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Research

Safety Management in Non-Nuclear Contexts

Examples from Swedish Railway Regulatory and Company Perspectives

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SKI

SKI PERSPECTIVE

Background

SKI has launched a three-year research project on safety management. In a pre-study to this phase of the project the authors introduced a system perspective on safety management. In the following study they established a frame of reference for studies of safety management that broadened the definitions of safety management and system theory and examples from regulatory organizations in the oil and aviation industry were used together with en earlier study of a car manufacturer. was also added to this research project.

Purpose

This report is the result of the next phase in the three-year project on safety management. The overall purpose of the on-going study has been to find a general framework for modelling safety management by establishing a frame of reference and analyzing safety management from a non-nuclear point of view with potential relevance for nuclear safety.

The purpose of this study was to conduct a complete analysis of a system consisting of both the regulator and the licensee and involved the Swedish railway safety management using the perspective outlined in the earlier studies. Both the regulator and a railway company were part of the empirical work. Three perspectives of safety management were applied: the structure of the organization, internal and external threats to the organizations and to the market, and information feedback systems.

Results

The authors describe important features of safety management and the results are modelled according to the systems perspective developed. These are definitions of safety management, the structure of the organizations, organizational change, regulatory and operational activities, safety strategy, threats to safety, information management and feedback, incident and accident reporting, and measurement of safety. The results tentative themes derived from the railway industry could be used in a systems approach to safety management in the nuclear context. However, the knowledge-transfer between different areas will still need more development.

Continued work

The next two studies will continue and conclude the overall safety management project. The studies will now involve the nuclear context, focusing on an organizational study, and a study of licensee event reports.

Effects on the SKI regulative work

The results give emphasis to the importance of the field. The frame of reference for safety management described in the report is one that can, when fully developed, have the potential

to be a support for SKI when choosing strategies to enhance the regulatory work on safety management.

Project information

SKI project coordinator: Lars Axelsson
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Safety Management in Non-Nuclear Contexts

Examples from Swedish Railway Regulatory and Company Perspectives

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Summary

Nuclear power operations demand safe procedures. In the context of this report, safety management is considered as a key instrument to achieve safety in technology, organization and operations. Outside the area of nuclear operations there exist a number of other technological areas that also demand safe operations. From the perspective of knowledge management, there exists an enormous pool of safety experiences that may be possible to shear or reformulate from one context to another. From this point of view, it seems highly relevant to make efforts to utilize, and try to understand how safety in general is managed in other contexts. There is much to gain from such an approach, not at least from economical, societal, and systems points of views. Because of the vast diversity between technological areas and their operations, a common framework that allow elaboration with common concepts for understanding, must be generated.

In preceding studies a number of steps have been taken towards finding such a general framework for modeling safety management. In an initial step a system theoretical framework was outlined. In subsequent steps central concepts from this framework has been applied and evaluated in relation to a number of non-nuclear organizations. The present report brings this intention one step further, and for the first time, a complete analysis of a system consisting of both the regulator and the licensee was carried out, in the above respects. This report focused the Swedish railway system, and the organizations studied were the Swedish Rail Agency (SRA) and SJ. The data used for this report consisted of various documents about the organizations, and interview data.

This report is basically structured around three, more or less, independent studies that are presented in separate chapters. They are: the system theoretical framework that in the following chapters is applied to the two organizations, and one chapter each for the studied organizations respectively. These three chapters give a detailed account of safety management from a system perspective and applications in the organizations studied, and could be read independently of each other. In the fourth chapter the report concludes with summarizing safety management in SRA and SJ by mapping the results on important concepts from the system theoretical framework, and general themes for safety management applicable across contexts are suggested.

The qualitative descriptions of the organizations generated a detailed account on how safety is managed in Swedish railway operations. Examples of safety management in practice are given both from the regulatory point of view and from an organizational position close to the actual operations. The Swedish railway operations are strictly regulated and the safety goals are identifiable along the legislative documentation from the government's goals for safe operations expressed in the railway legislation, through SRA's regulations, to SJ's internal regulations. There is a high degree of coherence between SJ's and SRA's formulations of safety management and safe operations in general. Both organizations have their origin in the former national railway company, which may is partly reflected in the high degree of correspondence between the approaches towards safety. Both organizations make use of a system approach to their operations, which are clearly reflected in the highly structured organizations, with core objectives, operational responsibilities, procedures, and information feedback prerequisites sufficiently mapped on the organizational units.

The report gives both detailed accounts and summaries of a number of central themes for safety management derived from the system theoretical framework, and also themes relevant for safety management in general. For example: the organizations definitions of safety management, descriptions of the organizational structures, recent processes of organizational change, the regulatory and operational activities, safety objectives, threats to safety, and information management and feedback regarding both internal and external system feedback. The event reporting systems and how the organizations measure of safety was also reported and modeled according to the general framework.

A number of tentative themes derived from the railway context that may be considered in a systems approach to safety management in nuclear (and other contexts) were suggested. However, the principles for knowledge-transfer between different areas are still under development, and will be concretized further in future contributions to this research area. Such general areas included, for example, facilitation of safety management in the interaction between authorities and companies, subsidiaries and temporary organizational units' contribution to the safety system, and clarification of criteria for event reporting in order to protect external feedback information to authorities.

A number of suggestions for future research were outlined. First, two planned studies that partly constitute a continuation and a conclusion of the safety management project were presented. These studies involve the application of system safety management on the nuclear context, and include one organizational study, and one LER report study. Further, a number of interesting themes for further investigations, derived from the results, were presented.

Sammanfattning

Det står klart för alla att kärnkraftsverksamheter kräver ett säkert handhavande. Denna rapport tar sin utgångspunkt i antagandet att säkerhetshantering är ett nyckelbegrepp för att uppnå säkerhet avseende olika teknologier, organisationer, och verksamheter. Utanför kärnkraftsområdet existerar ett antal andra teknologiska verksamhetsområden som också kräver säkert handhavande av sina verksamheter. Från ett kunskaps-hanterings perspektiv så kan man säga att det existerar ett enormt upplag av säkerhetsrelaterade erfarenheter som borde vara möjliga att dela eller omformulera från en kontext till en annan. Från denna utgångspunkt står det ganska klart att det borde vara högst relevant att försöka skapa sig en förståelse för samt försöka tillvarata kunskapen om hur säkerhet hanteras i andra kontext utanför kärnkraften. Det finns mycket att vinna med ett sådant närmande, inte minst från ett ekonomiskt, samhälleligt, eller ett system perspektiv. Då skillnaderna är mycket stora mellan olika teknologiska områden och deras verksamheter är det nödvändigt att försöka skapa ett gemensamt ramverk för förståelse, där olika teknologier kan modelleras med samma begrepp.

I föregående studier har man tagit ett antal steg mot att försöka finna ett sådant generellt ramverk för säkerhetshantering. Initialt, har huvuddragen för ett systemteoretiskt ramverk att användas för beskrivningar av säkerhetshantering beskrivits. I nästa steg har centrala begrepp från denna systemteori tillämpats och utvärderats på ett antal icke-nukleära organisationer. Föreliggande rapport drar detta ett steg längre, och för första gången kunde en analys av ett komplett system, bestående av både en kontrollmyndighet och en licensinnehavare utföras i samklang med det generella

ramverket. I denna rapport fokuserades det Svenska järnvägssystemet och de studerade organisationerna var Järnvägsstyrelsen och SJ. Underlaget till rapporten bestod av olika dokument som beskriver organisationerna samt intervjudata.

Rapporten är huvudsakligen strukturerad kring tre, mer eller mindre, oberoende studier. Dessa presenteras i tre separata kapitel. Kapitlen utgörs av: det systemteoretiska ramverket som i de påföljande kapitlen appliceras på de två organisationerna, samt, två separata kapitel för de två organisationerna. I dessa tre kapitel presenteras en detaljerad redogörelse för säkerhetshantering från ett systemperspektiv samt tillämpningar i de studerade organisationerna. Kapitlen kan läsas oberoende av varandra. I det fjärde kapitlet sammanfattas resultaten avseende säkerhetshanteringen i Järnvägstyrelsen och SJ genom att sammanföra resultaten till viktiga systemteoretiska begrepp härledda från ramverket. Förslag på generella teman för säkerhetshanteringen applicerbara mellan olika kontext ges därvid.

De kvalitativa beskrivningarna av organisationerna genererade en detaljerad redogörelse av hur säkerheten hanteras i Svenska järnvägsverksamheter. Exempel på säkerhetshantering i praktiken presenteras både från ett myndighetsperspektiv och från en organisationsnivå i nära anslutning till de praktiska verksamheterna. De Svenska järnvägsverksamheterna är strikt reglerade och säkerhetsmålen är identifierbara i dokumentationen alltifrån regeringens mål för järnvägssäkerheten uttryckt i järnvägslagen, genom Järnvägsstyrelsens regelverk, till SJ's interna regelverk. Det finns en hög rad av koherens mellan SJ's och Järnvägsstyrelsens formuleringar av säkerhetshantering och verksamhetssäkerhet generellt. Båda organisationerna har sitt ursprung i det tidigare statliga järnvägsbolaget "Statens Järnvägar" och detta märks delvis i den höga graden av överensstämmelse mellan hur de båda bolagen ser på säkerhet. Båda organisationerna använder sig av ett systemanpassat angreppsätt till sin verksamhet, vilket tydliggörs av de väl strukturerade organisationerna, med centrala målsättningar, verksamhetsansvar, procedurer och förutsättningar för informations-återkoppling tydligt anpassade till de olika organisatoriska undernivåerna..

I rapporten ges både en detaljerad redogörelse för, samt en sammanfattning av, ett antal centrala teman för säkerhetshantering härledda från det systemteoretiska ramverket, och ett antal andra teman relevanta för säkerhetshantering i allmänhet. Till exempel: organisationernas definitioner av säkerhetshantering, beskrivningar av organisationernas strukturer, aktuell organisationsomvandling, myndighets och operationella aktiviteter, säkerhetsmålsättningar, hot mot säkerheten, samt informationshantering och återkoppling avseende både intern och extern systemåterkoppling. Händelserapporteringssystemet och hur organisationerna mäter säkerheten appliceras också på det generella ramverket.

Ett antal tentativa teman härledda ur järnvägskontexten som kan vara förnuftiga att begrunda i samband med en systemansats till säkerhetshantering i kärnkrafts (och andra) kontext föreslogs. Men, principerna för kunskapsöverföring mellan olika områden är än så länge under utveckling och kommer att konkretiseras vidare i kommande bidrag till detta forskningsområde. Sådana områden inkluderar, till exempel, att underlätta för säkerhetshanterigen vid samverkan mellan myndigheter och bolag, hur underleverantörer och tillfälliga organisatoriska enheter bidrar till säkerhetssystemet, samt tydliggörandet av kriterier för händelserapportering i syfte att skydda den externa informationsåterkopplingen till myndigheten.

Riktlinjer för antal framtida studier föreslogs. Först, presenterades två planerade studier som delvis utgör en fortsättning av säkerhetshanteringsprojektet. Studierna omfattar en tillämpning av system-säkerhetshantering på en kärnkraftskontext. Dessa studier omfattar en organisatorisk studie och en händelserapporteringsstudie. Vidare presenterades ett antal intressanta teman för framtida studier härledda från resultaten.

CONTENTS

1. Introduction

This study takes its starting point in Svenson, Salo (2001), and Svenson, Salo, and Allwin (2005) studies in which a theoretical framework for studying safety management in non-nuclear contexts with relevance for the nuclear power sector is provided. The framework, which is based on system theoretical considerations will also be used in here, and applied on two case studies from the railway sector. The first case study describes safety management from the authority perspective - Swedish Rail Agency. The other case study describes safety management from the company perspective – SJ AB. The theoretical introduction and the two case studies are presented in separate chapters.

There are several arguments why it is important to study safety management in different technologies. It is quite recently that results from such projects have appeared in press. One argument is that, there has been lacking knowledge about how the different national agencies supervise safety in their respective fields. In the SKI report "How agencies inspect" by Lindblom et al. (2003), eight Swedish regulators were reviewed. The study revealed several interesting themes, for example differences between the agencies definitions of supervison, the role of inspection, and inspection styles.
Also the report series from the Nordic organization for cooperation about nuclear power safety - NKS has published studies oriented outside the own technological area. "Safety- and risk analysis activities in other areas then the nuclear industry" by Kozine, Duijm and Lauridsen (2000) is such an example. The report focused the legislative aspects of industries posing major risks to the environment and population. The report also gave good examples on how existing documents can be utilized in analysis of safety.

Another argument is that, although we may get more educated about how safety is managed in other technologies, there are few existing means for transferring this knowledge from some other technological area to the own technological area and to make use of it. One will encounter many difficulties when trying to translate good ideas generated in one technology and transfer them to another. In order to achieve this it is necessary to make use of a general framework, where experiences from various technologies can be modelled. In Svenson, Salo, and Allwin (2005), a system theoretical framework partly based on a living system theory by James Grier Miller (1978) was presented and applied in different technologies. The study presented examples from aviation, petroleum, and car production, about how descriptions of safety management in different contexts model can be modeled in a general systems framework. The results from that study will be discussed futher below.

Except the difficulties arising when transfering safety management (or any other concept) from one context to an other, one will soon realize that what is understood as safety management from one point of view is not necessarily the definition used elsewhere. Salo and Svenson (2001) used the general definition: "safety management is a process in which a producer, societal representatives and the public interact in finding a balance between the benefits, costs and risk of a product, an activity or process".

For example, it is beneficial for the society that it is provided with energy. There is a cost both for producing energy and maintaining a sufficient level of safety for the energy production. Here, it is necessary to balance the societys need of energy, with the

costs of production and the costs of maintaining sufficient safety. In a stable state the system is able to safely produce energy to an acceptable cost. The parameters of cost and safety is agreed upon and usually stated in law. If we do not maitain the safety parameter with investments, maintenance, training or what ever is needed, the parameter may change. An inbalance is created between the system parameters and the system starts drifting away from the desired equilibrium. Normally, we have prepared our systems with both control processes that will steer up the drifting parameter or with backup if the safety of a subsytem suddenly deteriorates beyond recovery. The system approach can be applied on all levels of a system. On a societal level politics is a means of controlling the parameters of energy production. On the component level a thermostate may do the job. Both operate with the same goal: maintaining a desired balance between system parameters so that the system can produce safe energy to an acceptable cost. The goal should be to find a balance, which is the best for most of the people in the society and at least acceptable for everybody. Safety management is executed as subprocesses at all levels of an organization (Svenson et. al., 2005). In this report we will revistit the systems theoretical considerations and model safety managemnent in Swedish Railway operations according to important themes of the framework.

This study focuses on Railway safety management from both an authority and a company perspective. The cooperation in the EU put demands on harmonization between member states concerning markets and legislation. In the railway area this process has been going on for a while and the successive demands from the European Commission on the harmonization of national railway systems have been published in separate so called “railway packages”. In April 2004 the European Commission published the Second Railway Package. The package contains three areas of legislation with implications for railway interoperability and safety management, which member states have to incorporate into domestic legislation within two year. The areas are: *interoperability*, *railway safety*, and *European rail agency regulations* (EU, 2004). The EU harmonization has many implications for the Swedish railways, and much have already been done in order to adjust market, legislation, and technical systems. For example the deregualtion of the former national Swedish Railway Company – SJ, the creation of a new railway authority, and the making of a new railway act.

From this scenario a system approach to safety management for several reasons become obvious and relevant. It is an area of change that expands the implications for the system from a national- to a Trans European level. From this level of analysis, the supra system can be described as consisting of subsystems on the national system level. Perhaps this is the right level of analysis for an EU politician, legislator, or technical expert, making up the big plan for European harmonization. On a national level the supra system is best described as all railway operations and activities in a certain country. Perhaps this level of analysis apply to Swedish politicians, legislators, or technical experts, companies, authorities etc. who make efforts in getting the national railway system adapted to European demands in areas of the market, legislation, and safety management. This is a big wind of change that is blowing across the national and European railways and it will certainly have implications on the area for a long time on.

From a nuclear power perspective we have still not seen (if ever) demands on international harmonization as with the European railway. There has, on the other hand, been a long and genuine cooperation on an international level about various nuclear issues in various fora (i.e., IAEA EURATOM, ESA, etc.). One may say that the areas

differ in great respect in their inherent characteriatics. One may also find it ridiculous to think about opening up the national nuclear energy markets for foreign actors to the full extent, as might be a consequence following the processes that take place in the railway area. But, in some areas of nuclear activities such a market has already been introduced. There are indications of an expansion of the international contractor market in the future, and it is from such a scenario that the topics discussed here become very important for nuclear power production. This raises questions such as: *the need of*, and *means of harmonizing the licensing system for European/intenational contractors*, *the supervision of contracor companies*, *and the distribution of responibilities in case of third-party contractors*, in order to secure that a sufficient level of safety is maintained, from one job or one firm to another, just to mention a few. Means of coordinating safety management between countries may, in this example, include not only the procedures for licensing, or insurances, but also demands on documentation of training and obligatory keeping of log-books on work history signed by the plants the contractor company has been working for. But that is another story.

From the perspective of the current study the areas of railway and nuclear safety (and many other risk technologies) have many issues in common, and it is highly beneficial for both areas to learn from each other's safety management. For this we need a common framework. Such a framework will be scrutinized below.

1.1 A system theoretical framework for safety management

1.1.1 Basic components of the system

Svenon and Salo (2004), and Svenon, Salo, and Allwin (2005) presented a theoretical framework in which different technological and organizational contexts can be modelled and compared. In this chapter we are going to revisit important parts of the systemtheoretic framework. In chapter 2 and 3, important themes from the framework, such as descriptions of the organizational structure, feedback processes, and threat detection will be used as background to the analyses.

Ludwig von Bertalanffy (1973, p. 124) noted that, *"modern science is characterized by its ever-increasing specialization, necessitated by the enormous amount of data, the complexity of techniques and of theoretical structures within every field. This, however has led to a breakdown of science as an integrated realm: The physicist, the biologist, the psychologist and the social scientist are, so to speak, encapsulated in a private universe, and it is difficult to get word from one cocoon to the other."* This statement summarizes von Bertalanffy's opinion of certain limitations of science in coping with complex systems. Von Bertalanffy came to a notion of a general system theory as an elucidation of handling systems (Ruben and Kim, 1975), though science is presumably still facing the 'cocoon' phenomena. Along with Bertalanffy's notion of a general system theory, Miller (1978) saw similar complications in his studies of living systems and their characteristics. He emphasized that any system, be it social, technical, living, or non-living, can be modeled as a suprasystem consisting of various subsystems. This general system theoretrical framework accounts different levels of system analysis, all from the highest level of analysis- suprasystems, such as a nuclear power plant or the Swedish railway system to the smallest system units of components etc. Suprasystems consists of subsystems. The subsystems are either living systems consisting of

individuals or organizations, or non-living systems consisting of the technological parts of the system (Svenson, Allwin, & Salo, 2005).

First, we will begin with defining the basic concepts of this framework. According to traditional systems theories (e.g., Miller, 1978) living systems exist in space. They consist of matter and energy that are organized by information. Both living and non-living systems can be described in terms of *structures* and *processes*. The processes are governed by information and driven by energy. Both structures and processes are needed in order to describe each of them.

Processes - needs a description of the structure of the process, for example bits of information that are transferred from A to B. Or in other words, a process is described by the change in the structure. Bits of information have moved from A to B.

Structures - needs a process to map on the structure. To exemplify, if we want to understand the structure of attitudes of the people working in a nuclear power plant, we ask them to process the information of a questionnaire and to give us an output on paper, which we in turn can process to reach a conclusion about the structure of attitudes Svenon, Salo, and Allwin (2005).

Let us take a look at a hypothetical suprasystem and use it in the purpose of describing the Swedish railway activities. As is shown in Figure 1, the supra system is hierarchically organized consisting of at least two subsystems on the next lower level. In our hypotetical model we have the living+technological system corresponding to the sum of Swedish railway activities at the suprasystem-level. On the subsystem level we have the government, the authorities, and the railway companies, each of them consiting of a living or a technological system or a combination of both a living and a technological system.

