member State"*. That demand is aimed directly at the Member States. But like the obligation to improve railway safety referred to in the previous section, the CSTs will also be passed on via the SMS to the railway companies and are reflected in the company-specific safety targets in Annex III 2 b).

**Introduction of the Common Safety Targets**

Introduction is to take place in two stages with the involvement of the ERA over the course of seven years after the Safety Directive comes into force. The first stage over a period of five years will initially involve only determining the status quo and defining targets to ensure that that safety level is maintained. The second set of targets will then be aimed at improving safety levels. However, such im-

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**Excerpt from Article 7**  
**Common Safety Targets**

- (3) *The first set of draft CSTs shall be based on an examination of existing targets and safety performance in the Member States and shall ensure that the current safety performance of the rail system is not reduced in any Member State. [...]*

*The second set of draft CSTs shall be based on the experiences gained from the first set of CSTs and their implementation. They shall reflect any priority areas where safety needs to be further improved. [...]*

*All proposals for draft and revised CSTs shall reflect the obligations on Member States laid down in Article 4 (1). Such proposals shall be accompanied by an assessment of the estimated costs and benefits, indicating their likely impact for all the operators and economic agents involved and their impact on the societal acceptance of risk. [...]*

provement must be seen in the context of the qualification "where reasonably practicable" as is expected of the Member States in Article 7 with reference to Article 4. An analysis of the ratio of cost to benefits also takes place at government level.

### **Designing the Targets**

The Safety Directive gives very little information about the content of the targets. What is certain is that they should define a safety level and must take the form of risk acceptability criteria, i.e. they must detail the risks that are considered acceptable for individuals or society. The questions as to whether they should be qualitative or quantitative targets or both and how the concept of social risks is to be understood remain unanswered.

In connection with the individual risks referred to in Article 7 (4) it makes sense to equate societal risks with the common term "collective risk". The interpretation also discussed of societal risks as general threats to the population by the railways is unacceptable. However, it is conceivable that, where there is interaction with other technologies (transport of chemicals, etc.), the failure of a system could possibly cause a disaster in extreme cases.

### **Societal risks**

Qualitative targets can be derived from the legislation. The railways are generally obliged to operate their businesses safely and to construct the railway infrastructure, the rolling stock and the equipment safely and maintain them in a safe condition for operation. Operation is safe if people and organisations act in accordance with laws, regulations and standards – taking account of the residual risk inherent in any technology. If rules advance, then the railways must adapt to them. In addition, however, in most countries there is an obligation to "anticipate", to proac-

### **Qualitative targets**

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**Excerpt from Article 7**  
**Common Safety Targets**

- (4) *The CSTs shall define the safety levels that must at least be reached by different parts of the railway system and by the system as a whole in each Member State, expressed in risk acceptance criteria for:*

- a) *individual risks relating to passengers, staff including the staff of contractors, level crossing users and others, [...],*
- b) *societal risks.*

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tively reduce the residual risk. In one form or another, the development and introduction of new techniques and technologies are part of improving safety in keeping with the legal requirements. From this it is possible to derive not only the aim of ensuring safe operation but also the more practical qualitative target of proactive measures for reducing risk.

### **Quantitative targets**

The probability of the present known residual risk, which remains even when all regulations are properly observed, is a socially recognised risk acceptability criterion. Otherwise the legislature would have to intervene. It can be described as a risk within the overall system but may also be subdivided among subsystems to any level of detail. By analysis of accident databases or other sources, the probabilities for such risks can be numerically quantified. Where it is a case of meeting the first qualitative target referred to above, those figures can be used as a guide. Adaptation to advances and the execution of proactive measures generally result in a new technology or operating procedure being used at subsystem level. If it can be compared with an old technology, then evidence of at least equal safety must generally be demonstrated so that the new one can be approved. The quantitative target is to equal or even improve on the known residual risk criterion of the comparable technology. If there is no comparable technology, then either the comparison must be made at a higher system level and the risks aggregated, or else risk acceptability criteria such as those described in EN 50126 are applied.