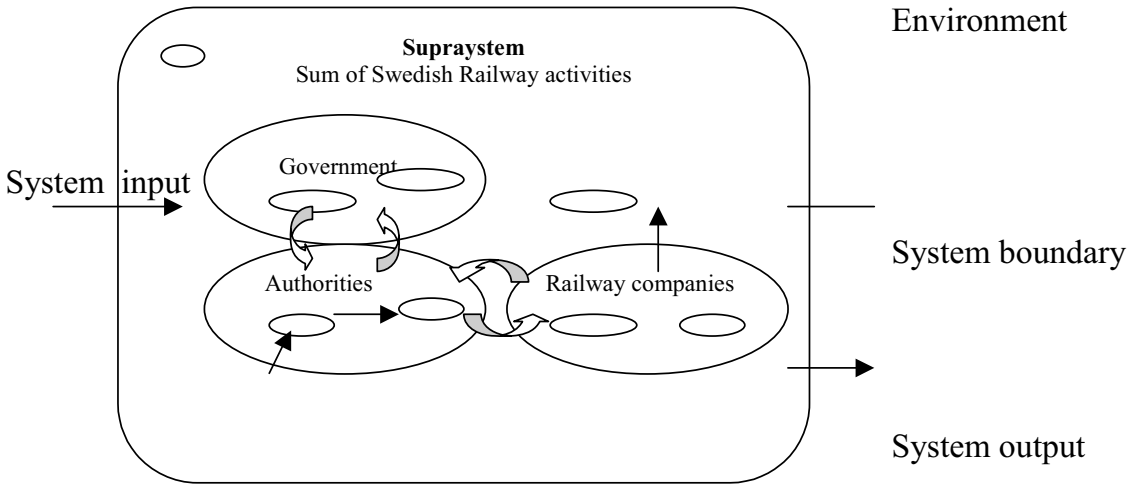

Figure 1: The structure of the hypotetical suprasystem "Swedish Railway activities and its subsystems. Arrows indicate system proceses consisting of flows of information, matter and energy.

From an organizational point of view, the subsystems may consist of various organizations, which interact to maintain themselves, and the suprasystem in a steady state. In this hypotetical example this can be safe railway transportation. Other steady states are also possible. The desired steady state may, for example, be a political agreement of the limits that a system may fluctuate. Such variables can for example be economical output, economical input, or some measure of safety. From this point of view it the conditions needed for keeping the supra system stable that decides the parameter settings for the subsystems. "A system is adjusted to its suprasystem only if it has an internal purpose or external goal which is consistent with the norm established by the suprasystem" (Miller, 1978, p.40).

1.1.2 System safety and the safety management

1.1.2.1 Deviation and control of deviation

According to the above definition of a system, system safety is a reference to the stable System State. Safety management from this perspective is a reference to keeping system variables within their limits and thereby keeping the system in a steady state decided by the goals of the sub and/or suprasystem. If the system variables do not meet the criteria for steady state, the system becomes instable is said to move out of the desired steady state towards another steady state. The system safety is at risk! Different scenarios may result from a drifting system:

A- moving away from the initial state, beyond the limits of recovery - *collapse*

B- moving away from the initial steady state to a new stable state – *adaptation*

C- moving away from the initial steady state but the *movement is counteracted*

Scenario A is a seldom-desired event. In scenario A the system moves away until it crashes without mesures taken to stop the event, or with unfruitful measurs that can not stop the event and bring the system back to the desired steady state. In scenario B the system moves from one state to another, and one example for this is a nuclear power plant moving from production phase to outage. An uncontrollable B scenario is also possible, the difference is that the system adapted to another state before crashing.

The measures taken in scenario C are of the kinds that are representative for safety management. In terms of system concepts, the system conteracts with negative feedback, which is the normal regulation of a system?

The system can react to various sorts of input. From a nuclear power plant operations-perspective, the system is designed to react on demands of increased or decreased power production. On such input sthe system is moving from the initial steady state preceeding the input (a certain production level) to a new steady state demanded by the input. When we are talking about safety management the event tyhat is indicative for a system reaction is usually a safety threat of some sort. Something internal or external the system is threatening the safety. This may, for example, be a component that is malfunctioning. From a systems point of view the component may be a subsystem that is moving away from its desired steady state, and which in turn is affecting other subsystems, and in turn, the steady state of the entire supra system.

In order to stop the system from drifting something has to bee done. In technological terms, new parameter settings, reprogramming of the component or replacement of the component may be required. In terms of the system, a process controlling the deviation with negative feedback, driving the systemback to its desired steady state is required. It should be pointed out that the system exists in an environment and can not survive by means of its own process and structure alone it consumes energy! Energy must be feeded into the system in order to maintain the prerequisites for system control. In addition there are limited resources to distribute among different processes of the system. *Optimal resource allocation* processes are essential in all system management including safety management, including reserves. Figure 2 shows where different controll processes in a hypothetical system take place.

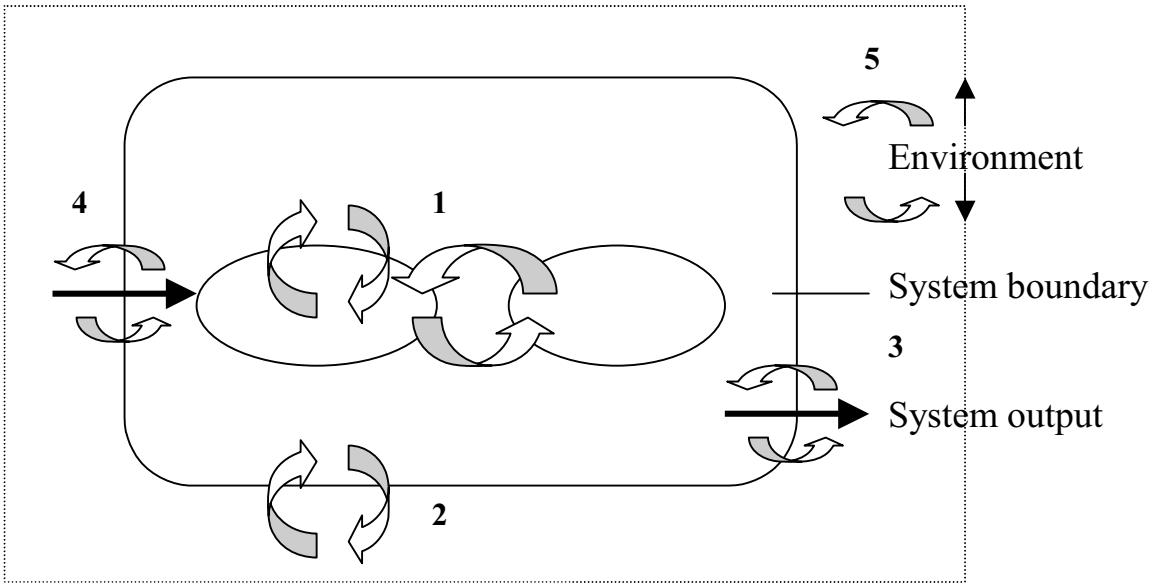

Figure 2. Examples of different control processes at different levels in a hypothetical system. Explanations to the numbers ar found in the text below. Other controll processes are possible.

In Svenson, Salo, and Allwin (2005) a number of controll processes relevant for the context of safety management from a systems perspective was presented. The processes may take place at different levels of a system and are intra-, inter-, or extra-systemical. The performance of system control depends on the *power*. Power represents one system's ability to control another system at the same or at another level.
The controll processes are summarized below and the number preceeding each process has its reference in figure 2:

(1) *internal feedback* with a feedback loop that never crosses the boundary of the system (e.g., temperature control functions in mammals). The interior of the organization of a nuclear power plant is full of such feedbacks on all levels.

(2*) external feedback*, which goes outside the boundaries of the system receiving input from other systems (e.g., legal action against a system). This includes all input from the outside that can be interpreted as responses to the behavior of an industry, owner reactions, public opinion, market reactions political, reactions etc.

(3*) output feedback*, where the output regulates the output at a steady state level (e.g., rate of production). This is a feedback that can be used to achieve goals determined by other feedbacks and strategies (e.g., constant production to save energy or to keep a price high and stable).

(4) *input signal feedback* uses the input to regulate the input (e.g., if too much information reaches the system the information can be buffered or slowed down). It also covers more material things, such as of how much is kept in stock by a company etc

(5*) passive adjustment feedback,* which reaches a steady state through altering environmental variables (e.g., the system of a heater controlled by a thermostat that cuts off power when the environment has reached a certain temperature). This is a very important kind of feedback because it involves changing the environment, e.g., in terms of legislation, attitudes etc. The feedback can be executed in the form of physical change of the environment, research, advertising, influencing the media, lobbying, bribing etc

In addition to theese controll processes the system may also be adjusted according to the following principles:

> *Loose feedback* is a feedback that permits errors or marked deviations from the steady state before corrections are initiated. The opposite is *tight feedback* with a feedback loop that is quick and immediately corrects a deviation. It has been shown repeatedly that humans have great problems, in particular when they control dynamic systems with delayed feedback.
>
> Adjustment of a system to its environment or interrelated systems can also take place through *changes in the system itself* in terms of its structures and internal processes. All adjustment processes have their costs. The costs of changing a system can be in terms of information, energy, material, money, time etc and scarcity may affect how close to the goals the system can operate.

If, despite all efforts, scenario A or C is happening, the preparedness for such situations, including the design of redundancies and back up, are other examples of safety management in terms of the systemic principles. One example of this may be the depth defence of a nuclear power safety system called safety barrier systems (Svenson, 1990; Svenson& Salo, 2001). It is important to note that a desired goal of the system for example, to produce electricity in not the only goal for the system. As seen here, safety is another important goal. The two kinds of goals (production and safety goals) sometimes coincide and sometimes they are antagonistic. Adequate management in a supersystem and its subsystems implies that adjustment and feedback functions are maintained so that the plant remains in a steady state during its life time, even under conditions of threat and stress. (Svenon, Salo, & Allwin, 2005).

In addition to the above, successful safety management requires *competence* and *integrity* of the management process at each level of an organizational hierarchy. A positive safety culture contributes in promoting the creation of theese conditions. If these conditions are not met, this means that there are obvious threats against safety. These concepts can therefore be consoders ad important prerequisites for successful management. For a more extensive review of this, see Svenson, Salo, and Allwin (2005).

1.1.3 The correspondence between system concepts and organizational concepts.

From the discussion above we can now, hopefully, begin to understand how organizations can be modelled in terms of this system theoretical framework. Another obscurity that may arise is how certain concepts from theories other than the system frame, such as organizational theory, can be modelled in the system. How does leadership, safety culture, or some other concept relate to the system. Is it a structure or a process. In Svenson, Salo, and Allwin (2005) examples of such concepts were discerned at related to system concepts. This is shown in Table 1.

Table 1: Examples of concepts in the safety management literature and living system theory according to Svenson, Salo, and Allwin (2005).

Management	**Systems**
1. Description of human-technology organization	System description with boundaries **Structure**
2. Goals	Goals **Structure**
3. Organizational behavior	The external output and internal reactions of a system, often at the macro level **Process**
4. Long term survival of organization	Resilience of system **Process: Long time perspective**
5. Maintenance and health care	Repair **Process**
6. Power	Power **Structure**
7. Leadership	The way power is executed by the decider at different levels (individuals and groups of individuals) ***Process***
8. Attitudes	Characteristics of the subsystem of individuals assumed to affect the output of the subsystems ***Structure***
9. Organizational culture	Characteristics of the subsystem of individuals in a group in terms of attitudes, behaviors etc. that are generally shared. ***Structure (also including structure of processes, e.g., habits)***
10. Safety culture	Characteristics of the subsystems of individuals in a group in terms of attitudes, behavior, etc that are generally shared and specially related to avoid, stop or ameliorate events disturbing the system on different levels. Includes disturbances to the environment of the system. Structure (also of processes)
11. Organizational learning	Signifies how a system memorizes its earlier history and its adjustments to internal and external changes ***Process***
12. Reactions to incident and accident investigations	External feedback ***Process***
13. Quality assurance	Internal feedback on monitoring of output ***Process***
14. Organizational effectiveness	The ratio of matter/energy produced to the goals of the system and matter/energy used per time unit. ***Process: Short time perspective (may lead to vulnerability in long term perspective)***
15. Time sharing functions, buffering	Input signal feedback ***Process***
16. Slow delayed reactions ofsystem internally andexternally	Loose feedback ***Process***
17. Fast close reactions of system internally and externally	Tight feedback ***Process***
18. Market reactions, information, regulation from society	External feedback ***Process***
19. Constant production	Output feedback ***Process***
20. Lobbying, buying out competitors	Passive adjustment feedback change of environment ***Process***

1.2 Prior studies in the project

1.2.1 System framework applied on safety management in: aviation and petroleum authorities, and car manufacturing

The current study was preceeded by, and highly related to, Svenson, Salo, and Allwin's (2005) study. In that study three different areas of operations are examined in separate case studies: civil aviation, petroleum production, and car manufacturing. Authorities represented two of the areas: the Swedish Civil Aviation Safety Authority; and the Norwegian Petroleum Directorate. A car manufacturer, Volvo, represented the third study. In order to study the interaction between authority and company, a Swedish airline company was also investigated. In each case study, a thorough description of the organizational structure, the activities and operations, and the safety management specific for each organization, was given. In the descriptions, safety management within each area was studied in relation to concepts central to the system theoretical framework discussed in the previous section. Structural aspects of the system studied, system regulation, information feedback, and detection and identification of threats to safety, are some examples of concepts that are related to keep the system stable, concepts that also are related to activities that are often labeled as central to safety management. Thus, the case studies generated illustrative descriptions about the unique in the areas studied, both from an organizational and a safety perspective, and, furthermore, related it to general system theoretical concepts transferrable across areas.

Among the detailed results given in Svenson and co-workers (2005) study, some general themes from analyzes with focal importance to the present report, are summarized below:

-A distinct division of responsibilities for safety work between organizational units.
-A clear communication about the organization’s safety policy and how each member of the organization is a part of the policy.
-Channels for information and information feedback are clearly represented in the system structure.
-Availability to incident reporting systems and the responsibility of each member of the organization to report incidents.
-The importance to differentiate between established structures for information management and established structures for information content.
-To make clear the range and meaning of power and authority.
-Identification of the organizations’ competence and integrity in relation to safety management.
-The importance of identifying threats to safety, not only for company activities and operations but also for authority activities and operations.

The present contribution will make use of the same approach as in the preceeding study regarding the system theoretic framework. Both a railway regulator and a railway company will be modelled in ralation to safety management from the systems perspective.

1.3 A background to passenger railway transportation in Sweden

1.3.1 Railway history in brief

It is known that people since ancient times have been using tracked transportation methods to move heavy load. In Europe the history of tracked transport systems can be traced back to the European "wagonways" from the 16th century. They consisted of wooden tracks on which wagons, pulled by horse or man, moved easier than on the muddy roads of those days, or on the rocky surface of a mine. Railway traffic as means of public mass communication, with engine powered carts with flanged wheels running on metal tracks, dates back to the days of the industrial revolution. Especially George Stephenson's trial 1825, in which his train was run between Stockton and Darlington (England) with the speed of 10km per hour, definitively set the course for the development of the modern railways. In a few years railways was built in many European countries (Encyclopædia Britannica, 2004).

In the mid 1800 three important developments took place that increased the integration of the Swedish society to a degree that had not been possible before. The establishment of the railway, the concurrent establishment of the telegraph, and the development of the postal service in accordance with the new technologies, increased the possibilities for communication and brought people closer each other. As today, with the introduction of new technologies people of that time also were resistant and afraid of what the railway might cause economically, politically, and environmentally (SJ, 2001). In a couple of decades it was clear to most people that the railway opened the doors and the opportunities for the dawning century. The industrialization of Sweden demanded not only passenger train services but also freight train services. Consequently, railway lines were built all away from the mining fields in the north to the factory establishments in the south (SJ, 2001).

Sweden's first railway line for steam locomotives was opened between Ervalla and Nora north of Örebro in March 1856, a private rail company. The first state owned railway line opened also this year between Malmö and Lund. Accordingly, the Swedish railways consisted very early of both private (enskilda järnvägar) and state owned railways. The ways in which the state-owned part should be organized was first formalized 1862 in a HM's regulation (kungligt reglemente) (Nordisk Familjebok, 1910). The expansion of the Swedish railways during the first decades was primarily accountable the private companies, and still in 1930's statistics a higher proportion of the total railway length belonged to private railways. The state and private railways existed beside each other until the late 1930's, when the Swedish Parliament in 1939 decided to nationalize all private railways. The Swedish State railways (Statens Järnvägar – SJ), made voluntary agreements with the private companies (partly as a consequence of bad economies in the private companies) and increased the buying and incorporation of private companies. The Swedish State railways successive buying of the private railways quickly changed the proportion to the state favor, and in 1950 over 90% of the Swedish railways (in length, including both normal and narrow track systems) had been nationalized. The total line length of the Swedish railways reached its maxima in the 1930's, with over 16800-km (Bantrafik 2002-2003, 2004, p.10). Following more than a half decade of slow decline, the total line length in 2003 was, depending on source, 11697-km or 11037-km (Banverket, 2005:2, and Bantrafik 2002-2003, 2004, p.10). However, beside line length there are several other ways to

characterize the size of a nation's railways (i.e., transport stock, train operations, staff, etc.).

Although the last steam locomotives were taken from regular SJ service in 1972 the electrification of the Swedish State railways started as early as 1915 when the first line was modified to electric power operability. It was between Kiruna and Riksgränsen (Norwegian border), the northernmost line in Sweden. However, SJ's testings of electric and diesel-electric locomotives in Sweden begun a couple of years earlier (1905 and 1910 respectively), and the first private Swedish electric railway line (part of Djursholmsbanan) opened already May 15 1895 (SJ, 2001; Nordisk Familjebok, 1910).

The dangers associated with railway traffic were, naturally, early recognized. In those days preventive work was not primarily at the agenda. Still, it was recognized that those subjected to the negative consequences of railway traffic should be economically compensated for their losses, and it was stated that the responsibility laid at the owners or the administration of the railways, although the consequence happened by mere accident. The Swedish State control or regulation of the railways and the railway traffic also dates back to the early days of Swedish railway traffic. The first Swedish Rail Agency (Järnvägsstyrelsen) was established 1863 as an office organized under the first Ministry for Civil Service Affairs (Civildepartementet) (Nordisk Familjebok, 1910). Along the 20th century SJ, as a state company, supervised its own activities. The company was thus both the regulator and the regulated. From a more recent perspective, SJ was 1988 divided into two parts: SJ as a transport company, and the Swedish National Rail Administration (Banverket) as the authority responsible for the railways. Swedish Railway Inspectorate (Järnvägsinspektionen) as a part of the Swedish National Rail Administration was established with a primary duty to inspect the safety in Swedish railway traffic, which also includes tramways and subways. January 1 2001 SJ was anew reorganized. The former SJ Company was hereby divided into 6 independent companies among which the one responsible for passenger traffic is named SJ AB. On July 1 2004 the Swedish Rail Agency was established and overtook the functions of Swedish Railway Inspectorate (that ceased to exist on June 30). These most recent formations of the Railway Inspectorate/Swedish Rail Agency and SJ AB are the organizations studied in here.

1.3.2 Recent developments: consequences of the deregulation

What the consequences from opening the former state controlled Statens Järnvägar to the open market are in the long run, is hard to tell. The Swedish railway market has at the time of this study only been "open" about four years. Despite the positive visions often brought ahead from the market in times of Railway deregulation, the actual results from empirical analyses some time after the deregulation do not uniformly support the initial visions.

Swedish SOU reports (the Swedish Government Official Report) have come up with a number of considerations and propositions concerning various parts of the harmonization with the EU and the deregulation of the Swedish railway.
In the interim report "Rätt på Spåret" (Right on track) propositions about how EG-directives in the first "Railway package" should be implemented in Swedish law (SOU, 2002). As a part of this work a proposition to a new structure for the Swedish railway legislation was prepared.

In the report "Järnväg för resenärer och gods" (railway for passenger and goods) propositions about how passenger and goods transportations can be developed to better serve the customers interests. Different models of how railway companies could organize transport and traffic flows, and measures for the development of the railway market is proposed (SOU, 2003). One important part of the work was the harmonization according to COTIF[1] should be incorporated in the Swedish legislation. The review of the legislation was accomplished in 2004 and resulted partly in the new Railway act.

UK is today one of the most deregulated railway markets in the EU. In the mid 90's. British Rail, the British state- national Railway Company was privatized. The British passenger railway industry today broadly consists of; 25 franchised Train Operating Companies (TOCs). The conservative Government was determined to see better use made of the railways, greater responsiveness to the customer, a higher quality of service and better value for money for the public who travel by rail and for the taxpayer (Cohn, 2003).

Malin Cohn at SJ AB has studied the British railway companies and her analyses show that after the privatization the whole branch is mowing towards more co-operation and centralized control. Cohn summarizes the results as follows:

> "To summarise the development; ten years ago, the idea of privatisation was to introduce competition and to let the private sector take the risks and rewards. The franchise was a genuine business opportunity to be exploited. Today the SRA (authors remark: Strategic Rail Authority, not to confuse wits Swedish SRA) are setting the operators timetables, sharing excess revenues and costs, regulating fares and monitoring TOCs business by detailed Key Performance Indicators. This leaves the operators with limited commercial freedom (Cohn, 2003)" .

When it comes to safety of the British railway following the deregulation Cohen concludes:

> "The national rail network has not delivered the expectations created at privatisation. There has been a need to re-structure the finances and organisation of the railway infrastructure controller in order to provide the passenger and freight train operating companies with safe and reliable infrastructure. Recent accidents have raised issues about the safety of rail…
>
> …Performance has suffered considerably in the aftermath of these accidents, for instance due to heavy speed restrictions, and also as a result of chronic under-investment in an ageing asset base. The Hatfield accident probably had the biggest impact, since it revealed the poor state of the tracks.
> The demand for increased passenger and freight journeys has made the situation worse and increased the tension that exists between increased rail traffic, the need to undertake more maintenance on the network and the desire to enhance network capabilities. The SRA has recently withdrawn services in order to make the network less vulnerable to interruptions and delays (Cohen, 2003)"

Cohen's report points at many interesting facts about consequences of deregulation of a Railway market with implications not only for the market from an economical point of view, but also from a perspective relevant to safety management.

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[1] Convention Concerning International Carriage by Rail (COTIF). Cooperation between OTIF (Intergovernmental Organization for International Carriage by Rail) and the member states. The principal aim of the Organisation shall be to establish a uniform system of law applicable to the carriage of passengers, luggage and goods in international through traffic by rail between Member States, and to facilitate the application and development of this system.

In analyses made by SIKA[2] (SIKA, 2004:3) the following consequences after the deregulation of the Swedish railway market are indicated in a five-year perspective (provided unchanged political situation):

Travellers
Unchanged or somewhat lower ticket prices; decreased service density and expansion of the lines; decreased coordination of timetables and time adjustments.

SJ AB
Lower prices and incomes following competition on the market; higher costs following lost benefits from large-scale operations and train position fees (tåglägesavgifter); decreased profitability.

New operators
Low but bearable profit; higher costs for producing traffic maintenance programs, traffic analyses, timetable planning, and collecting information; higher demands on traffic purchase following the discontinuation of unprofitable traffic.

The Government
Higher grants to Rikstrafiken[3] (because of the two reasons above) and SRA; decreased returns from SJ AB, and probable market competition costs; decreased fulfillment of transportation political goals; decreased availability, traffic safety (following increased car traffic), and environment.

However, in a long run SIKA estimates that there will be positive effects from the reform. The arguments are mainly related to efficiency through economy and the market. The positive effects of the incitements given in the analysis lies ten to fifteen years ahead in the future and the size of the effects are difficult to estimate. SIKA estimates the advantages outweigh the disadvantages. The analyses gives no univocal or straightforward for a choice of road and suggests that there are reasons to point at it is possible to move on more carefully and more stepwise towards enhanced competition than suggested in the Swedish Railway inquiry (SIKA, 2003).

1.4 Method

1.4.1 Aims of the present report and outline

The general goal with the present report was analyzing safety management from a non-nuclear point of view with potential relevance for nuclear safety. More specifically, the report aimed on studying Swedish railway safety management according to the systems

2 SIKA, The Swedish Institute for Transport and Communications Analysis, is an agency that is responsible to the Ministry of Industry, Employment and Communications. SIKA was established in 1995 and has three main areas of responsibility in the transport and communications sector: to carry out studies for the Government; to develop forecasts and planning methods; and t be the responsible authority for official statistics.

3 Rikstrafiken (the National Public Transport Agency) coordinates long-distance travel in Sweden. It was established as an agency in 1999, following a government decision on a new transport policy. It is subordinate to the Ministry of Industry, Employment and Communications, and has two main tasks: to foster and coordinate public transport throughout Sweden; and, to procure interregional public transport, by air, rail, sea and land, which would not be commercially viable

perspective outlined by Svenson and Salo (2004). Two main actors were analyzed, the inspecting agency and a railway company. First, the Swedish Rail Agency (Järnvägsstyrelsen), which is the authority that exerts supervision of the Swedish rail-, tram, and sub-ways, was analyzed. Second, SJ AB, the major passenger rail Travel Company in Sweden was analyzed. The analyses of the inspecting agency and the company resemble two separate studies and are, accordingly, reported in two separate chapters. For both the authority and the company, the general structure of and scope of activities within the organizations were illustrated, and modeled according to the applied system model. Three perspectives of safety management were applied to the analysis of safety management within each organization: (1) the structure of the organization; (2) Internal and external threats to the organizations and to the market, and; (3) information feedback systems. In the concluding chapter we will attempt to outline the interactions relevant for safety management between subsystems from a higher-level system perspective, full system train operations in Sweden, that besides the agency and the companies also includes other authorities and the market.

1.4.2 Document analysis

In the present study, documents put forward by several Swedish and European authorities, and from the companies have been used in the analysis. Mainly four documents have been exploited, (1) Annual reports 2004 for both the Swedish Rail Agency and SJ AB was used; (2) Swedish Rail Agencys's Handbook; (3) Railway statistics from the SIKA institute, Banverket, the Swedish Rail Agency and SJ AB; and (4) Acts, ordnances, and regulations for Railway operations published by Ministry of Industry, Employment and Communication, the two Swedish Railway authorities, The European Commission and related organizations.

1.4.3 Interviews

1.4.3.1 Participants

Key persons for interviews were recommended by the studied organizations themselves during the initial contacts taken. Three employees at the Swedish Rail Agency were interviewed. All there had experience as inspectors and one of them worked in a middle managerial position. The participants represented two offices at two different locations, Borlänge and Stockholm. At SJ, one key person was interviewed, a safety manager at the Stockholm office.

1.4.3.2 Material

The questionnaire used in the interviews was in a semi-structured format. The questionnaire was developed by Svenson, Salo and Allwin (2004) and had previously been used in other studies covering safety management from a systems perspective. The interview questions covered three important areas of safety management retrieved from the system theoretic model posed by Svenson (see previous chapter): (a) the structure of the organization, which concerns the identification of main, statistical, and perceived risks, and the organization's definition of safety management, and the structures and processes relating to safety management; (II) threats against the organization; and (III) information system feedback, including both internal feedback (ex: incident and

accident reports), external feedback (i.e., the relationship between the organizations studied and the market), and, feedback about regulatory strategies. The formulations in the questionnaire were slightly modified to fit the interviews with the Swedish Rail Agency and SJ AB respectively (see Appendix 1 for the questionnaire).

1.4.3.3 Procedure

Initial contacts with the Swedish Rail Agency and SJ AB were made by telephone. Key persons for the interviews was suggested by the organizations respectively and an official letter was sent to the key persons by email in order to establish initial contact with them. The letter declared the purpose and the goals with the investigation and asked whether they were willing to be interviewed. The key persons returned a letter in which they declared that they were willing to participate. After this dates for the interviews were arranged.

The interviews were conducted at the organizations' offices in Borlänge and Stockholm on three different occasions. During the interview the participants responded to the set of questions in the semi structured interview questionnaire. During the interviews, the answers were recorded by means of pen and paper by the author. The procedure took approx. two hours. After the interviews, a manuscript in which the answers to the interview questions were summarized and remitted to each one of the participants, allowing them to add information and/or correct the material and finally return the corrected manuscript. In a second round, the sections of the manuscript focusing each organization respectively (includint the corrected interview section, and document study for each organization), and the introductory chapter was again remitted to the participants for final comments.

In the Following, separate chapters are devoted for the descriptions of the Swedish Rail Agency and SJ AB respectively.

2. Järnvägsstyrelsen, The Swedish Rail Agency

In this chapter a detailed account of the availale documentation regarding the Swedish Rail Agency (Järnvägsstyrelsen) will be given and analyzed. In the end of the chapter interviews with the Swedish Rail Agency will be analyzed regarding safety management from the systems perspective outlined by Svenson, Salo and Allwin (2004). Accordingly, the interviews will be modelled in terms of system structures and processes, the information feedback and threat detection (see preceding section).

2.1 Results

2.1.1 The structure of SRA

The organizational structure of SRA is, partly, stated in law. According to the *Ordinance on the Mission of the Rail Agency* (2004:3), the SRA consists of one *Director-General* who is the head of the authority. There is an *Advisory Board* consisting of not more than five members. The Director-General is included in the board as chairman. The other members of the board are chosen by the government for a limited time. The advisory board shall give the Director-General necessary advice so that the operations can be run efficiently and in accordance with the goals. The Director-General shall inform the board about the activities.
There is also a *Technical board* consisting of not more than six members. The Technical board shall assist SRA with technological advice. The members of the board are chosen by SRA for a limited time (Näringsdepartementet, 2004:3).

In other respects SRA themselves decide the organization. The subsidiary the Director-General and the boards, the SRA is constituted of five divisions:

> **"The legal division** issues regulations, investigates accidents, follows and studies accident investigations, produces accident statistics and decides on health exemptions.
>
> **The infrastructure division** is responsible for issuing permits, monitoring markets and supervising safety issues for infrastructure managers, managing infrastructure registers, ensuring underground and tram safety and issuing related permits.
>
> **The technical division** is responsible for Technical Specifications Interoperability (TSI), essential requirements, exemptions, the co-ordination of Article 21 Committee standpoints, market supervision and the approval of vehicles and subsystems as well as matters concerning OTIF.
>
> **The rail company division** issues permits, monitors markets and safety issues for rail companies and manages vehicle registers.
>
> **The administrative division** is responsible for accounting, personnel, office premises, IT support, the switchboard and telephony, office materials, the co-ordination of budget work and operational planning, the archives, official register, public relations and travel and secretarial services."
>
> (Järnvägsstyrelsen, 2005:3).

The *infrastructure-,* and the *railway company-division* are responsible for the safety oversight including: *inspections*, *audits*, *market contacts*, and *hazardous materials*. (see figure 3. for SRA's organization).

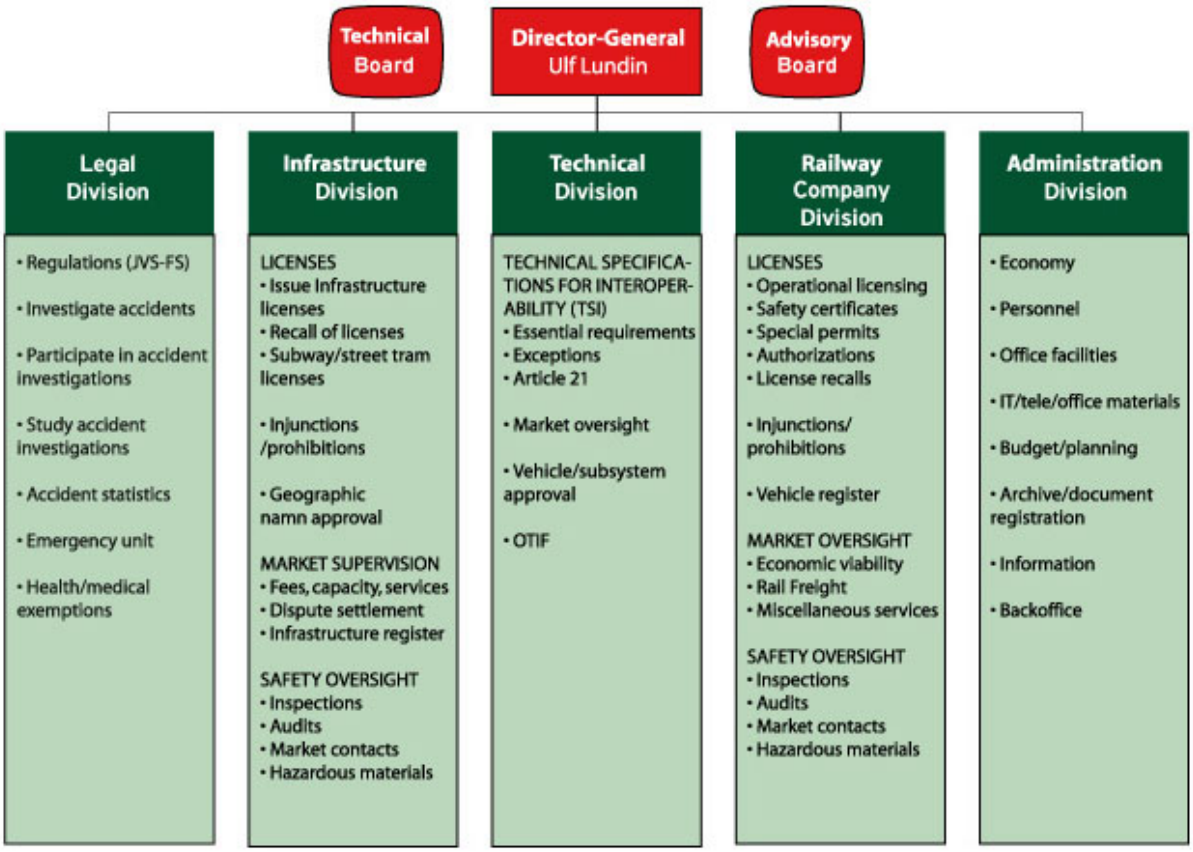

Figure 3: SRA's organization and the divisions' main activities (Järnvägsstyrelsen, 2005:2).

SRA's oranzation is designed to put the customers in focus. The aim is to make it easy for railway companies, infra structure administrators, and the railway industry to find their way into and make contact with SRA (Järnvägsstyrelsen, 2005:2, p.10).

2.1.2 Regulatory activities

The Swedish Rail Agency is located with its head office in Borlänge. At the end of 2004 the organization had 35 employees. About three fourth of the employees were men.

2.1.2.1 Roles

RRV call attention to that supervision is a political means of control in government agencies, in order to make sure that rules and regulations are followed. They indicate that the culture in Swedish government agencies often seek compromise solutions that may obstruct the more controlling forms of supervision, which according to RRV may

explain why supervision often tends to result in mere information, advice, and support (Dahlberg, 2003; RRV, 1996). However, according to a comparative study of Canadian agencies, “the degree to which one adopts a "soft" versus "hard" (or, Compliance White Hat and Enforcement Black Hat, p 6.3) approach is a function of the regulatory area, the level of risk, the management approach, the public’s willingness to accept change, and the industry’s interest and willingness to focus on safety” (The Canadian R/I Secretariat, 2000).

There are several ways to describe how agencies main duties are characterized. For example, the Swedish National Audit Office (Riksrevisionsverket) identifies four different categories of agencies: (A) *with supervison as the main task*; (B) *supervision stated along with other tasks*; (C) *supervision not stated*; and (D) *some tasks related to supervision stated*. From that perspective the former SRI counted to category B, in contrast to the Swedish Nuclear Power Inspectorate (SKI) that counted to category A (Lindblom, et.al., 2003; RRV, 1996).
In Lindblom, and coworkers (2003) Swedish agencies were asked which activities among 8 categories they regarded as a part of their own supervision. The categories, previously used in a study by Rudén et. al, (1998), were: (a) *regulatory work*, (b) *inspection*, (c) *coordination of supervision*, (d) *checking rule abidance*, (e) *taking measures against transgressions of the law*, (f) *granting of permits* (licensing), (g) *preventive measures; counselling and information*, and (h) *work with the companies’ self-inspection*, *and control programmes*. In response to that question both SKI and SRI replied that: *b*, *d*, *f*, and *g*, was considered as activities included in the authorities definitions of supervision. In contrast to SRI, SKI included *a*, in their definitions (Lindblom, et.al, 2003). The authors concluded that differences between how agencies use the supervision concept, makes both quantitative and qualitative comparisons and interpretations between agencies difficult.

How the newly established SRA relates to the above we do not know. However, they do describe their work approach as process oriented including 6 main processes: *regulations* (föreskrifter), *licensing* (tillstånd), *approvals* (godkännanden), *supervision of safety* (säkerhetstillsyn), *accidents and incidents* (olyckor och tillbud), and *market monitoring* (marknadsövervakning). In addition to these main processes the operations are managed by means of control and support which can be summarized as management and administration. A detailed account of the 6 main processes will be given under separate headlines in section 2.2, below.

2.1.2.2 Acts and ordinances

The safety efforts of rail traffic operations in Sweden are stated in Law. There are a number of acts (lagar) and ordinances (förordningar) on particular aspects of railway operations issued by the Ministry of Industry, Employment and Communication (Näringsdepartementet). The *Railway Act* (2004:1) is applicable on railway infrastructure and railway vehicles, and also operations and organization of railway traffic, except tram- and sub-way traffic that has its own act and ordinance. The government decides which authority that, according to the law, shall grant permissions and supervise the activities. That authority is the Swedish Rail Agency (from here on SRA) and this is stated in the *Railway Ordinance* (2004:2). That document also declares the duties of the SRA. Instructions for the SRI work is stated in a separate *Ordinance on the Mission of the Rail Agency* (2004:3). The other acts and ordinances on railway

safety are: the *Act and the Ordinance on underground and street tram safety* (1990:1, 1990:2); the *Investigation of Accidents Act and Ordinance* (1990:3, 1990:4); and the *Transport of Dangerous Goods Act and Ordinance* (1982:1, 1982:2).

SRA, the regulatory authority for Swedish rail transportations was created in July 1 2004 when the former Swedish Railway Inspectorate (from here on SRI) was reorganized. SRI emphasizes that the change process was a very "tough challenge" because of the very short time for preparations. SRA overtook SRI's responsibilities and duties concerning safety in the railway-, subway-, and tramway-system. At that time, new acts and ordinances were effectuated which meant that additional responsibilities were assigned to the new authority, for example the supervision of: (a) that charges drawn for the use of the railway infrastructure, and (b) that the allotment of the capacity of the railway infrastructure and the supply of services, is managed in a competition-neutral and non-discriminative way. Among the new assignments, SRI shall also supervise that (c) the markets for railway services works efficiently from a competition-perspective, and that (d) a register of Swedish railway vehicles, and the Swedish railway infrastructure is kept (Järnvägsstyrelsen, 2005).

2.1.3 SRA's relations to Banverket

Banverket (located in Borlänge) is the Swedish authority that has the responsibility (sektorsansvar) for the railway sector in Sweden. Banverket leads and follows the development of the railway sector and assists the Swedish government and the Swedish parliament in questions concerning the whole railway transport system (Banverket, 2005). Until June 30 2004 SRI was organizationally part of Banverket. Here, the concept "railway sector" includes partly: the actors, both private and public, who have their activities bound to railway traffic, and partly the technical and administrational system that performs railway transportation including subway and tramway (Banverket, 2002). See figure 4 (below) for the scope of Banverket's activities and sectors responsibilities. Instructions for Banverket's operations are stated in an *Ordinance on the mission of Banverket* (Näringsdepartementet, 2004:4).