### **Deliberations on the Definition of the CSTs**

There are a number of ways in which the development of the targets is being approached, such as the work of the UIC safety platform in which the targets are to be initially derived at a high system level from statistical accident data, and the EU-project SamRail which has dealt extensively with the classification of risks for subsystems. The differences are to be found in the system limits and the degree to which the system is broken down. The proposals have yet to go through rigorous examination before the first draft CSTs are submitted by the ERA. When selecting targets, there is a risk of exposing the railway system as one of the safest modes of transport to a government-imposed industry-specific safety spiral. Instead, the targets and their associated indicators should be capable of being based on the safety levels of other modes of transport. If the risk acceptability criteria were defined as average levels at European level and regularly revised, then they must not continually spiral upwards with no upper limit, but should asymptotically approach a generally accepted level.

All deliberations on the definition of targets must be based on an analysis of the relationship between cost and benefits taking account of political and economic factors.

#### **General deliberations on the selection of CSTs**

- Qualitative and quantitative targets may only specify an improvement of the system subject to evaluation of the ratio of costs to benefits taking account of the economic, social and customer-related requirements.
- Quantitative targets must be comparable with those of other modes of transport so as to help avoid an industry-specific safety spiral.
- Quantitative targets must not be calculated in such a way that they can endlessly spiral upwards to ever higher and unaffordable levels of safety.

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## 4.8 Comparison with Other Modes of Transport

Those modes of transport which compete with parts of the railway system should be taken as comparisons. Those include air travel, inland waterways and road transport.

### Air Transport – Aircraft Operators

Operational safety in air travel is defined at international level by the Joint Aviation Requirements (JAR). Those regulations are published along with the technical requirements for aircraft licensing by the Joint Aviation Authorities (JAA). That body was established by the Member States of the European Community as supranational institution. Since its foundation, other countries have now joined the association.

**Institutions  
and legal basis**

The JAA does not act directly as a regulatory authority. Instead, there is an international agreement that all JAA regulations will be adopted in national law by the Member States. In 2004, the functions of the JAA will be passed to the European Air Safety Agency (EASA). The world governing body is the ICAO (International Civil Aviation Organisation), a global association of air carriers initiated as the umbrella organisation by the UN. The ICAO does not restrict itself to formulating specifications for aircraft operators, it also sets standards for the organisation of airports and air space which the member countries have committed themselves to in the Chicago Convention.

The European air transport legislation demands the appointment of an accountable safety manager in the implementation of the JAR. It also specifies that that person must occupy a position at senior management level within the structural organisation of the airline company. A number of very large airlines have diverged from that requirement without, however, restricting the function of the accountable safety manager in terms of his/her legally required internal and external functions.

**Safety  
management**

The law specifies two lines of action for the accountable safety manager: he/she has a duty to report directly to the regulatory authority, while that authority can issue him/her with direct instructions. Such instructions constitute administrative action under public-sector law. Thus the function of the accountable safety manager differs fundamentally from that of the railway chief traffic manager in Austrian or German Law and also from the position of safety co-ordinator at the SBB. As an additional power, the accountable safety manager also has the authority to issue direct instructions to all staff involved in safety-related activities. The air transport legislation of the JAA member countries also defines wider-ranging regulations on the structural organisation of safety management in airline operators. They demand that the accountable safety manager appoints four nominated post-holders for

- flight operations,
- crew training,
- ground operations and
- maintenance system.

The legislation also defines their areas of responsibility.

The very detailed specifications of the JAA for the structure and procedures of an SMS, which have been incorporated in the national air transport legislation, do not themselves define any measurable safety targets. Nor do they demand the setting of

**Safety targets**

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such targets by those involved. Instead, the observance of safety-related procedures and methods is demanded to a high level of regulatory detail.

### **Air Transport – Infrastructure (Air Space and Airports)**

#### **Institutions and legal basis**

The control of air space has been privatised. The regulation of the private companies performing that function is carried out by the highest national transport authorities in accordance with the national air transport laws. In terms of content, the work of air traffic control is based on the standards set by EuroControl, an international body which defines the safety requirements (European Safety Regulation Requirements). Those requirements are to a large extent based on those of the ICAO. The duties of air traffic control are also governed by ICAO specifications implemented in national air transport legislation.

The grounds of civil aviation airports are governed by two different regulatory and licensing authorities of the national governments. The runways and main taxiways are subject to licensing and regulation by the highest national transport authorities, while licensing and regulation of the minor taxiways and aprons including refuelling and boarding areas, etc., is delegated to subordinate authorities. The duties of the airport operators are defined by the national air transport legislation and the air transport licensing regulations.

#### **Safety management**

A SMS is specified for both. Air traffic control in all European countries benefits from established safety management systems, the design of which is governed by very precise legal requirements specified by the air transport legislation, which for its part implements the ICAO requirements. The function of a safety manager is not specified for air traffic control.

For airports, an SMS is demanded by an appendix to the ICAO regulations. For operation of the airports, the licensing authority can order the appointment of "qualified persons for managing the traffic and operating the airport" under the powers conferred by the air transport regulations. The authority must confirm the appointment of the qualified person (who may be referred to as chief traffic manager, for example), though that person does not as a result – in contrast with the flight director on landing strips – attain a position of sovereign authority; instead he/she is restricted to the exercise of internal powers in respect of airport users on behalf of the airport operator under civil law. Sovereign powers are only invested in the function of "co-ordinator of air traffic control" under national air transport legislation. Only that position attains the level of air traffic control. It is a function which safeguards proper management of traffic and operation based on public-sector law on the taxiways and aprons. Air traffic control does the same in the air space including landing and take-off areas and on the runways and main taxiways.

#### **Safety targets**

Legal requirements for the setting of safety targets exist neither for the airport operators nor for air traffic control. Neither the JAA regulations nor those of the ICAO require safety targets.

### **Inland Waterways**

#### **Institutions and legal basis**

The territorial responsibilities of the regulatory and licensing authorities for inland waterways are not structured according to the boundaries of national territories. They are primarily arranged according to the course of navigable rivers and man-made waterways.

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National legislation for inland waterway transport governs the maintenance of safety and ease of waterway transport. That relates to the clearance from obstacles in the water, the marking of shipping lanes by buoys, floats or signs, or the licensing of special events or construction work on the banks. Because of the fact that river transport crosses national boundaries, there are special implementing regulations for the Moselle, Danube and Rhine rivers (e.g. Rhine Shipping Police Regulations) that constitute legal standards for all countries through which they pass. In order to implement the regulations, international bodies have been created such as the *Zentralkommission für Rheinschifffahrt* in Strasbourg which has authority for the entire length of the river Rhine.

The licensing of river craft is dependent on their size. Whereas leisure boats are licensed by the waterway and shipping offices, the authorities have established ship inspection commissions for the licensing of large inland-waterway vessels.

Neither for the inland waterway system nor for the waterway owners and their regulatory authorities, nor for the water craft operators, are there any safety targets or requirements for a SMS. A water craft operator is required only to act according to the law. That means laws, implementing regulations, general decrees and licensing requirements including ancillary specifications (time limits, restrictions, conditions).

**Neither safety management nor targets**

## **Road Transport**

Roads are owned by regional/local authorities that also act as the bodies responsible for road construction. The roads are designated for public use according to the standards of national road traffic legislation.

**Institutions and legal basis**

Motor-traffic use of the public roads is subject to compliance with specific conditions imposed by the general legislation that the vehicle and driver must meet (driver and vehicle licensing). Safety is supposed to be ensured by legal requirements on the parties involved. In order to be licensed, vehicles must meet various design specifications and definite approval requirements arising from the licensing laws. The design of the road space is also subject to standards, legal provisions and implementing regulations by which those responsible for road building are bound when developing and maintaining the roads. Apart from the driving-licence requirements, drivers are also subject to numerous restrictions on driving behaviour arising from the road traffic legislation and - the general decrees of the public order authorities by whom they are enforced.

Due to the lack of overall organisation for road traffic, a SMS is not generally demanded and, accordingly, there are no safety targets arising from such a system.