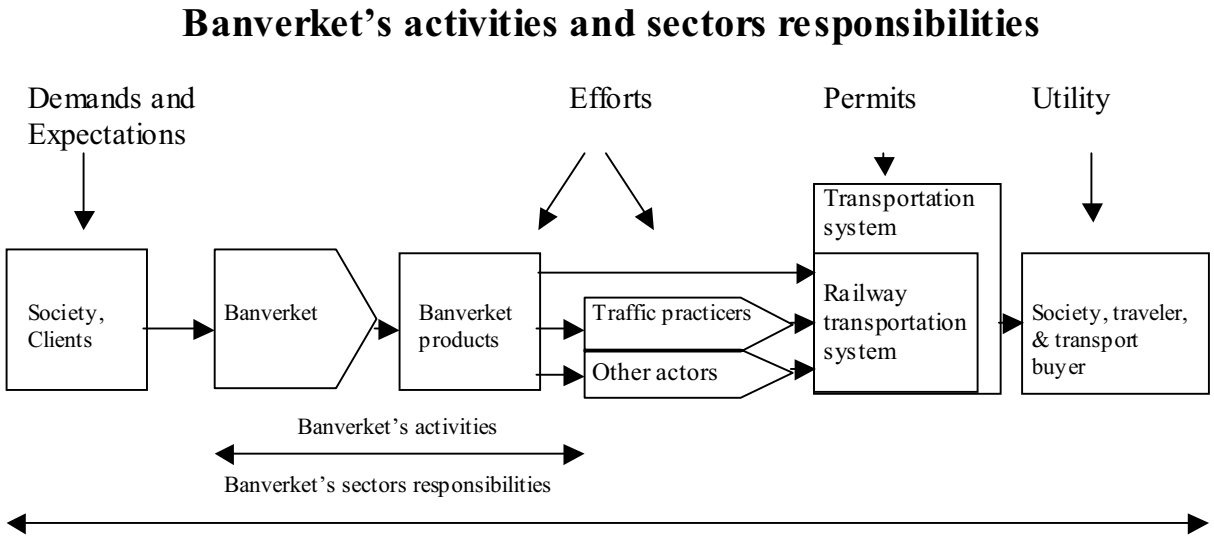

Figure 4: Banverket's activities and sector responsibilities (according to Banverket, 2002, p.4).

According to the government's instruction, Banverket shall especially work for that: (a) the railway transportation system is available, safe, trafficable, efficient, and adapted to environmental demands, (b) the competitiveness of the trackbound public transportation is strengthened, (c) considerateness is paid to the demands of the disabled within the railway transportation system, (d) society motivated research within the railway system is performed and distributed, and, (e) traffic information prior to, during, and after the transport is improved (Banverket, 2005).

When SRA was established as a "new" authority in the railway area some activity areas that previously belonged to Banverket was moved to SRA. Those areas include supervision of the railway market and the railway actors, and also to decide in cases of dispute. This means that the activities in the former SRI and the Train Traffic Control have been transferred to SRA. Banverket has the continued responsibility for the Traffic Control and the train time scheduling. Banverket has functions for exercising authority control, track keeping, sector duties, and production. For these purposes, the organization of Banverket is divided between administrative and production units. See figure 5 for the organisation of Banverket.

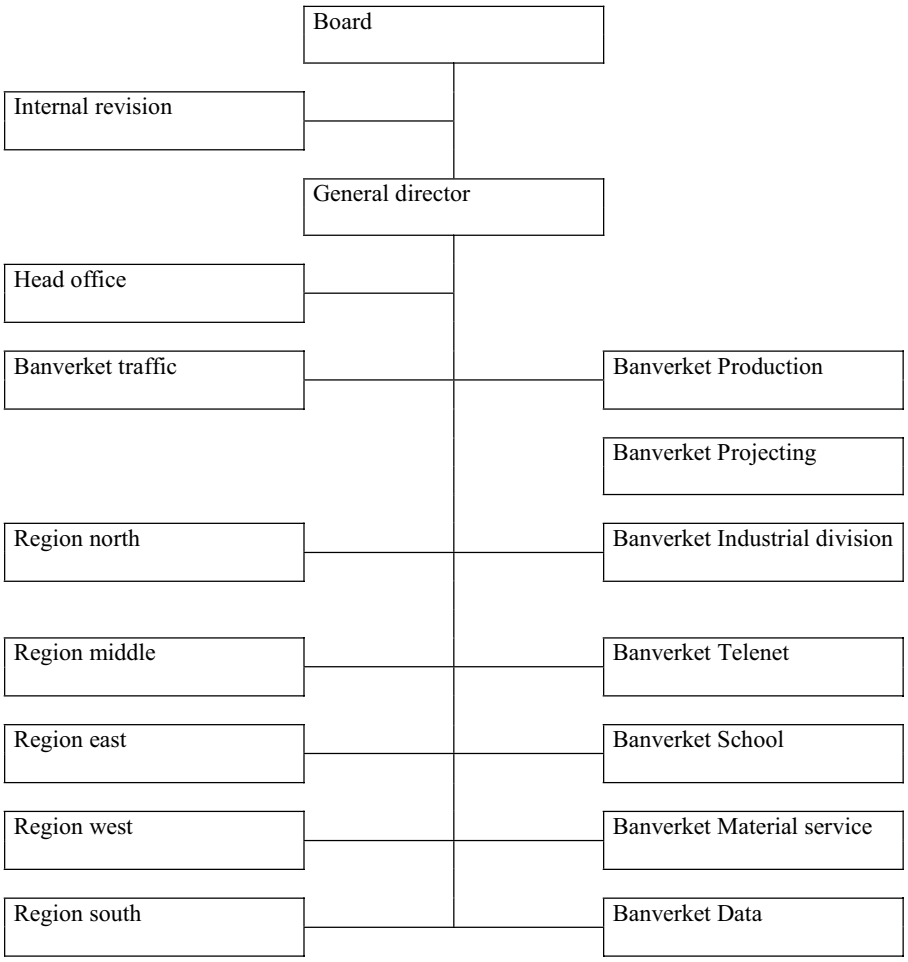

Figure 5: Banverket's Organization. The Swedish words "banregion" and "banskola" are exchanged to region and school respectively (according to Banverket, 2005, p7,).

2.1.4 SRA from a European perspective

The Swedish Railway operations do not stop at the border, but extends outside Sweden as a part of the European railway network. The opposite is also true, as the foreign railway companies operate on Swedish rail. There are two main connections to the European Union railway network, the Danish and the German borders. In addition, there are also train operations with Norway. Norway participates, through the EEA Agreement, in a large number of EU programmes covering most EU policy areas, and is also associated to various EU agencies (EU, 2005).

The European cooperation concerns mainly the Technical Specifications for Interoperability (TSI). TSI concerns the construction and upgrading of the European Interoperable High-Speed Rail Network (Lindblom et. al, 2003). SRA examines and make comments on harmonizing standards for the European railway system. During the second half of 2004 12 proposals were treated. TSI's for high-speed trains are already introduced in Swedish legislation. A "first round with such technical specifications for

conventional trains was adopted by the EU-commission's TSI committee November/December 2004.

A European Railway Agency (hereafter, ERA) was established in April 29 2004. The agency will be located in Lille/Valenciennes (France). The Agency will progressively be set up between May 2004 and May 2006. Initially it has two main objectives: to reinforce railway safety and interoperability of railways in Europe. A third objective is, of course, to set up the agency! The agency is composed of one representative of each Member State, four representatives of the Commission and of six professionals from the sectors most concerned. The tasks of the Agency, its organization and its working methods with the representatives of the railway sector are stated in Regulation (EC) No 881/2004 (EU, 2004; European Railway Agency, 2004).

Every Member State shall established/set up a Regulatory Body. Countries with regulatory bodies established July 1 2004 was: Austria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Lithuania, Latvia, the Netherlands, Poland, Portugal, Sweden, United Kingdom, Norway, and Switzerland. Their main task is to ensure a fair and non-discriminatory access to the rail network and services. The legal basis for the creation and competence of the Regulatory Body can be found in Article 10.7 of Directive 2001/12/EC and in Articles 30 and 31 of Directive 2001/14/EC. At European level and with the help of the European Commission, the Regulatory Bodies shall exchange information about their work and decision-making principles and practices with the aim to develop a common approach in order to avoid conflicting decisions (European Railway Agency, 2004).

ERA is among four agencies are subsidiary DG TREN (the European Directorate-General for Energy and Transport) and is organized directly under Director General (DG-TREN, 2005). Other European Commission actors are: TEN-T (Trans-European Transport Networks), and also AEIF, which is the joint representative body mandated by the EU Commission to lay down the Technical Specifications for Interoperability (TSIs). AEIF are constituted by representatives of the infrastructure managers, railway companies and industry (AEIF, 2005).

The European Parliament has, so far, voted for three Railway packages, the first in 1999. The second railway package was adopted on 23 January 2002, including measures to revitalize the railways by rapidly building an integrated European railway area. Sweden has in 2004 accomplished several important parts of the second package, not at least by establishing the new authority SRA. The third railway package was adopted on 3 March 2004 containing measures for the gradual opening up of the market for international passenger services.

When asking Swedish agencies it seems as if there is an increased use of European regulations although the agencies are in various phases of harmonization. An increased volume of regulations and lacking precision and clarity in some regulations are issues they have in common (Lindblom et. al, 2003).

2.1.5 Distribution of costs

From a process view, Table 2 shows that the cost for management and administration draws the highest costs among the other processes. But, from the perspective of the two

branches of SRA, supervision of safety takes the highest costs. This gives an implication of the safety-oriented focus of the organization.

Table 2: SRA's costs distributed on processes and branches respectively (according to: Järnvägsstyrelsen, 2005, p.10)

SRA's costs second half 2004			
Cost per process			
Regulations	1102	Approvals	2663
Permissions (tillstånd)	1654	Supervision of safety	4350
Accidents and incidents	1654	Dangerous goods	563
Management and administration	5443	Market monitoring	591
Cost per activity-branch			
Market monitoring	594	Supervision of safety	17396

2.1.6 SRA's Duties

The SRA organization puts the clients in focus of their activities. Their clients are, mainly, railvay companies, infrastructure administrators (förvaltare), and the railway industry. SRA's main duties are to decide about approvals, monitor the market, and supervise safety. In addition, SRA shall issue regulations (föreskrifter), investigate accidents and administer vehicle and infrastructure registers. The duties and responsibilities are also stated in *Ordinance on the Mission of the Rail Agency* (Näringsdepartementet, 2004:3).

2.1.7 Goals

The government has put up goals for the area of railway activities as a whole. The goals can be summarized as follows:

-An available transportation system, in which the railway transportation system is designed as such that the citizens and the industry transportation needs, is provoded.

-A high transportation quality, in which the design of the railway transportation system allows high transportation quality for the citizens and the industry.

-A safe traffic, where nobody is killed or seriously injured within the system for raibound traffic. The design and the functions of the railbound traffic shall be adapted to the demands in here.

-A good environment, in which the design and functions of the railway transportation system are adapted to the demands on a healthy life-enviromnment for everybody, and where nature and culture environments are protected against damage.

-An economized use of ground, water, energy, and other resources shall be facilitated. The design of the railway transportation system shall contribute to that the national environmental goals become fulfilled.

-A positive regional development, in which the railway transportation system contribute to level differences in possibilities for various parts of the country to develop, and to counteract disadvantages of long distance transportation.

-An equal/leveled railway transportation system designed to answer to the transportation needs for both women and men. Women and men shall get the same opportunities to influence the creation, the design, and the administration of of the transportation system and their values shall be assigned the same weight.

Two of the goals are specific for the SRA, and are adopted by SRA as their market- and safety-goals (Näringsdepartementet, 2004:3; Järnvägsstyrelsen, 2005, pp.12-13):

-SRA shall work for a efficient railway market on equal conditions and a healthy competition (market goal).
-SRA shall work for a high safety in the railway-, tramway-, and subway-systems (safety goal).

2.1.8 Reporting to the Government

In a Government budget document (regleringsbrev) it is stated that SRA shall report back how the activities have contributed to fulfill the goals for the business area. The documents states for each of the goals what shall be reported back and times for the reports. For example, according to the safety goal it is stated that: SRA shall report the number of accidents, the number of killed, the number of seriously injured, the number of incidents, the number of inspections, the number of reports to the emergency call center, the number of demanded accident investigations, the number of accident investigation fullow-ups, number of own investigations, number of concluded issues Näringsdepartementet (2005).

2.2 An account on the six main processes of SRA

An account of the 6 main processes of SRA will be given below. The processes are: (I) *regulations* (föreskrifter), (II) *licensing* (tillstånd), (III) *approvals* (godkännanden), (IV) *supervision of safety* (säkerhetstillsyn), (V) *accidents and incidents* (olyckor och tillbud), and (VI) *market monitoring* (marknadsövervakning). In addition to these main processes, the operations are managed by means of control and support, which can be summarized as *management* and *administration*. Also transportation of dangerous goods can be viewed as a special area of activities. All processes have their counterparts in the Ordinance on the Mission of the Rail Agency (2004:3), and are thus stated in law. Market monitoring, management and administration, and transportation of dangerous goods will not be discussed further in here.

2.2.1 Regulations

At the time for the study 14 regulations together with commentaries was published by SRI. They relate to 14 different areas of railway safety. The regulations apply to all who provide rail transportation or who are responsible for a track network.

The collection of regulations is called the “Handbook” and all regulations are presented according to a common model. Each section of regulations begins with the topical statute from Banverket’s statute book. (BV-FS, Banverket författningssamling) in which SRI’s own cogent rules, SRI’s regulations are published. After this follows comentaries to the regulations and adjacent to these ”cut-outs” of paragraphs from BV-FS are repeated in order to provide the highest readability and comprehension. In order to further enhance the readability, all cogent rules are printed on a yellow backround. The text of non-commented paragraphs is presented in grey-tone. The handbook was reviewed 2003 (Järnvägsstyrelsen, 2003).

Following the establishment of the new authority much time 2005 has been devoted for planning and preparing regulations in accordance to the new railway act. At the time of the study, not all of the regulations were available in English translation. The regulations are:

-License application regulations
-General regulations on safety rules (*1. below*)
-Railroad company safety rules (*2. below*)
-Safety instructions for light railways
-Medical examination and health status regulations
-Education and training regulations (*3. below*)
-Approval of vehicles
-Inspection, testing and maintance of vehicles
-Internal safety systems (*4. below*)
-Approval of track systems
-Inspection and maintance of track systems
-Naming regulations for geographical locations on railways
-Interoperability in the trans-European high-speed rail system
-Reporting of accidents (*5. below*)

2.2.1.1 Regulations with implications for safety management from a systems perspective

SRI’s Regulations apply to the broad area of Railway safety. In the current context, some regulations are more relevant for the system safety management outlined here. We have presented them below as a collection of regulations with especial importance for safety management from a systems perspective (all below quoted from BV-FS, and Handbook; Järnvägsstyrelsen, 2003).

1. Regulations on internal systems of safety rules

> The Swedish Railway Inspectorate’s (Järnvägsinspektionen) regulations on internal systems of safety rules (BV-FS 2000:2)
>
> The Railway Inspectorate lays down the following regulations under the authority of § 7 of the Ordinance (1990:1165) regarding safety on railways, underground railways and light railways.
>
> § 1 An internal system of safety rules is a collective term for the operator’s own detailed safety regulations on traffic, staff, rolling stock, track installations, accident and near miss management, and internal controls.

§ 2 Internal systems of safety rules shall contain regulations on: 1. traffic safety instructions; 2. medical examinations and state of health for personnel with duties of importance to the safety of rail traffic operation; 3. competence of and training for personnel with duties of importance to the safety of rail traffic operation; 4. inspection, functional checking and maintenance of rolling stock; 5. loading of vehicles; 6. inspection and maintenance of track installations; 7. investigation of accidents and near-misses, and clearance in connection with accidents: 8. internal control.
§ 3 Internal systems of safety rules need only contain such sections that are of relevance for the operations that are carried out.
§ 4 Internal systems of safety rules shall be documented and arranged in such a way that it is clear which regulations are included and where they can be found. The list shall be kept up-to-date. The date of the latest revision shall be specified.

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2. Regulations on traffic safety instructions for railways

The Swedish Railway Inspectorate's (Järnvägsinspektionen) regulations on traffic safety instructions (BV-FS 1995:3)

The Railway Inspectorate lays down the following regulations under the authority of § 7 of the Ordinance (1990:1165) regarding safety on railways, underground railways and light railways.

§ 1 Traffic safety instructions shall contain: 1. descriptions and explanations of terms specifically related to operations; 2. regulations on operations, forms of rolling stock movement, speeds, including regulations for work with an impact on traffic safety; 3. regulations on the appearance and content of boards, plaques, signs, hand signals, light signals, etc. that are used; 4. regulations that determine when brakes are to be performance tested and how the testing is to be carried out; 5. regulations on procedures to be observed in the event of faults in track, faults in signal safety installations, faults in vehicles and when vehicles are stationary in unsuitable locations; 6. regulations governing the passage of rail vehicles over level crossings; 7. regulations on rolling stock combinations; 8. any exemptions in accordance with § 10 second paragraph and § 12 second paragraph of the Ordinance (1990:1165) regarding safety on railways, underground railways and light railways, and 9. regulations on the obligation to give way to other rail vehicles where there may be a danger of collision.
§ 2 For railways, § 1 Items 8 and 9 do not apply. For light railways, § 1 Item 2 may only consist of regulations governing work carried out on tracks.
§ 3 Traffic safety instructions need only contain those sections that are of relevance to the operation being carried out.
§ 4 Each operator shall, for the purpose of approval, submit prescribed traffic safety instructions to the Railway Inspectorate.
§ 5 Traffic safety instructions that concern several operators shall be of identical wording in common parts. If an operator's own railway operations come into contact (in any respect) with those of another operator, the operator concerned shall seek consultation with the other operator to the extent required by the operations before the safety instructions are submitted to the Railway Inspectorate.
§ 6 The traffic safety instructions shall be submitted to the Railway Inspectorate no later than four months prior to their coming into force.
§ 7 From the documents submitted, it shall be apparent for which operations the traffic safety instructions have been prepared, by whom and the point in time from which they are proposed to apply.
§ 8 Exemptions from these regulations will be granted by the Railway Inspectorate.

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3. Regulations on training

The Swedish Railway Inspectorate's (Järnvägsinspektionen) regulations on training for personnel with duties of importance to rail traffic safety (BV-FS 2000:3)

The Railway Inspectorate lays down the following regulations under the authority of § 7 of the Ordinance (1990:1165) regarding safety on railways, underground railways and light railways.

§ 1 These regulations apply primarily to those who, in the performance of their work, are directly responsible for its effect in terms of rail traffic safety. If someone other than the person who carries out the task monitors or supervises the work in some way by which rail traffic safety is constantly safeguarded, the responsibility may be deemed to have been transferred and the person in question is instead covered by the regulations.
The following duties are included: 1. Controlling or supervising rail traffic. 2. Operating vehicles. 3. Shunting and marshalling. 4. In addition to the intentions of Item 2, taking action on trains, trams or other similar vehicles in accordance with the company's traffic safety instructions. 5. To take measures in accordance with the company's traffic safety instructions in connection with rolling stock movements and track work. 6. Assessing the condition of vehicles and track installations from the traffic safety point of view regarding to technical functions.
§ 2 The duties may only be carried out by personnel who have undergone and been certified in the training prescribed by the operator.
§ 3 Personnel shall undergo a basic course of training which gives them the competence necessary to be able to perform the duties in a suitable way from the traffic safety point of view.
§ 4 Competence and safety awareness shall be maintained by periodical re fresher programmes. The intervals between the training and its extent shall be determined on the basis of the nature of the duties involved.
§ 5 Supplementary training shall be provided if changes of essential importance to the work are introduced within the framework of a duty.
§ 6 Refresher programmes and, where necessary supplementary programmes, shall be provided for personnel who, through an interruption in the performance of a duty, no longer have the necessary knowledge and proficiency.
§ 7 There shall be documented regulations on how the training is to be carried out. From the regulations it shall be clear: 1. which functions in the organisation are covered by this ordinance; 2. what basic training is required for each function; 3. what the longest intervals are between the periodical refresher programmes; 4. when refresher and supplementary training programmes according to § 6 are to be held; 5. what principles apply when taking examinations.
§ 8 Each training programme shall be described in a training plan. The description shall comprise: 1. an identifying designation; 2. the goal of the training programme; 3. necessary prequalifications; 4. content; 5. training period, divided into theory and practice; 6. maximum number of participants; 7. requirements regarding the competence of teachers/instructors; 8. examination principles; 9. requirements for application in connection with the completed training.
§ 9 No later than four months before coming into effect, a training plan, according to § 3, shall be submitted to the Railway Inspectorate for approval.
§ 10 It shall be ascertained that the personnel who commence a programme of training have the necessary prequalifications as specified in the trainingplan in question.
§ 11 All training shall include an examination that determines whether theparticipant has achieved the goals of the training. It shall comprise theoretical knowledge and, where appropriate, also practical skills. Examinations shall normally be written. They may be conducted using other methods provided that proficiency in reading and writing are not necessary for the duties in question. In the case of re-examination following a failed examination, the new examination may not simply comprise the checking of what led to the original failure.
§ 12 Each completed programme of training shall be documented. The documentation shall specify: 1. the participant's name; 2. the name of the training programme; 3. the date; 4. the name of the instructor; 5. the level of competence attained; 6. the examination result. § 13 Training plans and documentation according to § 12 shall be saved for at least 10 years. In the case of training plans, the time shall be calculated from the date on which the plan ceased to apply. § 14 There shall be collated and easily accessible information

demonstrating that a person, in accordance with current training requirements, is authorized to carry out duties.
§ 15 Training activities shall be evaluated on an on-going basis. Essential changes in the extent of the training provided shall be justified and documented.
§ 16 Exemptions from these regulations will be granted by the Railway Inspectorate.