**Neither safety management nor targets**

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## 5 Excerpts from the Safety Directive

### Article 1

#### Purpose

The purpose of this Directive is to ensure the development and improvement of safety on the Community's railways and improved access to the market for rail transport services by:

- a) harmonising the regulatory structure in the Member States;
- b) defining responsibilities between the actors;
- c) developing common safety targets and common safety methods with a view to greater harmonisation of national rules;
- d) requiring the establishment, in every Member State, of a safety authority and an accident and incident investigating body;
- e) defining common principles for the management, regulation and supervision of railway safety.

### Article 4

#### Development and improvement of railway safety

(1) Member States shall ensure that railway safety is generally maintained and, where reasonably practicable, continuously improved, taking into consideration the development of Community legislation and technical and scientific progress and giving priority to the prevention of serious accidents.

Member States shall ensure that safety rules are laid down, applied and enforced in an open and non-discriminatory manner, fostering the development of a single European rail transport system.

(2) Member States shall ensure that measures to develop and improve railway safety take account of the need for a system-based approach.

(3) Member States shall ensure that the responsibility for the safe operation of the railway system and the control of risks associated with it is laid upon the infrastructure managers and railway undertakings, obliging them to implement necessary risk control measures, where appropriate in cooperation with each other, to apply national safety rules and standards, and to establish safety management systems in accordance with this Directive.

Without prejudice to civil liability in accordance with the legal requirements of the Member States, each infrastructure manager and railway undertaking shall be made responsible for its part of the system and its safe operation, including supply of material and contracting of services, vis-à-vis users, customers, the workers concerned and third parties.

(4) This shall be without prejudice to the responsibility of each manufacturer, maintenance supplier, wagon keeper, service provider and procurement entity to ensure that rolling stock, installations, accessories and equipment and services supplied by them comply with the requirements and the conditions for use specified, so that they can be safely put into operation by the railway undertaking and/or infrastructure manager.

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## Article 7

### Common Safety Targets

- (1) The CSTs shall be developed, adopted and revised following the procedures laid down in this Article.
- (2) Draft CSTs and draft revised CSTs shall be drawn up by the Agency under mandates which shall be adopted in accordance with the procedure referred to in Article 27(2).
- (3) The first set of draft CSTs shall be based on an examination of existing targets and safety performance in the Member States and shall ensure that the current safety performance of the rail system is not reduced in any Member State. They shall be adopted by the Commission five years after this Directive comes into force in accordance with the procedure referred to in Article 27(2), and shall be published in the Official Journal of the European Union.

The second set of draft CSTs shall be based on the experiences gained from the first set of CSTs and their implementation. They shall reflect any priority areas where safety needs to be further improved. They shall be adopted by the Commission five years after this Directive comes into force in accordance with the procedure referred to in Article 27(2), and shall be published in the Official Journal of the European Union.

All proposals for draft and revised CSTs shall reflect the obligations on Member States laid down in Article 4 (1). Such proposals shall be accompanied by an assessment of the estimated costs and benefits, indicating their likely impact for all the operators and economic agents involved and their impact on the societal acceptance of risk. They shall contain a timetable for gradual implementation, where necessary, in particular to take account of the nature and extent of investment required to apply them. They shall analyse the possible impact on TSI for the subsystems and contain, where appropriate, consequential proposals for amendments to the TSI.

- (4) The CSTs shall define the safety levels that must at least be reached by different parts of the railway system and by the system as a whole in each Member State, expressed in risk acceptance criteria for:
  - a) individual risks relating to passengers, staff including the staff of contractors, level crossing users and others, and, without prejudice to existing national and international liability rules, individual risks relating to unauthorised persons on railway premises;
  - b) societal risks.
- (5) The CSTs shall be revised at regular intervals, in accordance with the procedure referred to in Article 27(2), taking into account the global development of railway safety.
- (6) Member States shall make any necessary amendments to their national safety rules in order to achieve at least the CSTs, and any revised CSTs, in accordance with the implementation timetables attached to them. They shall notify these rules to the Commission in accordance with Article 8(3).

## Article 9

### Safety Management Systems

- (1) Infrastructure managers and railway undertakings shall establish their safety management systems to ensure that the railway system can achieve at least the CSTs, is in conformity with the national safety rules described in Article 8 and Annex II and with safety requirements laid down in the TSIs, and that the relevant parts of CSMs are applied.

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(2) The safety management system shall meet the requirements and contain the elements laid down in Annex III, adapted to the character, extent and other conditions of the activity pursued. It shall ensure the control of all risks associated with the activity of the infrastructure manager or railway undertaking, including the supply of maintenance and material and the use of contractors. Without prejudice to existing national and international liability rules, the safety management system shall also take into account, where appropriate and reasonable, the risks arising as a result of activities by other parties.

(3) The safety management system of any infrastructure manager shall take into account the effects of operations by different railway undertakings on the network and make provisions to allow all railway undertakings to operate in accordance with TSIs and national safety rules and with conditions laid down in their safety certificate. It shall furthermore be developed with the aim of co-ordinating the emergency procedures of the infrastructure manager with all railway undertakings that operate on its infrastructure.

(4) Each year all infrastructure managers and railway undertakings shall submit to the safety authority before 30 June an annual safety report concerning the preceding calendar year. The safety report shall contain:

- a) information on how the organisation's corporate safety targets are met and the results of safety plans;
- b) the development of national safety indicators, and of the CSIs laid down in Annex I, as far as it is relevant to the reporting organisation;
- c) the results of internal safety auditing;
- d) observations on deficiencies and malfunctions of railway operations and infrastructure management that might be relevant for the safety authority.

## Article 10

### Safety Certificates

(1) In order to be granted access to the railway infrastructure, a railway undertaking must hold a safety certificate as provided for in this Chapter. The safety certificate may cover the whole railway network of a Member State or only a defined part thereof.

The purpose of the safety certificate is to provide evidence that the railway undertaking has established its safety management system and can meet requirements laid down in TSIs and other relevant Community legislation and in national safety rules in order to control risks and operate safely on the network.

(2) The safety certificate shall comprise:

- a) certification confirming acceptance of the railway undertaking's safety management system as described in Article 9 and Annex III, and
- b) certification confirming acceptance of the provisions adopted by the railway undertaking to meet specific requirements necessary for the safe operation of the relevant network. The requirements may include application of TSIs and national safety rules, acceptance of staff's certificates and authorisation to place in service the rolling stock used by the railway undertaking. The certification shall be based on documentation submitted by the railway undertaking as described in Annex IV.

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(3) The safety authority in the Member State where the railway undertaking first establishes its operation shall grant the certification in accordance with paragraph 2.

The certification granted in accordance with paragraph 2 must specify the type and extent of the railway operations covered. The certification granted in accordance with paragraph 2(a) shall be valid throughout the Community for equivalent rail transport operations.

(4) The safety authority in the Member State in which the railway undertaking is planning to operate additional rail transport services shall grant the additional national certification necessary in accordance with paragraph 2(b).

(5) The safety certificate shall be renewed upon application by the railway undertaking at intervals not exceeding five years. It shall be wholly or partly updated whenever the type or extent of the operation is substantially altered.

The holder of the safety certificate shall without delay inform the competent safety authority of all major changes in the conditions of the relevant part of the safety certificate. It shall furthermore notify the competent safety authority whenever new categories of staff or new types of rolling stock are introduced.

The safety authority may require that the relevant part of the safety certificate be revised following substantial changes in the safety regulatory framework.

If the safety authority finds that the holder of the safety certificate no longer satisfies the conditions for a certification which it has issued, it shall revoke part (a) and/or (b) of the certificate, giving reasons for its decision. The safety authority that has revoked an additional national certification granted in accordance with paragraph 4 shall promptly inform the safety authority that granted the certification under paragraph 2(a) of its decision.

Similarly, a safety authority must revoke a safety certificate if it is apparent that the holder of the safety certificate has not used it as intended in the year following its issue.

(6) The safety authority shall inform the Agency within one month of the safety certificates referred to in paragraph 2(a) that have been issued, renewed, amended or revoked. It shall state the name and address of the railway undertaking, the issue date, scope and validity of the safety certificate and, in case of revocation, the reasons for its decision.

(7) Within five years of this Directive coming into force the Agency shall evaluate the development of safety certification and submit a report to the Commission with recommendations on a strategy for migration towards a single Community safety certificate. The Commission shall take appropriate action following the recommendation.