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4. Regulations on internal controls

The Swedish Railway Inspectorate's (Järnvägsinspektionen) regulations on internal control through safety management (BV-FS 1996:1)

The Railway Inspectorate lays down the following regulations under the authority of § 7 of the Ordinance (1990:1165) regarding safety on railways, underground railways and light railways.

§ 1
Safety Management
The term 'safety management' means all measures which an operator takes in complying with the Railway Safety Act (1990:1157), the Ordinance on Safety on Railways, Underground Railways and Tramways (1990:1165) and any regulations issued under the terms of the Act or Ordinance.
Safety Management System
'Safety management system' means the activities affecting safety concerning organisation, responsibility, procedures, processes and resources which are required to control and manage operations.
System Audit
'System audit' means a systematic examination to determine where activities which affect safety and the associated results are in compliance with what had been planned, and whether the activities have been carried out in an efficient way and are appropriate for achieving the objectives.

Scope
§ 2 The requirements of safety management cover, over and above the operations of the operator, operations which are carried out by contractors on behalf of the operator, as well as products which are significant for safety, which the operator uses.

Safety Management
§ 3 The operator's executive management shall apply safety management to the operation. Safety management shall be followed-up to the extent required by the operation.

§ 4 A system of safety management shall be established for operations the size or complexity of which makes more than one operational level necessary for the operation of track installations, rail or special traffic-management activities. This system may be arranged as part of an overall Quality System and shall in that case be documented in such a way that it is simple for the Railway Inspectorate to study the relevant parts. The follow-up of safety management shall, for those covered by system requirements, take place through system audits in accordance with a documented plan. The plan shall be evaluated and updated to the extent required by the operation. The results of system audits shall be documented.

§ 5 Safety management, in accordance with §§ 3 and 4 shall not only be documented overall but also, to the extent required, broken down and tailored to the underlying operational levels. The documentation shall record policy, goals, standards, resources and methods concerning safety management. The documentation shall be kept up to date and be available to personnel concerned.

§ 6 The operator shall have procedures which guarantee that accidents, near accidents and deviations in operations and production are rapidly picked up. The procedures shall be well-documented and shall describe how accidents, near accidents and other deviations

shall be identified, documented, evaluated and remedial action taken, and how information shall be provided for those affected.
§ 7 The operator shall define and document tasks, authority and collaboration and consultation relationships for those who lead, carry out, or control work which affects safety.

§ 8 The operator is responsible for ensuring that the required resources are available to fulfil the operational safety requirements.

§ 9 When it is intended to introduce new technology, new principles, significant changes in the existing organisation or untried solutions which are significant for traffic safety then risk analysis, or, in simpler cases, risk assessment, shall be carried out, verified and documented.

§ 10 Exemptions from these regulations will be granted by the Railway Inspectorate.

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5. Regulations on the reporting of accidents

The Swedish Railway Inspectorate's (Järnvägsinspektionen) regulations on reporting accidents and near misses (BV-FS 1997:3)

The Railway Inspectorate orders, after consultation with the Swedish Board of Accident Investigation, the following, under the authority of § 7 of the Ordinance (1990:1165) regarding safety on railways, underground railways and light railways and § 20 of the Ordinance (1990:717) on Investigation of Accident.

§ 1 Over and above anything following from § 20 first paragraph of the Investigation of Accident Regulations (1990:717), traffic operators shall report without delay on The Railway Inspectorate's emergency telephone line if an accident occurs in the course of railway, underground railway or tramway operations which has caused: 1. the death or serious injury of a person, or 2. substantial damage to a rail vehicle, track installations or property which was not transported by rail vehicle, or substantial damage to the environment.
§ 2 Accidents not covered by § 1 shall be reported without delay on The Railway Inspectorate's emergency telephone line if they have given rise to: 1. the discharge of hazardous goods into the environment, or 2. serious damage to rail vehicles carrying hazardous goods or serious damage to load carriers holding hazardous goods transported on rail vehicles. § 3 Immediate reports of accidents or near misses in accordance with §§ 1 and 2 shall contain information on what happened, the time and location of the incident, the extent of any damage, what movements, vehicles and other equipment were involved and which operator is responsible for further contact with The Railway Inspectorate.
§ 4 Written reports on accidents or near misses are to be submitted by the operator on request by The Railway Inspectorate. They must be submitted at the latest four months after the receipt of a written request from The Railway Inspectorate. Note: This text has been translated with a view of giving an insight into the spirit and content of the Swedish Inspectorate's regulations. No assessment of quality or accuracy in legal terms has been made. Reports in accordance with the first paragraph shall contain a more detailed description of the accident, and of any circumstances which are significant for the course of events and for the conclusions reached by the operator on the causes of the incident and the measures which are planned, or which will be taken, as a result of the incident.
§ 5 At the latest on 30 April every year, the operator shall submit information on accidents and near misses in the preceding year, with their causes, to The Railway Inspectorate. The information shall be submitted on the form supplied by The Railway Inspectorate.
§ 6 Exemptions from these regulations will be granted by the Railway Inspectorate.

2.2.2 Licensing

Permission is required for a company to run railway traffic in Sweden. This consists of a licence and a safety certificate. SRA is responsible for the examination of applications for permissions. The licence is issued to companies that supplies engines (dragkraft), performs railway traffic, and are located in Sweden. An insurance covering MSEK 300 is recuired.

Administration of railway infrastructure also requires permission according to the railway act. (Näringsdepartementet, 2004:1). The administrator does not have to own the installation; it is enough that the administrator independently has the installation at one's disposal and is responsible for its attendance and maintenance.
During 2004 45 permissions were approved. The mean time for the permission process for each application was appr. 25 days (counted from when the last relevant document reached the authority). The time has increased from 2003 when the time for the process was roughly 15 days (Järnvägsstyrelsen, 2005, pp.16-19).

Applicants aiming on organizing railway traffic, but not practicing are objects for *authorization*. This permission is relevant for regional public transport authorities and large buyers of goods transportations. Regional public transport authorities are, without authorization, allowed to organize some public passenger traffic until the end of 2006.

SRA can recall permissions if conditions for the permission are not fulfilled and if the possessor of the permission does not fulfill their duties according to the railway act. 12 permissions have been recalled during 2004 (Järnvägsstyrelsen, 2005, pp.16-19).

2.2.3 Approvals

SRA is responsible for aproving new systems and sub-systems within the rail-,tram-, and sub-way. The primary aim with the process is to test if new systems and sub-systems are as safe as or safer than already existing systems. Areas objected to the approval process are: *vehicles*, *track installations*, *technical systems*, *traffic safety instructions* (TRI), *training plans*, *station names* (trafikplatsnamn), and *market control*.

An approval is the first step in the safety chain. The other steps are maintenance and operations. Within the frame of the companys or the administrators own safety management (säkerhetsstyrning) the function of operations and maintenance is controlled. The function of safety management is controlled by SRA's supervision activities. SRA emphasizes that safe traffic is dependent of that several links in the chain do not split. During the second half 2004 no approved or temporarily approve vehicles caused an accident or incident (Järnvägsstyrelsen, 2005, pp.20-23).

2.2.4 Supervision of safety

The purpose of SRA's supervision of safety aims on maintaining and/or improving the prevailing high degree of safety. The activities are directed towards administrators of

infra structure and railway companies with valid permission for their acitivities. At the end of 2004 this applied to 701 administrators of infra structure, and 133 railway companies. The main purpose of the Supervision of the licensees is to control that they have a well functioning safety management. This shall include: follow-up's, internal information/reporting, and handling of deviations, which in turn leads to that the companies detects and corrects their own errors and shortcomings.

SRA applies five methods for the supervision of safety: *audits* (revision), *theme-inspections*, *mini-themes*, *inspections*, and *company meetings*. Operations with a higher probability for an accident with unacceptable consequences are prioritized. Figure 6. shows how the different methods are applied within a company.

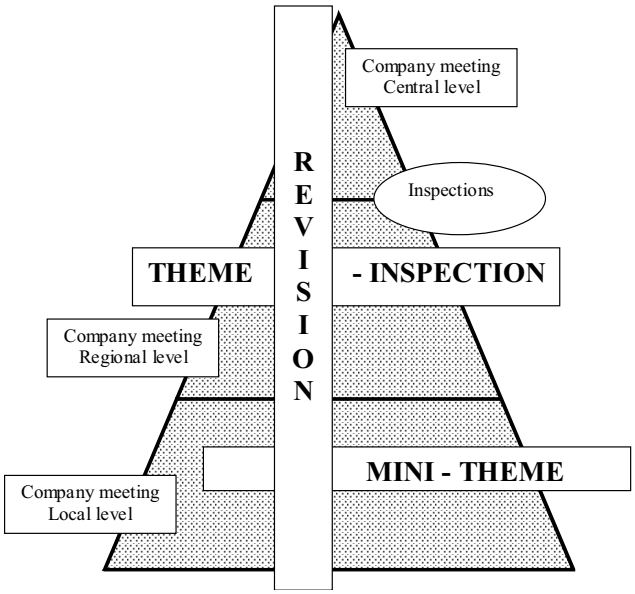

Figure 6: SRA's five methods for supervision of safety applied on different levels of a company indicated by the grey triangle (according to: Järnvägsinspektionen, 2005 p.24).

SRA puts up goals on the desired level of annual supervision. The annual goal was that 200 inspections, 20 company meetings, 4 theme-inspections, and 9 audits should be accomplished. The actual result was 153, 22, 1, 2, 7, on the five supervision forms respectively. SRA reports that the main reasons for the lacking quantitative goal fulfillment (qualitatively the supervision was at the same level as the previous year) was a lack of personnel mainly depending on retirements, dismissals, and that new tasks have been introduced before new personnel had been recruited for the tasks. These shortcomings will be attended during 2005, mainly by internal training programs and by the recruitment of new personel.

Concerning the results of the annual supervision, SRA emphasizes the following results:

-Obscurities have been identified in the three-part relationships that sometimes occur in relation to purchased (upphandlad) traffic. This applies to cases in which the purchaser of traffic is supplied with vehicles and appoints a workshop for the maintenance. In this case the Railway Company responsible for the traffic safety cannot take his full

responsibility for the maintenance and investments in the vehicles. SRA has called attention to these unsatisfactory conditions when they have beed discovered.

-The supervision has also pointed at certain problems with safety management in railway companies and administrators of infrastructure. Most injunctions are in relation to transports of dangerous goods.
-Systematic shortcomings in the railway- and track-systems are decreasing which also is a sign of that safety has been enhanced (Järnvägsstyrelsen, 2005, pp.24-26).

2.2.5 Accidents and incidents

In case of a railway accident, incident, or other deviation related to railway traffic, it shall be reported to SRA. SRA keeps a 24-hour on-call duty, all days of the year, aiming on answering each call within 30min.

The accident investigation activity is connected to the on-call duty. Facts are collected and analyzed, which enables that experiences become safeguarded and in turn can be utilized for safety improving measures in all track-bound areas of activity. Following the analyses, SRA produces proposals to actions and follow-ups. SRA follows the investigations made by the operators, and makes own investigations.

During 2004, 437 accidents, incidents and other deviations were reported to SRA. This was a small decrease from the year before. Of the reported events 94 was of the category with “obligation to report” according to the regulation of reporting of accidents and incidents. Among these reports, SRA has demanded reports from 34 of the operators about the events, the causes to the events, and which actions the operators will take. No train travelers were killed during the year.

SRA has during 2004 started a co-operation with the Swedish Accident Investigation Board (Statens Haveri Kommission – SHK) in order to establish what shall be reported from SRA’s on-call service to SHK. According to a audit report on the legislation in this area there is an ongoing project aiming on clarifying the work boudaries between SRA and SHK The accident investigation activity is connected to the on-call duty. Facts are collected and analyzed, which enables that experiences become safeguarded and in turn can be utilized for safety improving measures in all track-bound areas of activity. Following the analyses, SRA produces proposals to actions and follow-ups. SRA follows the investigations made by the operators, and makes own investigations. (Järnvägsstyrelsen, 2005, pp.28-29).

2.3 The interviews with the former SRI

2.3.1 Organizational change, structure, and safety

The creation of the new authority was partly related to a EU-directive about that the agency not should be part of the organization they are supervising. The Railway Inspection is not becoming reorganized, but cease to exist and is replaced by the new Railway Authority. The improvements following the change focus more on the customer’s perspective than on improving the organization. Due to the changes in the railway act some improvements have occurred, for example the possibility to check

sealed areas, something that previously only the customs were allowed to do. However, this is an improvement related to the changes in the act on dangerous goods, and has not anything to do with deficiencies in the prior organization.

There exists an opinion that there are too few local inspectors. This happened already in 1999 when the regional responsibility was dissolved, and the "areas of responsibilities" (ansvarsområden) were introduced instead. Those areas of responsibilities were: (a) dangerous goods; (b) SL (in some sense regional); (c) tramways; (d) museum-railways; and "big actors" (e.g., SJ, and Green Cargo).

After the establishment of the new authority 204-07-01, the most important effects for the safety work are that: SRA will enter new areas, such as market-control and market-supervision. We will get a structure for approaching the customers' needs. The customers will have clear "entrances" for contacting the authority. Also, more effort can be laid down on licensing. There have previously been limited resources for this at the rule section. This work will now be shared between two units. Still another advantage is that it will be easier to take advantage of competence "across" the organization.

There was a concern about that the commitment and spirit tends to fail when the local offices are closed down. The local offices with inspectors correspond roughly to the regions in Banverket's former organization. It was noted, that Gothenburg and Boden were closed in September 2004 and incorporated to the new organization. Ängelholm and Karlstad are already closed down, primarily due to retirements and are replaced with personnel in Borlänge. Following this, SRI is no longer located "on the spot" and does not have the same local knowledge and relation to the local area (personal contacts etc.) as previously. In May 2004 the decision came to keep the Stockholm office and to close down the remaining local offices. The closedowns comprise experienced personnel who should be able to transfer knowledge, within the frame of the local operations, to new personnel.
The personnel at the former Stockholm office are in the new organization still located in Stockholm, but belong to the Infrastructure division and the Railway Company division. All other activities of supervision are initiated and carried out from Borlänge

It took a lot of time to push through the changes. The parliament directives came about New Year 2004, and the inquiry was finished at march-April 2004, and the new organization shall be in operation at July 1 2004. At the time for the interview in June 23 2004, it was not known what the changes exactly would imply, so the development of the new organization should continue after July 1 2004. Much time was laid down on discussions about the organizational change but the time consumption did not affect SRI's main duties negatively. Much time was also laid on investigating what the reorganization would imply for the regional offices. This included, for example, to study the investigation report on the new railway organization "Rätt på spåret", the new railway act, how other agencies are organized, and some labor union work. In this regard, effort was made to point at important arguments to keep the local offices. The work goals have been fulfilled, and there has not existed any threats from this point of view. The colleagues have of course thought a lot about what the new authority will bring about. One positive aspect with the new organization is the closer co-operation between colleagues, and consequently, a better calibration. From a safety perspective there is no big difference with the new organizational structure.

One further improvement that could be made in order to increase the safety work is to put more effort on licensing (tillståndsgivningen).

2.3.2 Threats against railway safety and how SRI manages them

2.3.2.1 Internal risks in companies

The companies' own organizations are important internal risks for deteriorating safety. The companies do not emphasize the safety organization in a sufficient degree. Some companies may perceive that there is no "in-account" for safety from the perspective of economy. It is not unusual that the safety organization is not represented in the board. They are therefore not part of the economical decisions that may be of vital importance for the safety work.

Two other areas of essential internal risks for deteriorating safety in the companies were identified in the interviews: (a) economy, it is a tough branch (and there is also less funding from the government than before); and (c) small companies cannot have all sufficient competencies within the own company.

2.3.2.2 External risks for companies

One important external risk for the companies is the economy. Road transports are cheaper. The deregulation is also an external risk for the companies, partly due to that the traffic purchase time limits (upphandlingstider) with the National Public Transport Agency (Rikstrafiken) are often too short to make the companies invest in safety. Three essential internal risks for deteriorating safety in the companies were identified: (a) the free competition on trained personnel. External training for every profession does not exist. Consequently, there is a fear that an individual that has cost a lot to train internally will leave for the competitor; (b) the rules are used and interpreted in somewhat different ways by different companies. Smaller companies tend, depending on limited resources, to drift towards the "minimum acceptable level" of a certain regulation; and (c), companies do not train their personnel more "broadly" than needed. Sometimes they trust that a person has got broader training with another company that she/he in fact has.

Regarding changes in external risks from the surrounding world (economy, terrorism, etc.), the issue is most relevant for transportation of dangerous goods. The consequences may be big. From a Swedish perspective, there has been minimal risk so far. But no countries that have been struck have thought that they would be! At the moment, there seems to be no such threat, but one could imagine that there would be future threats of theft or sabotage of dangerous goods.

SRI has no method to measure such risks, other authorities have. For risk in general, SRI has recruited competencies in the areas of MTO and risk analysis. But, it is the companies them selves who shall carry out the risk analyses. Here, SRI has a controlling function and the inspectors have received some training in risk analysis.

There exist no formal indicators for changes in safety, but sometimes the increase/decrease in number of complaints is reviewed. The main reason for this is to more to calibrate the inspectors, than use it as an indicator on safety. Green cargo has developed something called “key-figures for safety” (“nyckeltal for säkerhet”). Also minithemes could be utilized as indicators. They are perhaps the type of supervision that is most suitable for that purpose. However, they have to be initiated by SRI.

2.3.2.3 Internal risks for SRI

When it comes to the internal risks for SRI’s work, there is a general risk in to focus too much on the most urgent problems and to push the long-term to the future, in order to prevent other problems. For example, when foreign licensees are introduced on the market. SRI does not know exactly how to act when the licensee is located abroad, there are problems to communicate, etc. The economy influence what can be done. The most urgent has to be paid at the moment – the future you do not have economy for though it may cost more in the long run. But if this happens, the selection is based on experience. Analyses of accidents are important and give much in return in the longer perspective. There are minor risks for the long-term work as long as there is time and other resources for doing proper analyses.

2.3.3 Systematic feedback and safety management

2.3.3.1 Internal feedback

Information is communicated primarily at various meetings. Here, participation at the own sections meetings is important, but also participation at other sections meetings. The rule section meets every 14-day, the head of the inspection unit (CJT) gathers the unit 8 times a year, and the group of inspectors meets each Friday. It was noted that the inspection group gets “a lot of space” at the meetings for their issues. Letters with section-relevant information is distributed by email. The head of the section sees that information is communicated between sections.
At the Stockholm office, the protocols from the rule sections meetings are communicated by email. Telephone contacts are also made each week. Every sixth week there is a meeting with the supervision section (tillsyns sektion) and a site meeting (arbetsplatstäff). Discussions between inspectors are possible at those occasions. Information between the local offices was primarily communicated per telephone and by email. The personnel from Boden and Gothenburg often visited Stockholm and used the Stockholm office during their visits, and the other way around.