## Article 11

### Safety authorisation of infrastructure managers

(1) In order to be allowed to manage and operate a rail infrastructure the infrastructure manager must obtain a safety authorisation from the safety authority in the Member State where he is established.

The safety authorisation shall comprise:

- a) authorisation confirming acceptance of the infrastructure manager's safety management system as described in Article 9 and Annex III, and

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- b) authorisation confirming acceptance of the provisions of the infrastructure manager to meet specific requirements necessary for the safe design, maintenance and operation of the railway infrastructure including, where appropriate, the maintenance and operation of the traffic control and signalling system.

(2) The safety authorisation shall be renewed upon application by the infrastructure manager at intervals not exceeding five years. It shall be wholly or partly updated whenever substantial changes are made to the infrastructure, signalling or energy supply or to the principles of its operation and maintenance. The holder of the safety authorisation shall without delay inform the safety authority of all such changes.

The safety authority may require that the safety authorisation be revised following substantial changes to the safety regulatory framework.

If the safety authority finds that an authorised infrastructure manager no longer satisfies the conditions for a safety authorisation it shall revoke the authorisation, giving reasons for its decisions.

(3) The safety authority shall inform the Agency within one month of the safety authorisations that have been issued, renewed, amended or revoked. It shall state the name and address of the infrastructure manager, the issue date, the scope and validity of the safety authorisation and, in case of revocation, the reasons for its decision.

### Annex III

#### Safety Management Systems

##### 1. Requirements on the Safety Management System

The safety management system must be documented in all relevant parts and shall in particular describe the distribution of responsibilities within the organisation of the infrastructure manager or the railway undertaking. It shall show how control by the management on different levels is secured, how staff and their representatives on all levels are involved and how continuous improvement of the safety management system is ensured.

##### 2. Basic elements of the safety management system

The basic elements of the safety management system are:

- a) a safety policy approved by the organisation's chief executive and communicated to all staff;
- b) qualitative and quantitative targets of the organisation for the maintenance and enhancement of safety, and plans and procedures for reaching these targets;
- c) procedures to meet existing, new and altered technical and operational standards or other prescriptive conditions as laid down
  - in TSIs, or
  - in national safety rules referred to in Article 8 and Annex II, or
  - in other relevant rules, or
  - in authority decisions,

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and procedures to assure compliance with the standards and other prescriptive conditions throughout the life-cycle of equipment and operations;

- d) procedures and methods for carrying out risk evaluation and implementing risk control measures whenever a change of the operating conditions or new material imposes new risks on the infrastructure or on operations;
- e) provision of programmes for training of staff and systems to ensure that the staff's competence is maintained and tasks carried out accordingly;
- f) arrangements for the provision of sufficient information within the organisation and, where appropriate, between organisations operating on the same infrastructure;
- g) procedures and formats for how safety information is to be documented and designation of procedures for configuration control of vital safety information;
- h) procedures to ensure that accidents, incidents, near misses and other dangerous occurrences are reported, investigated and analysed and that necessary preventive measures are taken;
- i) provision of plans for action and alerts and information in case of emergency, agreed upon with the appropriate public authorities;
- j) provisions for recurrent internal auditing of the safety management system.

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## Appendix Example of a Safety Management Manual

### **Safety Management Manual**

This safety management manual documents a safety management system that was developed and put into practice by a European railway company according to the incremental introduction method as outlined in Section 3.2 before the EU Safety Directive 2004/94/EC of 29/04/2004 came into force.

### **Notional Railway Com- pany RWC**

Although the real safety management system already meets many requirements of the EU, it has been extended for the purposes of this paper for a notional railway company, RWC, in order to serve as a source of ideas for other railway companies. That railway company might take the form of a holding company with an IM and several RUs for passenger and goods transport. Nevertheless, this safety management manual can, of course, also be used by companies that consist solely of an IM or RU or have yet other structures.

### **Maintenance and updating**

As with other management manuals such as the quality management manual, this safety management manual should be produced alongside the introduction process and subsequently constantly and regularly updated and maintained.