Informal meetings such as coffee breaks and morning meetings are considered as important for the communication of information. The local offices units have not the same opportunity to “discuss issues in the corridor”. From this poit of view, informal meetings have been lacking. But, there is ongoing work to get closer to each other by means of new technology, such as videoconference, etc. Sometimes it is difficult to catch people quickly enough. By means of the new technology the Stockholm office could become an extension of the office corridor in Borlänge.

It was also noted that coffee rooms at different levels in the same building might be disadvantageous from an informal-meeting point of view.

2.3.3.2 External feedback between SRI and Banverket (and other authorities)

SRI and Banverket meet at company meetings twice a year. The meeting is obligatory and pre scheduled. Meetings also take place following emerging situations, and there is a mutual information exchange between SRI and Banverket. From a SRI perspective, Banverket is regarded more as an operator than an authority (SRI inspects some of Banverkets activities). For example, prior to a directed inspection of Banverket, they are first contacted by telephone, and then a formal letter is mailed.
A new national forum called "inspection forum" ("tillsynsforum") has been created. About 30 Swedish authorities are represented there, among them the national inspecting agencies for: sea-, air-, road-, and railway-transportation. There are also meetings between the Nordic and the European railway inspection agencies 3 times a year.

Communication with other authorities not primarily related to railway traffic, is most common in relation to dangerous goods. The Rescue Services Agency coordinates the efforts between the customs, police, coast guard and the Maritime Safety Inspection. Other authorities with relevance are: SIKA, the Work Environment Authority, and Banverket, who is the authority with sectors responsibility. There is also communication with some departments, the Ministry of Industry, Employment and Communications, and with the Ministry of Defense, often in relation to issues concerning transportation of dangerous goods. This has, so far, worked best in the Stockholm area. The Swedish work environment authority has published directions for work with railway switches.

There is also communication with some departments, basically with the Ministry of Industry, Employment and Communication.

2.3.3.3 External feedback between SRI and Companies

Communication between SRI and the companies takes place through the activities of supervision, in investigations of accidents and incidents, and at company meetings. When the activities in a company are changed in a way that it may affects safety, the company shall report it, and a risk analysis shall be carried out. Communication with companies that organizes traffic, so called "trafikhuvudmän" (e.g., skånetrafiken) does not normally take place. The communication between SRI and the large companies is usually good. That is because both have their origin in the former SJ, where safety culture usually has been emphasized. But in step with the deregulation, and when new actors are coming into the market there is a risk that this will decrease.

Information to the companies concerning identified deficiencies occurs sometimes. Examples of such occurring deficiencies was when a certain type of transistorized igniter to a fluorescent tube suddenly could become a risk of fire, or, when a door-bolt belonging to a certain type of car from the 60's suddenly could open up by it self. In these cases the companies were contacted.

There are great differences in the ways SRI and the companies look at safety. In small companies traffic safety is often dependent on one individual. For example, sometimes the same person may manage both safety and environmental issues. A large company may have different organizations for the different issues. Also in the Railway business there are fortune hunters, interested in quick profit. They do not always have the genuine knowledge of railway safety.

Some informants say there has been an "old-fashioned tradition" within the railway area to suspend the people who are doing wrong. For example, could drivers be suspended from driving. And, as a consequence, companies may not report own incidents in a sufficient degree.

From a historical point of view, military officers once started up the tramways, and terms such as "mess room" for dining room still exist at SL, and some informants say that the military tradition is still visible in some aspects of the SL's organization.

2.3.4 Safety analysis

Railway activities are in a continuous development, for example in the areas of vehicles and signal systems. From an organizational point of view there is a trend towards smaller companies. The large companies get slimmer and new small companies are introduced.

The operators (trafikutövare) are demanded by SRI to carry out risk analyses if there have been changes in materials or in the organization. However, SRI only control if they have been carried out, for example, at company meetings or at an audit. Companies seem to have difficulties in assessing when when risk analyses shall be done, for example, regarding changes in maintenance intervals. SRI has recently recruited new competence in the areas of risk analysis and MTO, and has internal training programmes in this area.

2.3.5 Safety policy

SRI demands the companies to have both general and decomposed goals and a policy. This is checked at audits. Most companies have a policy, but it is not always so that they have sufficiently clear objectives concerning safety. The companies shall have a formal written safety policy in form of traffic safety goals that are divided into sub goals that shall be measurable. A policy is often stated in general terms and is difficult to measure. The decomposed goals are most important. They shall be measurable and comparable over time. There are often difficulties in the formulation of the decomposed goals. These are demanded from the traffic operator (trafikutövare) and are checked at audits and inspections. It is up to the companies to develop their own policies. They need something that is adjusted to their own activities, and they have the responsibility. On the other hand, SRI has a well-pronounced regulation strategy, which is clearly stated in the regulations.

2.3.6 Accident and incident analysis

Serious accidents or incidents with people killed or injured shall immediately be reported to SRI. Also accidents or incidents with gross material damage or environmental effects shall be reported. When an accident has occurred, an investigator at the emergency call center at SRI receives an initial report and a chief investigator decides about the measures.. A secretary files the report in JAS (the Railway Administrative System) within 24 hours after the call.

Possible measures are: (a) SRI investigates; (b) SHK investigates; SRI follows-up a company investigation (SRI participate during the investigation as advisors); (d) SRI demands and examines an investigation report made by a company, after the investigation has been accomplished. There is often a designated investigator at the companies, but not always. Sometimes the companies hire the competency.

Information about accidents is sometimes transferred to an international level, This is more the rule between the Nordic countries. Information about accidents is also communicated on European meetings at the issue “the table around”, and at Nordic meetings.

There is no formal difference in the procedures between an incident or an accident, but the companies sometimes make different assessments of how serious an incident is, which leads to if they report the incident or not!
Here, it was noted that "the longer the perceived distance between the train and a possible cause to an accident, it seems as if it more seldom become recognized as an incident or danger".

Some examples of SRI measures following the evaluation of an incident report are: (a) initiated supervision; (b) demand actions against deficiencies; (c) injunction about measures; (d) injunction with fine, if the measures do not correspond to agreements; (e) prohibition; (f) suspension of license; (g) report to public prosecutor.

There is no formal difference in the procedures between an incident or an accident, but the companies sometimes make different assessments of how serious an incident is, which leads to if they report the incident or not!

2.3.7 Human resource management in SRI and in Companies

Despite the workload on the personnel at SRI, they have time to handle most tasks. However, some areas are more vulnerable, such as vehicle approvals. When SRI is moving into the new organization they are increasing the number of employees from 31 to 48. This increase must be viewed as an enlargement to cover the new tasks for the organization, and not as a relief on existing tasks. It is not possible, today, to estimate if it will be sufficient or not.

It is difficult to know the level of training among the personnel in various companies, and how much practice they have received recently. The entrepreneur-market increases drastically, which lead to that administrator/operator (förvaltare/utövare) issues also

increase. They who buy competence do not always know what is needed and are not capable of assessing the competence of the entrepreneur.
Some companies have not understood the meaning of safety management (säkerhetsstyrning). The competence about safety management in companies must be improved, and be part of the management of the company as a whole. The safety departments are often small and separated from other activities, and should not be expensive to run. Some small companies hire competence in the area whilst large companies (e.g., SJ, SL, Green Cargo) have an own intrinsic safety organization.

3. SJ AB – the major actor on the Swedish railway market

In this chapter a detailed account of the availale documentation regarding the SJ will be given and analyzed. In the end of the chapter an interview with SJ Agency will be analyzed regarding safety management from the systems perspective outlined by Svenson, Salo and Allwin (2004). Accordingly, the interviews will be modelled in terms of system structures and processes, the information feedback and threat detection (see preceding section).

3.1 Results

3.1.1 SJ's organization

During 2004 extensive organizational change has been carried out within SJ. The company's main argument for the reorganization is that is has created a more efficient organization with shorter paths between customer and the company management. All train traffic management has been gathered in one division, which facilitates planning, and uniformity. The administrative resources have been centralized, and SJ emphasizes that this has been done without decreasing the level of service. SJ argues further that the changes has created a simpler organization and in turn created better conditions to take care of and develop the competence of the personnel (SJ, 2004, p.10).

Following the reorganization SJ is constituted of three divisions and four staff units (staber). The head management consists of the managing director, the company board of directors, and a control group (ledningsgrupp). The managing director reports to the board. The board is appointed by the Ministry of Industry, Employment, and Communication. The control group consists of nine persons including the managing director. The other eight are the directors of the four staff units and the three divisions, plus the director of communications. The board consists of a chairman and six members. The board is responsible for that the government's interests as owners are safeguarded in the SJ group. They are also devoted to the long-term planning.

The three divisions are: *train traffic*, *vehicles*, and *sales*. The sales division is primarily a *production unit* and also the division that carries the operational responsibility. It shall promote quality and service in train operations. The two other divisions are considered *support units*. The train traffic division is the largest in numbers with about 2000 employees, among them the onboard crew and engine drivers. The vehicle division comprises for example the purchase and maintenance of vehicles. The sales division includes travel shops, customer service, and telephone sales. The division also takes care of external sales contacts such as travel agencies. The strategic control and coordination is handled by the four staffs: business development; economy; traffic safety; and operational development (SJ, 2005, p.10; 2005:2). See figure 7. for SJ's organization.

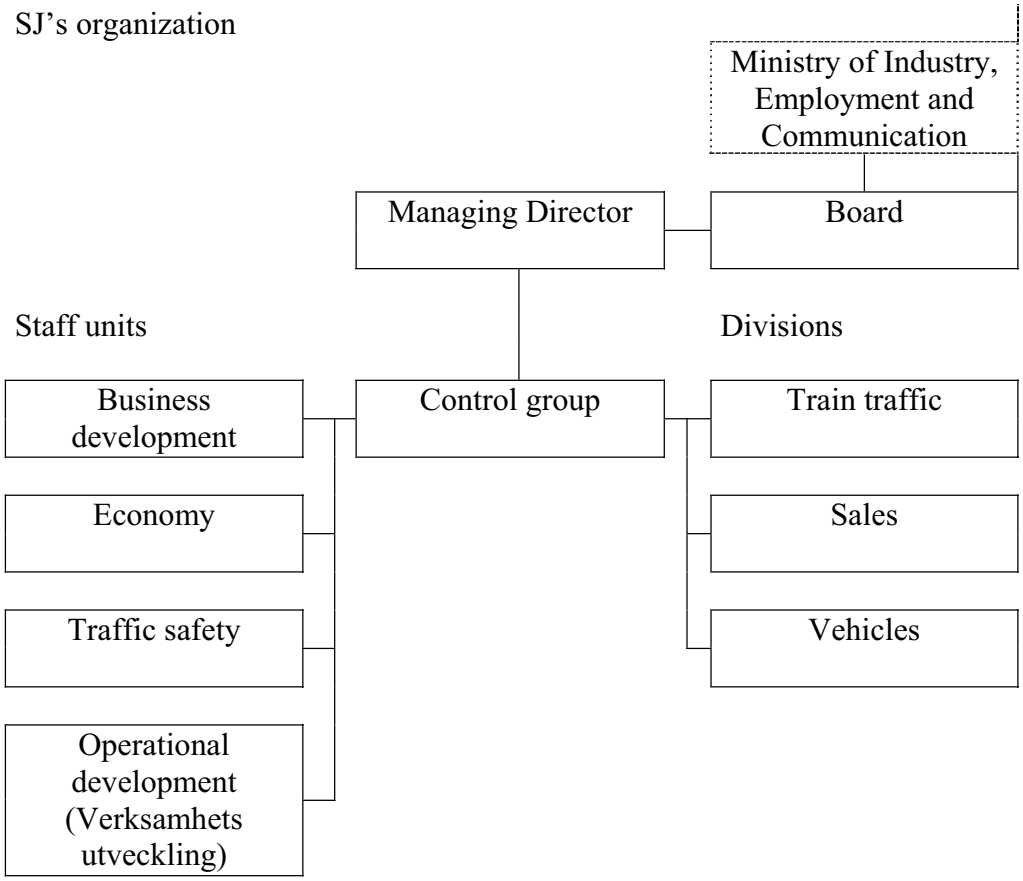

Figure 7: SJ's organization (SJ, 2005, p.10; 2005:2).

In the SJ AB group also a number of subsidiaries are included. These companies manage, for example, SJ's insurances and financing. Other subsidiaries and related companies run business activities closely attached to SJ's core activities:

-Linkon AB, owns SJ's ticket sales system
-SJ Invest AB, is the internal finance company in the group
-SJ Försäkring AB, is a captive company that signs insurances for the group.
-SJ Event AB, former SJ Rent a Train, offers travels outside the standard range of travels
-Vilma AB, e-learning related to train activities was sold during 2002 and remaining activities -rom that company ends in 2005
-PS ParkSmart AB, 90% of the stock was sold 2004.
Other subsidiaries are resting.

3.1.2 Business activities

In a press release December 12 2000, SJ responded to the Swedish parliament's clear-sign to deregulate the former Statens Järnvägar – we are prepared! After Great Britain, Sweden is the most open railway market in Europe. Foreign companies are already in

Sweden and in step with the opening of markets in other countries SJ wanted to join the competition (SJ, 2000). In January 2001 the former Swedish State Railways (Statens Järnvägar) was divided into 6 independent incorporated companies, each of them actors on separate markets:

SJ AB, which this chapter is devoted to.

JernhusenAB, (the former SJ Terminalproduktion) owns, administer, and develop a stock of buildings consisting of stations, workshops, offices, and warehouses along the Swedish railway lines. They contribute actively to the building of new stations and further travelling with train- and other public-transportation. Jernhusen rents area for commerce, and sees to that the travellers have access to waiting-rooms, storage, toilets, etc (Jernhusen, 2005).

Euromaint AB, (the former SJ Teknik and SJ Verkstäder) is the leading supplier of maintenance solutions and modifications for the rail traffic branch in Sweden. It has workshops on 14 locations across Sweden (Euromaint, 2005).
Jernhusen and Euromaint are owned by the holding company Swedcarrier AB, which in turn is owned by the Swedish state through *Ministry of Industry*, *Employment, and Communication*

Green Cargo AB, (the former SJ Gods) is a company in the area of railway and car transportation and logistics (Green Cargo, 2004). It is the largest Swedish actor on the rail freight market. Green Cargo is owned by the Swedish state through Ministry of Industry, Employment, and Communication.

ISS TraffiCare AB, (fusion of different functions of the former Statens Järnvägar, including the the former SJ Terminalproduktion) are offering specially developed services to customers within the areas of vehicles-, station-, and cleaning-service. Their service ”Färdigt Tåg” gives customers service-ready trains at the platform. Among the customers are: SJ AB, Tågkompaniet, BK-tåg, Banverket, Jernhusen AB and Arlanda Express. ISS Facility Services AB is part of the international service company ISS A/S (ISS Trafficare, 2005).

EDB Unigrid, (the former SJ Data) supplies solutions for IT systems in several areas. Important customers are travel and logistics, bank and finance, and retail trade. EDB Unigrid is an affiliate company owned by EDB Teamco AS, a company in the EDB Business Partner group.

3.1.2.1 The market

SJ AB is the largest actor on the Swedish Passenger Railway market with an annual turnover 2004 on MSEK 5709. It is a government owned incorporated company with a 55% share of the Swedish train traffic market. The enterprise is divided in two parts, one part that is exposed to competition on the market, and one part that is not. On the lines exposed to the market, the Swedish state, and the *regional public transport authority*[4] are buying traffic from various operators for instance from SJ. On other lines,

[4] Authority responsible for local and regional scheduled passenger services within a particular county, Sw. *Trafikhuvudman*

the Swedish government has given only SJ the assignment to run the traffic. On those lines SJ are exposed to competition from other means of transportation, such as airline, cars, and bus. In addition, SJ are exposed to competition from foreign train companies that, on equal terms, are welcome to compete on the Swedish market on The company serves appr.70 000 travellers per day. The company has 3273 employees and the head office is located in Stockholm (SJ, 2005).

After the deregulation the company slipped down into an economic crisis 2002, but in 2004 the company again showed positive results. During 2004 a second step was taken towards lowering the costs for administration. In the first step the production costs were reduced, and in the second step train traffic was gathered in one division thereby centralizing the administrative resources. The reorganization was accomplished without lowering the service level. SJ has developed a business plan (affärsplan) consisting of four areas they consider critical for achieving competitiveness and price worthiness: *Basic quality*; *result improvements and financing*; *business- and market-orientation*; and growth. According to the company they have made progress in the two first areas in the business plan and for 2005 they will make efforts on the area of *business- and market-orientation*, mainly by focusing 6 important areas: *leadership*; *offers to customers*; *treatment of customers*; *marketing and sales*; *efficiency and quality*; and, *contracted traffic* (avtalstrafik) (SJ, 2005, p.6).

3.1.2.2 Market philosophy

The philosophy of the company can be summarized as follows:

Vision: Everybody wants to take the train!

Mission: SJ will offer price worthy train based travels in and outside Sweden, so that they at their best can manage their planned activities during the travel and at arrival.

Business idea:
-SJ will offer business-, leisure-, and commuter-travellers an attractive offer according to the concepts of ”Hela resan” och ”En användbar stund” (the whole travel, a useful time).
-SJ will offer regional public transport authorities (trafikhuvudmän) and the National Public Transport Agency (Rikstrafiken) an attractive offer from a modular concept based on train.
-When profitable, SJ will offer ”adjacent” services that increase the competitiveness of the train.
-SJ will create a business oriented, strong and flexible delivery system that in a cost efficient manner, and under own private management or in co-operation with others, is capable of delivering the services.

Financial goals: The owners’ long-term financial goal for SJ is 30% solidity, a 13% yield on own capital after tax during one business cycle, a debt-degree of 1 and a degree of interest covering at 2.

Strategy: We shall operate according to the needs and conditions of the market. SJ will be a competitive, strong, and flexible company that on a cost-efficient and customer-adjusted manner will deliver services self and in co-operation with others. It shall also

be exciting and developing to work in SJ. SJ's strategy is to create value-growth for the owners by generating business oriented yield on own capital. We shall be strong enough to create financial freedom in order to control our own development and our investments for the future (SJ, 2004, p.8).

3.1.2.3 The railway legislation and the market

The overall conditions for SJ as an actor on the railway market changed substantially when the propositions in the government railway inquiry report "Järnväg för resenärer och gods" was published (SOU, 2003). The following changes in the legislation were intended to increase compatibility on the railway, but will probably also change the views on the conditions for rail travel in general. The third railway package includes proposals to open the market for international passenger traffic on the railway not later than January 1 2010. The Swedish government will publish their proposition on this issue during 2005. As a part of the work on analyzing solutions for the future passenger train traffic the report "Vem får köra var" (Who is allowed to drive where) was presented in December 2004. In a statement on this matter SJ presents their vision. SJ argues that in order to fully open up the Swedish market requires that corresponding changes takes place in the rest of Europe and that the changes are coordinated in time and that no actor is favored over others because of direct or indirect support from the own government. Extensive analyses and preparations are demanded before such a change is carried out.

3.1.2.4 Market threats

Competitors. SJ identifies two companies, BK Tåg and Tågkompaniet, as the main Swedish competitors. The international competitors on the Swedish market are Conex, DSB, and Keolis. SJ is counting on an increased competition in the near future from foreign actors.
As discussed above, SJ states that their opinion on the topic is clear: competition shall always be on equal terms. By this SJ means the foreign railway companies with own government support shall not be allowed to compete on the Swedish railway net. Sweden must act within EU so that member countries liberalize their markets in the same fair way.

Trends in EU. The EU commission indicates possibilities for increased competition on passenger traffic in Europe. Companies who want to operate the lines will need a special license and safety certificate. Super high –speed trains with top speeds of 350 Km/h are becoming operational in Spain in a few years. Such technologies demand huge investments. This development forces some countries to difficult decision about future systems.
The demand on night train services is decreasing. People choose fast day trains and budget airlines instead.

SJ concludes that the main competitors on the long-distance travel market are not domestic or international competitors on the railway market, but other means of transportation. The competition from car still dominates although it has recently been reduced. Instead, the real competitors are the budget airlines who have invested on the

domestic lines to the degree that some lines have been over established. Despite the better economy in general, the travelling has not increased SJ, 2005, pp 12-15).

SJ have developed some measures to enhance the own competitiveness which may help to counteract the market threats:

-Budget ticket systems
-Good offers to customers will draw more passengers to the trains. SJ needs 5 percentage-points better reservations to achieve a sufficient profitability. This means, for example, only 20more passengers per departure with the X2000 train. It is a reasonable goal that could be reached by means of good service and pricing.
Some current projects to increase the interest of SJ train travels are: *new vehicles*, *increased availability*, *punctuality, travel time warranty*, *better traffic information*, *clean and fresh trains*, *customer ombudsman*, *new and developed service concepts*.

3.1.3 Safety management in SJ

3.1.3.1 Safety management through internal regulations

Before 1988 SJ regulated its own activities. In a supplement to the regulations of the Swedish statutes (Justitiedepartementet, 1976) it was stated that that Statens Järnvägar is one of the central authorities that can proclaim (announce) statutes in other ways than referred to in the Swedish Code of Statutes regulation (SJF, SJM, and other published documents). When Banverket became the authority responsible for the railway sector they also overtook the role as regulator of railway traffic. Today, SJF exists as SJ AB's internal regulations. There are SJF's covering generally every area of SJ AB's activities. When it comes to SJ's safety order (säkerhetsordning vid SJ), it is regulated by SJF 014, and is primarily based on SRI's regulations about safety order (Banverket, 2000). The SJF documents reviewed here were available at Infonät September 2 2004. The documents consisted in large parts of the SJF series; 014 including documents concerning "Internal control through safety management"; and "Investigation of accidents and incidents"; but also documents in series 015 concerning "Health investigations and health conditions" and, "Competence and training". The following sections relate mainly to SJF 014.2, "Management of accidents, incidents and traffic safety related deviations".

3.1.3.2 Safety management systems

Safety management corresponds partly to "säkerhetsstyrning" in SJF 014.1. As with the other SJF it is based on the existing authorities' railway acts and regulations. This SJF applies also to other companies partly owned by SJ AB, such as Linx AB and Merresor AB. These companies are here treated as a combined division and operational area within SJ. The company describes its safety management as a reoccurring, systematic work of planning, follow-up, and actions (SJ, 2004:2). The following systems are designated for safety management and are regulated by documents in the SJF series 014 and series 015. The systems are (SJ, 2004:3, p. 5):

-Safety order (säkerhetsordning)
-Activities and organization

-Responsibilities and delegation
-Safety management meetings
-Agreements with traffic safety affecting content
-Traffic safety goals
-Handling of accidents, incidents and traffic safety related deviations
-Vehicle technological safety responsibilities
-Traffic safety audits
-Risk analyses and risk estimations
-Training and licensing
-Follow-up of personnel
-Health demands
-(Others)

3.1.3.4 Traffic safety goals

The traffic safety work in SJ aims on preventing accidents and incidents. Traffic safety has a core value within SJ and shall, hence, be prioritized, both at planning and at the accomplishment of the traffic production. The overall goals are:

-It shall be secure and safe to travel by train with SJ.
-No passengers and no SJ personnel shall be killed or seriously injured following SJ's operations. A decomposition of the traffic safety goals are reported in SJ's annual traffic safety report (SJ, 2004:1).

In SFF 014.1 some activities to achieve the goals are stated. The comprehensive traffic safety activity is to create and maintain a system covering all aspects of the traffic safety work, and that a sufficient competence level is made certain among personnel with traffic safety affecting work duties. One of the most important activities is to to achieve the goals is to have a functional safety order (säkerhetsordning) including safety management. The safety order describes mainly the traffic safety system and gives instructions for the traffic safety work. Safety management regulates responsibilities and powers, and shall make shure that the activities are carried out according to the safety order.

The more specific activities for achieving the goals are related to the competence of the personnel. In SJF 014.1 (SJ, 2004:1) the competencies for personnel in: traffic safety duty, managers and management personnel, and other co-workers are specified. The specified competences include: sufficient knowledge and understanding to achieve the traffic safety goals (personel); general knowledge about the railway safety act and the SJ safety order, and that co-workers get sufficient training (managers); that personnel with no direct safety related duties gets sufficient knowledge and understanding of the indirect traffic safety importance of their work (other co-workers).

3.1.3.5 SJ as a rail traffic operator

Banverket's traffic agreement (trafikeringsavtal) comprises the companies that have signed the agreement. They are denominated traffic operators (trafikoperatör). That company may have another entrepreneur that actually carries out the traffic and is hence

also considered traffic operator according to the railway act. The entrepreneur is denominated traffic entrepreneur in the agreement. SJ's activities as a traffic operator includes (1) traffic in own private management, (2) traffic on mission for another company which operates with SJ's traffic agreement, or (3) who is in possession of an own traffic agreement. According to the railway safety act SJ's activities do not include the operations of the track (spårinnehav) or certain traffic control activities. In its role as a traffic operator and in accordance to the railway safety act, SJ has a responsibility for all activities carried out within the frame of the agreement for rail traffic operations that SJ has with the SRA. The company board is in possession of that responsibility but has delegated it to the managing director. Further delegations downward the organization (staff, division, unit, area) is stated in SJF 014.1 (SJ, 2004:1). Each delegation is "until further notice" or limited to a 3-month period, and are signed in a standardized form. Certain responsibilities of the safety management belonging to each organizational level's own activities (e.g., division, operative area) cannot be further delegated.

For example, the manager of an operational unit is responsible for the personnel's competence and health; the manning of the trains; that the operational area has a functional and documented information system for communicating regulations and information concerning traffic safety work; accident, incident and deviation management, etc.
When it comes to safety management each unit manager are responsible that; the unit has a working system for safety management; that safety management meetings are held; to look after that the activities has the demanded organization and manning; to look after that the functional specifications (funktionsbeskrivningar) for traffic safety activities are available for administrative personnel with importance for traffic safety, and, to look after that risk assessments or risk analysis are carried out when so is demanded (SJ, 2004:1).

3.1.3.6 Traffic safety coordination

Each operational area shall have a function for traffic safety coordination (TSS – funktion). The function shall include one TSS-responsible, and (if needed) one or several TSS-handling officers. The aspects of a TSS-function is specified and includes, participation in safety meetings, monitoring of safety work, identification and analysis of risk, run activities for improving safety in the traffic safety area, participate in traffic safety audits. Each operative area shall also have a sufficient number of other traffic safety handling-officers, or can by agreement use officers from another unit.
At the division-level the TSS -coordinator function has its correspondence in the D-TSS coordinator.

3.1.3.7 The safety management meeting

A safety management meeting is held each quarter with: (a) the managers of the operational units, (b) the units for division train traffic, (c) and units directly under the managing director. There is one week between the meetings a-c and during that time a protocol is prepared and communicated to the manager at the level immediately above and to the manager of the traffic safety staff. There are templates for the safety management meeting agenda, designed for the purposes of certain operational areas, divisions, units, and staffs.

3.1.3.8 Contracted personnel with traffic safety duty

Personnel defined as being in traffic safety duty includes persons that have functions closely related to the practical handling of the operation of a train. Among them are drivers, responsible for departure signaling, switchers, etc. Each person in traffic safety duty is belonging to a certain operative area.

Persons in traffic safety duty shall be employed by SJ AB (or Linx AB and Merresor in Sweden AB) or be employed by a company that SJ has an agreement with. SJ shall have a traffic safety agreement with the company about the hired personnel. This agreement could be signed by an operative area or by a division that the contractors will work for. Before hiring traffic safety personnel, SJ has to make considerations about training and competence, health demands, the contractor companies own traffic safety regulations correspondence to SJ's regulations, routines for information about SJ's traffic safety regulations to the contracted personnel, etc (SJ, 2004:3).

3.1.3.9 Traffic safety audits

The purpose with the audit activities in the traffic safety area is to identify deviations in relation to SJ's control documents, to identify the potential for improving the traffic safety work, and to be a part of the basic data for decisions within SJ's safety management. It is stated in SJF 014.5 (SJ, 2004:4). Here, an audit is defined as a systematic and independent investigation to settle if the activities and results are in accordance with the planning, if the activities are carried out efficiently, and if the activities are appropriate according to SJ's control documents. There are two major types of audits: system audits of SJ's safety management system (SJF 14.1), and theme audits of particular areas of the SJ activities. Theme audits apply to operational units, and the delegations of the operational units. In addition, audits of suppliers (leverantörer) of services within SJ's traffic safety activities are also carried out. The audits of the suppliers are carried out as system audits. Such suppliers are, for, example, companies that deliver maintenance, reparations or modifications of vehicles with importance for the traffic safety, and companies from which SJ hires personnel to traffic safety duties.

3.1.3.10 Risk analysis and risk assessments

When new technology, essential changes in the organization, work methods, training etc. are introduced in areas important for traffic safety, either risk analysis or risk assessment (in simpler cases) shall be carried out. Risk analysis according to an established model shall be carried out prior decisions about change. The manager in charge of the change initiates it. The responsibility is on the manager of the traffic safety staff in cases of changes that is affecting the entire company, in other cases on managers of the division, staff or unit in question. Results from the risk analysis and risk assessments shall be included as part of the data used for the decisions preceding the change (SJ, 2004:5).

SJ also makes continuous economical risk evaluations and action plans for unexpected events. They are prepared partly on calculations of risk and are complemented with

sensitivity analyses showing the influence of different costs on the resultbefore tax. See figure 8 for a coarse estimation of various risk factors and their impact for SJ during the next few years.

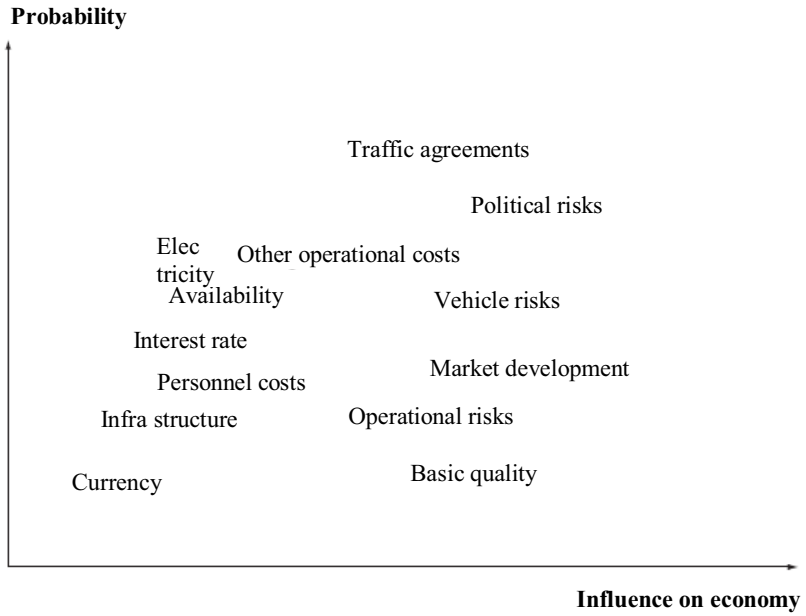

Figure 8: SJ's estimations of probabilities and consequences of various riskfactors on economy (according to SJ, 2005, p.37).

3.1.4 Accident and incidents investigations

SJ AB uses three different designations for events in reporting, investigation and measures. They are: (I) *accident*, an unwanted event that results in damage on people, equipment, or environment; (II) *incident* (tillbud), an unwanted event that under other conditions could have resulted in damage on people, equipment, or environment; and (III) *deviation*, something that deviates from specified demands.

3.1.4.1 Procedures for initial reporting

In case of an accident so severe that rescue service is needed SOS-alarm is contacted. Either the stationmaster (tågklarerare) or the manager of the operational unit (driftenhetschef) makes contact with the SOS-alarm, depending on which track sections the accident has occurred. The event is also reported to the SJ traffic safety emergency call center located at the traffic safety staff (stab trafiksäkerhet). The call center is manned around the hour and can be reached by telephone. Other events are reported to the manager of the operational unit in concern. Routines for the reporting and persons responsible for reporting are stated in SFS. The traffic safety emergency at SJ is responsible for reporting an event to the SRA and the authorities of electrical safety and environmental protection. The responsibility of reporting issues belonging to work environment and safety authorities belongs to the manager of the employee in concern.

Information concerning the event is also fed into the Synergi™ database. The information is used to facilitate the identification of the event both during and after the investigation, and serve as the basis for various compilations of the event information. A report shall be entered into Synergi™ not later than seven days after the event.

3.1.4.2 Levels of investigations

Irrespective of other companies and/or authorities efforts to investigate an accident or an incident, SJ shall always make an own investigation. Concerned parties can make investigations in parallel with SJ. Three levels of investigations are stated in SJF, initiated on different organizational levels. *Level 1* investigations are initiated by the manager of the traffic safety staff. A *level 2* investigation is initiated by an operational unit manager. At *level 3*, a person with safety duty, and who by the operational unit manager or by the traffic safety emergency service is regarded to possess sufficient knowledge to collect facts and in other aspects to document an event may perform the information collection. After the investigation he shall handle over the results to a designated investigator. The three levels of investigations put different demands on investigator training. For example, an investigator must have passed the SRA's course "BASÄUTR" to be allowed to investigate at level 1. Level 1 investigations includes accidents with people killed or injured.

3.1.4.3 Investigation reporting

SJ uses two main types of investigation reporting: *comprehensive* (fullständig) reports, and *simplified* (förenklad) reports. Comprehensive reports are produced according to a specific checklist. The checklist covers 11 different sections described with more than 50 individual items (*summary*, *fact-descriptions*, *damage*, *external conditions*, *witness information*, *registration*, *analysis and conclusions*, *accident cause*, *costs, actions taken*, *proposed actions*). Among the items, the checklist allows identification of *direct causes*, *causes behind* (bakomliggande), *deficiencies in control* (styrning), and the interplay between *man-technology-environment*. This type of investigation report should be completed not later than three months after the event. A comprehensive report is produced following: accidents and incidents initiated by the manager of the traffic safety staff; other accidents and incidents involving killed or injured people; when deficiencies in the safety system have been found; or if the event has caused costs exceeding SEK 100.000. Simplified reports are produced following events that do not demand the comprehensive format. This type of report should be completed not later than one month after the event.

Based on a collection of four different type examples of reports acquired from SJ, there some variation in the reporting procedure can be noted. For example could a preliminary-type report be distributed to the investigated organizational unit for comments on the results before it is finally published. SJ also uses technological consultants for some investigations. In such cases the consultants also writes the investigation report. One example is of such actors is Interfleet International, a well-known international rail technology consultant.

3.1.4.4 After the investigation

After the completion of an investigation, the manager responsible for the investigation shall assess the needs for corrective and/or preventive measures according to the investigators conclusions and recommendations. Time limits for this are not stated. On the other hand, the manager responsible for the investigation is responsible that a system for controlling the implementation of decided measures exists. He/she is also responsible that the investigation report and supplemented decisions become distributed to concerned parties, and that the specific event become completed in Synergi™ .

The manager of the traffic safety staff shall regularly establish a summary of all accidents and incidents within SJ, including analyses of the events, trends, and implemented and or decided measures, and report them at the SJ safety board meeting. In March each year the traffic safety staff publishes a compilation of accidents and incidents (Trafiksäkerhetsraport) from the preceding year. This publication, called "Trafiksäkerheten" summarizes the accidents and incidents during each quarter of the last three years, for each type of accident/incident category (e.g., collisions, hits, derailments, level crossing accidents), and for categories of people killed/injured (travelers, non-travelers, suicides, etc.). The report also gives an account on other traffic safety related deviations, accomplishment of the traffic safety goals, and the safety programs including both accomplished and ongoing (SJ, 2004).

3.1.5 Computerized information systems

Among SJ AB's internal computer systems five systems are more related to information management and distribution and are in various ways important for information safety management. They are:

Infonät, which is SJ AB's internal computer system. It is here important information updates (e.g. SJM) including safety-related information, such as, the company's internal regulations (SJF) are published in electronic form. In SJM information relevant for traffic safety and electrical safety is published every third month. Infonet contains much other information and documentation. When a user logs on the system she/he will receive the news and information the system defines as relevant according to a certain profile based on the employee category and location. The current valid originals are only available at Infonät and outprints of the documents are, as such, only considered valid at the moment of print. However, all documents available on Infonet are considered valid until further notice, but not longer than 5 years for SJF and 1 year for SJM. The publisher is noticed 2 months before the end of validity. Prior editions are only available for the publisher. A link from Infonet to the railway inspection was under preparation during the time of the audit.

Synergi™, a computerized system for reporting of accidents, incidents, and deviations belonging to SJ's operations. The traffic safety coordinators (trafiksäkerhetssamordnare, TSS) make all entries in the system. Reports from train drivers and train masters (tågmästare) are not directly fed into Synergi™. A special form is used for such train reports (REDA blankett) and the procedures for this are stated in local regulations. The results from Synergi™ are published annually in SJ AB's traffic safety report (e.g., SJ, 2004).

TRYCK, a computerized system for prenumerations, distribution, and management of printed matter. For example, it is here that SJF is found in print on paper. It is decided locally if some documentation should be published in print.

Josefina, a computerized system for reporting of vehicle fault status. The system is primarily used by the workshops.

PREG, a computerized Personal Register for reporting of training, health controls etc. At the time for SRI's audit in 2002, PREG was not yet fully adapted to all of the different business regions and local registers were used for the above purposes instead (Järnvägsinspektionen, 2002).

3.1.6. Ecological safety management

SJ argues that train travels are best for the ecology. On SJ's website you can make a environmental-cost calculation comparing travel by car, bus, plane or by train. At the site SJ gives good information about their environmental policy and actions and the whole environmental policy is downloadable from there. SJ travels by electric trains uses the Swedish Society for Nature Conservation's (Svenska naturskyddsföreningen) ecolabel "Bra Miljöval" referred to as "Good Green Buy" or "Good Environmental Choice" in English.

SJ has a very well developed environmental policy and take various actions aimed on minimizing ecological risks. SJ argues that the company's environmental policy shall permeate all activities (SJ, 2005, 16-18).

3.1.7 Safety management audit of SJ AB 2002

SJ AB became an independent company in January 2001. Following the reorganization and the demands on market adjustment of the company, SRI completed in 2002 a safety management audit. The audit had the purpose to determine if the safety management system in the new company confirmed to the requirements of the Swedish Rail Safety Act as well as the SRI's own regulations (Järnvägsinspektionen, 2002). After this report was published SJ AB has again reorganized and the indications revealed in that audit report may not correspond to the conditions in current organization. However partly obsolete, a number of SJ AB's current safety systems are discussed in the report, and it also touches some important features with implications for railway safety management in general.

The results of the audit indicated that the safety management system had a suitable organizational structure, and the staff appeared to be competent and having high safety aspirations. The audit has shown that SJ AB has a functioning system for safety

management. It is important to note here, that even tough SJ reorganized large parts of the organization in 2004, they kept their safety organization/department in large unchanged!

A number of areas relevant both for railway traffic safety management, and safety management in general, could be derived from SRI's audit results:

-Decomposition of general safety regulations and goals and adjustments to lower organizational levels (e.g., divisions, departments, etc.).
-Standardized documentation of safety management routines throughout the organization.
-Departmental interpretations of global goals, document management and safety management. –To facilitate for the employees to orientate themselves in a new organization.
-Routines for dealing with discrepancies from standard procedures.
-Avoiding departures from legislated requirements and procedures (e.g., concerning transnational traffic, risk analysis etc.).
-Good reporting routines concerning departures from standard procedures, and accidents and near-accidents.
-A proper use of risk analysis and risk assessment (Järnvägsinspektionen, 2002).

3.2 The interview with SJ AB

3.2.1 Organizational change, structure, and safety

Sj´s organizational structure has gone through a number of organizational changes during the last decades but the traffic safety staff has been kept more or less unchanged since the SRI was created in the 90's. The reorganizations have affected almost all operational areas and divisions. Two important reasons for the recent reorganization was, first, management reasons, such as increasing the efficiency and the possibilities to win purchases (upphandlingar). And, second, to move from de-centralization in 1999 to more centralization in 2004, in response to that the similar issues were managed in too many different ways across the organization. The safety work was not threatened by the reorganization, this because that the safety staff unit was kept unchanged and that for safety reasons. From a safety perspective, a well-defined organization was created, with well-prepared responsibilities for the different areas of the organization. Also the quarter based reporting to the safety staff unit was one positive development among others that came with the new organization.
On the other hand, there may be too many smaller managerial areas downward the organization. And these managers can sometimes get responsibilities delegated that they do not manage efficiently enough when safety problems occur.
Further organizational improvements that could be done are to train new managers, especially at the lower level, close to the operational safety activities.

3.2.2 Threats against railway safety and how SJ AB manages them

No essential internal risks for deteriorating safety in the company were reported. When it comes to the essential external risks for the company it is important to distinguish between:

(a) *security*, (skalskydd) at stations, and also things that has to do with threat of violence, and trespassing in computer systems; and, (b) traffic safety, which means safe train operations.
When it comes to security, SJ is an "open area of activities" and consequently, train personnel are subjected to threats. It happens very seldom though! And there has, for example, not yet been a need for x-raying bags that is a normal security procedure at airports today. As one example of safety development as a consequence of a changed risk-picture in the surrounding is work on countermeasures for computer attacks. Safety measures regarding terrorist activities etc. belongs to the domain of the police. SJ has no methods for measuring these kinds of risks, and there are no existing safety indicators in this respect. As in many other areas there is often very little time to handle all occurring events. A general safety issue related to this is that there may be too much focus on solving the most urgent problems, and as a consequence the long-term problems become pushed to the future.

3.2.3 Systematic feedback and safety management.

3.2.3.1 Internal feedback

How the flow of safety information is managed in the own organization is primarily controlled by the internal regulations, such as the SJF (SJ's Föreskrifter). and there is a suggested decision concept for every regulation. It was noted that control directives (styrande direktiv) are not distributed by email. Email lists are problematic for safety information. New employees are often not on the most recent email lists and may miss important information.
For time-delimited information SJM (SJ meddelar) is used instead of SJF. SJM are also control documents but during a shorter time period. They are used when something urgent has occurred. Both SJF and SJM are published on SJ's information system Infonät. Email is sometimes used to alert that new information has come up on the Infonät. The area managers (områdeschef) distribute SJF and SJM. This is done via an orderboard, orderbox, or morning meetings, depending on the work area. The drivers check the orderbox in the morning and take part of the SJF and SJM. According to SJF 014.1 (4.5.4) the area managers shall keep a system for handling information and regulations. Safety information is also distributed at the quarterly management meetings. The role of informal meetings for safety information, for example, coffee breaks, morning meetings is not known

The accident and incident information feedback flow is initiated when the traffic safety staff unit is contacted following an event. There is always one person in readiness at emergency service. When an accident occurs, the people in alert choose an investigator form an adjacent operational area to investigate the accident. The person in alert calls SRA if the accident is of the type that demand reporting to the authority. All facts concerning the accident are fed into SYNERGI [tm] information system. A report from the accident is sent to the traffic safety manager for a decision of which actions to take. PRIDE Co produces the SYNERGI [tm] system. It is a database system that handles accidents, incidents, deviations, etc. The system can also handle MTO aspects or Work environment issues. However this aspect has not yet been been included in the reporting procedure. SYNERGI [tm] is used internationally, for example by DSB and NSB. Banverket manages leveled crossing accidents. Such accidents have in almost ever case

been proven to be caused by road users, and not by caused that are related to SJ's activities. However, such accidents are yet marked in SYNERGI [tm]. The reporting is regulated by SJF-014.2.

There is no difference in how accidents and incidents are reported. Sj uses the following definitions of the concepts of accident, incident and deviation: (a) accident, e.g., when a person falls out the door when train is running; (b) incident, i.e., there was no accident, but could be under other circumstances, e.g., the door opened up but no one fell out; and (c) deviation, a function deviates from what is normal, e.g., one discover that the door can not be closed, when train is at the platform.

3.2.3.2 External feedback between SJ , SRA , other authorities, and other companies

Contacts are usually made during the referral procedures prior to that SRA publishes new regulations. Contacts are also taken in relation to vehicle approvals, when it comes to new vehicles and modifications of existing vehicles, and, in the case of serious accidents and incidents. Other authorities with relevance for the traffic safety are, for example, the Electrical safety authority and Banverket. The relations are as with SRA but on other issues.

External safety information between SJ and other companies is handled in the same way as internal safety information. SJ has the traffic safety responsibility for the train traffic even if SJ runs it as an assignment for another company. For example, both Skånetrafiken and SJ are "trafikhuvudmän". The difference is that Skånetrafiken organizes train traffic and SJ operates train traffic. Skånetrafiken has no traffic safety responsibility. Instead, SJ has the traffic safety responsibility for the train traffic that Skånetrafiken organizes. SJ is responsible for personnel and trains in this context, even though Skånetrafiken owns them.

It was noted that SRA ought to train the people who are purchasing (upphandlar) traffic about which parties has the safety responsibility in a higher degree than has been done. There may be economical consequences if it has not been stated in contract. SRA shall from July 1 2004 authorize the people who make the purchase according to the new legislation.

There is, in principle, no difference between the ways SJ and SRA look at safety. There are also similarities between SJ and other companies concerning safety because many other companies have adopted SJF in large. A big difference is how the companies build their safety cultures. They often copy SJF but with new logotypes and typefaces, the question is how they understand the deeper meaning of it.

3.2.4 Safety analysis

SJ's activities are in continuous development. For example, the introduction of new vehicles implies huge tasks for safety analysis! Safety analysis is also carried out on modifications of vehicles, and before organizational changes and other significant changes in the activities. Prior to the recent organizational change the transfer of responsibilities/tasks from old unit managers to new unit managers was central in the

risk analysis. On the other hand, the signal systems have not changed much since the implementation of the ATC system, and the behavior of the driver is constant. There are formal procedures for safety analysis and this is stated in SJF. The traffic safety staff unit for often makes the analysis following the SWIFT method.

3.2.5 Safety policy

SJ's formal written safety policies are the Traffic safety goals according to SJF 014.1 (9). It has been discussed if they shall be converted to an "own" SJF. But this has not happened yet. The annual traffic-safety account follows the goals. The most important here is the formulation of "No dead or seriously injured".

3.2.6 Accident and incident analysis

There is a standard method for accident and incident analysis and this is stated in SJF 014.2.
There is also a function in the SYNERGI [tm] –system in which classifications in a risk-matrix can be established.

SJ does not have a system of safety indicators but some systems could be utilized as such.
For example in the reports, the accidents, incidents, and deviations are described as trends.
They may be used as a kind of safety indicator. An increasing trend on a door could, for example, be an indicator of safety on such doors. Also the parameters in SYNERGI [tm] correspond to indicators. The database is expanding in step with that accidents are fed into the system. They are creating a common accident database for railway accidents on the European level that will be useful for safety.

In the SJ investigation reports not only the primary causes to accidents and incidents are investigated but also the causes behind! The MTO perspective is recognized in SJ's activities and is included as an item in the investigation reports. Also SYNERGI [tm] includes MTO in a recent version.

SJ makes investigations and decide about the measures and reporting to SRA. It is only a fraction of all events that are reported to SRA. Its such things that SRA has defined as obligatory, for example dead and collisions. If a train goes of track on a switch yard without people involved, involuntary door opening, stone throwing at trains, fallen trees, etc. are not reported to SRA. In such cases, as in others, the traffic safety staff follow-up the event and the measures that are taken. SHK take part of the report and/or participate in the investigation when there are at least two people dead.

The consequences *that may follow the evaluation of an incident report* are delegated to the operational areas and divisions. For example when it is an act of commission the area manager takes care of training. When it comes to health problems, the area manager takes care of health control. Consequences and the following measures are not regulated.

3.2.7 Human resource management

There is at the moment no need to increase the number of employees. All positions in the organization are at the moment filled. So no operational safety demands are hanging behind, and only a few investigations are delayed.

3.2.8 The concept safety management

The concept used for safety management in SJ is "säkerhetsstyrning". The concept is from the SRA handbook (internal control by means of Safety management p. 97). The concept covers all activities. The safety organization is in fact SJ's organization as a whole.

There are some organizations outside SJ's own organization that SJ has safety responsibility for. They are Green Cargo, and also Euromaint who take care of the maintenance for SJ vehicles. The authority does not certify -Euromaint. It is the operator (trafikutövaren) who is responsible for that the Euromaint maintenance answers to SRA's demads. SRA has no direct relation to Euromaint. Maintenance issues are discussed between SRA and the operator. But, Euromaint shall look after that they have regulations themselves that stand up to SRA's and SJ's demands. In this sense there is a difference between for example aviation and railway traffic. In aviation Luftfartsinspektionen sees that all activities are certified, in Railways - the operator shall keep a regulation. There could be problems when it comes to small operators because SRA do dot inspect directly.

3.2.9 Other issues discussed

Important parts of the SJ's safety organization are: (a) the traffic safety staff unit consisting of 10 persons, 1 safety manager and 9 handling officers; (b) traffic safety coordinators (mainly old engine drivers) often 1 per operational area, is placed under (is assistant to) the manager of the operational area. They prepare safety regulations that are locally adapted to the areas. They take care of the training and the follows-up of the personnel. They have no own safety responsibility (the area manager has it). The traffic safety staff's duties are mainly: to prepare and state regulations; to audit the activities, both internally and in maintenance contractors; audit and approve agreements, dispenses, training plans etc; investigates and make decisions following accidents and incidents; and takes all contacts with authorities.

4 A conclusive summary of the analysis: Relating the results to system concepts

In this chapter important feature of safety management in the organizations is summarized, and the results are modeled according to the systems perspective outlined in the introductory chapter. In order to facilitate this mapping, the information from the documents and the interviews was condensed and reorganized under a number of paragraphs resembling important features of the systems framework adapted in this study. It is important to note that this step exclude much of the rich descriptive information in the preceding chapters. For example, although not discussed here, it is understood that SJ's operations are formalized and controlled partly by SRA's regulations, and not only by the SFS, which are focused in this chapter. For SRA it is also implied that the railway law constitute the foundations for SRA's regulation, etc. Each paragraph concludes with pointing at suggestions for themes that might be relevant to consider when applying a systems approach to safety management in other contexts. The themes exemplify possible areas of knowledge transfer between different areas and will be concretized further and tested in coming contributions within the project, therefore still tentative.

4.1 Definitions of Safety Management

SRA

SRA's definition of safety management in is clearly stated in the regulations, and "means all measures which an operator takes in complying with the Railway Safety Act, the Ordinance on Safety on Railways, Underground Railways and Tramways and any regulations issued under the terms of the Act or Ordinance". Safety management is well adapted to the systems approach to safety outlined in the introductory chapter. This comes clear in the way SRA defines the "Safety management system", including the "activities affecting safety concerning organization, responsibility, procedures, processes and resources which are required to control and manage operations". The scope of the concept is not only limited to operators of concerned companies, but extends to also include "operations which are carried out by contractors on behalf of the operator, as well as products which are significant for safety, which the operator uses". It is emphasized that it is the management that shall take the responsibility of applying safety management to the operations. In the interviews it was noted that there are big differences between safety departments in small sized companies and the large actors. It was also noted that it is important that competence about safety management in companies must be improved, and be part of the management of the company as a whole. However, the meaning of safety management means, and how safety is established within SRA's own organization is not stated.

SJ

Both in the documentation and in the interview it was strongly emphasized that SJ's operations in large are governed by the internal regulations SJF's. There are SJF's for almost every area of activities including safety management. SJF's applies also to other companies partly owned by SJ AB, and is treated as a combined division and operational area within SJ.

SJ's definitions of the concept safety management include "a reoccurring, systematic work of planning, follow-up, and actions". SJ has designated a number of systems for

safety management, also regulated by specific SJF's. The concept used for safety management in SJ comes from the SRA handbook and covers all activities. The safety organization is in fact SJ's organization as a whole.
The responsibilities for safety management are defined down to the managerial level of organizational units. Formal procedures for the managers' to maintain the safety are thoroughly described in the internal regulations.
From a safety management point of view it is important that the actors of the safety organization are clearly identified. According to SJ's definitions, this includes personnel, employed by SJ or related companies, who are defined as being in traffic safety duty that implies they have their work close to the operation of a train. These personnel categories are formulated in the documentation.
For contracted personnel SJ shall have a traffic safety agreement with the Contractor Company about the hired personnel. Before hiring, SJ has to make the considerations about various safety aspects including the contractor companies own traffic safety regulations and the routines for information about SJ's traffic safety regulations.
It was mentioned in the interview, that here is, in principle, no difference between the ways SJ and SRA look at safety.

It is clear that SRA's and SJ's conceptions of safety management map almost perfectly. The same definitions are used in both the authority regulations and the company's internal regulations. From a systems perspective it is important that the regulations, which are part of the system control, map on the structures where they are applied. A good resemblance between the authority's and the licensee's conceptions of safety vouch for a good integration between both systems regarding the scope of companies operations and the authority control of their operations. There are several imaginable scenarios resulting from a less good overlap between regulations. In a previous study by the authors (Svenson, Salo, and Allwin, 2005) such a scenario was illustrated in the area of aviation. In that case a misfit between the authority and the company regulations lead to ambiguities in the interpretation of a particular event, which in turn lead to difficulties deciding which regulations that were appropriate to apply on the event.

From a systems perspective, one theme to take into consideration in the efforts to facilitate safety management in the interaction between authorities and companies, is to find a good mapping between the authority's and the licensee's regulations.

4.2 The structure of the organizations

SRA
SRA's organizational structure is, stated in the legislation. The activities and responsibilities of the different organizational structures are clearly outspoken in the organizational descriptions and charts in the documentation. The way SRA describes their organization is in large parts adapted to a systems perspective. Also the procedures within the organization are regulated. The structures that are responsible for the safety oversight (infrastructure, and railway company divisions) are clearly identified in the documentation. The organization's extension and boundaries to higher-level systems, and particularly the procedures with the government through the Ministry of Industry, Employment and Communication, also becomes clear in the documentation. On the other end, the boundaries and the interfaces towards the companies are also clearly identifiable.

SJ

From the documentation it stands clear that the way SJ describe its own organization is clearly adapted to a systems approach regarding both structure and processes. The organization is well structured according to the company's different operations (*train traffic*, *vehicles*, and *sales)*. The related responsibilities and the sufficient interfaces for the different organizational units are clearly stated and identifiable. The extensions from the own organizational boundaries to other organizations are also easily accessible from the documentation. This include, at one end, the proceedings at the company board in relation to the *Ministry of Industry, Employment, and Communication* who sees to that the governments interests as owners are attended at one end, and at the other end, the interfaces to the customers. The three divisions are: *train traffic*, *vehicles*, and *sales*. In addition to the core organization, a number of subsidiaries related to SJ's activities were recognized.

From a systems perspective, both SRA's and SJ's organizational structures are clearly structured. The system boundaries to adjacent systems, for example authority-company, are clearly demarcated. The subsystems, consisting of the various organizational units, are clearly structured and their contribution to maintaining the system regarding operations and responsibilities are easily identifiable. There is a good mapping between subsystems and their operations in practice and regarding the regulations that governs their actions. Some negative consequences from applying a less structured organizational model to safety critical organizations were discussed in a previous study by the authors (Svenson, Salo, and Allwin, 2005). Such negative consequences included a difficulty of grasping the essence of the safety organization, including the distribution of responsibilities, formal channels for various proceedings, and the formalized information flow within and between the operational areas in the organization regarding safety.

One theme from a systems perspective to take into consideration in efforts to facilitate safety in organizations, is to create organizational structures that corresponds to the safety operations of the organization, has clear counterparts in the regulations, and are easy to grasp among the employees. The system structure and the processes mapped on those structures should, ideally, be sufficient enough for understanding the purpose and the control of the system. Here, it is also important to clearly define the degree of various subsidiaries and temporary organizational units' contribution to the safety system.

4.3 Organizational change

SRA

In July 1 2004 the new independent railway authority SRA was established. At that time the former SRI, who organizationally was one part of Banverket, ceased to exist. Although SRA overtook SRI's responsibilities and duties concerning safety in the railway-, subway-, and tramway-system, it is emphasized that the organizational change should not be considered as reorganization, but a creation of a new authority. The change was managed during a very short time period. Also new responsibilities were added to the new organization, among them such as market-control and market-supervision but also a higher focus on the customers' perspectives. The change was

accompanied with a contemporary effectuation of new acts and ordinances, partly as a consequence of a harmonization with EU Railway legislation.

SJ

SJ was reorganized in 2004. The main reasons for the reorganization was to enhance the efficiency in the organization, and at the same time create a simpler organizational structure. It was hoped that the new organization would create shorter paths between customers and the company management. Even though SJ prior to the reorganization has had a clearly structured organization it seems that the reorganization has clarified the distribution of activities and responsibilities across the organizational units still further. The organizational change implied concentration of certain managerial functions, and centralization of administrative functions. SJ hope this will give positive effects to the development of competencies in the company. It was emphasized that the reorganization was accomplished without lowering the service level. There was an indication in the interview that there may be too many smaller managerial areas downward the organization with delegated responsibilities that they do not manage efficiently enough.

The interview indicated that the safety work was not threatened by the reorganization, this because that the safety staff unit was kept unchanged during the reorganization.

It is important to note that a major organizational change took place in January 2001 when the prior state controlled railway market was deregulated. At that time the former Swedish State Railways (Statens Järnvägar) was divided into 6 independent incorporated companies each of them actors on separate markets, among them the current SJ AB.

From a systems perspective it is important to recognize how external changes, in this context changes in the market and demands about harmonization with the EU, are related to the impetus for the organizational change.

Four positive visions of the new organization was identified in the interviews: clearer entrances for customers to the authority; positive effects for licensing, when this task is divided between two units; greater possibilities to take advantage of competence "across" the organization; and, closer co-operation between colleagues, and consequently, a better calibration. The last statement follows from that almost all former local offices was now closed down, except the former Stockholm office, which now is considered as an extension of the Infrastructure division and the Railway Company division, to meet the specific customers needs in the Stockholm area.

At the time of the study it was not possible to evaluate the consequences of the new organization. Still the changes has been made according to new demands in the railway legislation and the structuring of the new organization seems to have taken into account the functions required to carry out the new demands. However, there were indications in the interviews that the new organization, as a consequence of closing down the local offices, may have lost part of its former local competence.

The powers behind the organizational change in SRI are clearly identifiable, and are partly extrinsic to SRI. The powers behind SJ's reorganization are not as easily identifiable, but it seems as if they in a higher degree are intrinsic SJ's organization. Regardless the origin for the demands for organizational change, the imminent change ought, from the very beginning, to be recognized as an opportunity for safety improvements.

From a systems perspective this implies, for example, restructuring of system structures and mapping of processes to the system structures, by means of clarifying the operations and responsibilities of organizational units and the formal procedures for maintaining safety, but also mapping regulations to actions, both in response to new organizational demands, and as means for safety improvements in general.

4.4 Regulatory and operational activities

SRA

The intentions of SRA's regulatory activities are clearly defined and formulated at various levels, all from the general goals of the activities, definitions of regulative processes, the railway regulations, to the method of supervision. The responsible counterparts are identifiable in the organizational structure.

The railway traffic in Sweden is partly guided by the government's goals for the Swedish railway traffic. SRA has adopted two of them as their market- and safety-goals. The goals are quite general in their formulation, for example the safety goal states that: "SRA shall work for a high safety in the railway-, tramway-, and subway-systems".

SRA's work approach is described as generally process oriented with 6 main processes: *regulations licensing*, *approvals*, *supervision of safety*, *accidents and incidents*, and *market monitoring*. This approach is well adjusted to a systems approach to safety management.

The duties of the SRA are outlined in *the Railway Ordinance*. Instructions for the SRI work are stated in the *Ordinance on the Mission of the Rail Agency*. Besides railway traffic there are corresponding regulations for other track bound transportation systems.

The regulatory activities are clearly structured and defined in the SRA's regulations. In the context of safety, five of the regulations were identified as being of particular relevance.

Among them, the *regulations on internal controls* gives the definitions of good safety management of railway operations, and the scope, the prerequisites and the procedures to achieve it are clearly identified.

SRA applies five different methods for the supervision of safety: *audits*, *theme-inspections*, *mini-themes*, *inspections*, and *company meetings*. The different methods either pinpoint specific areas on particular organizational levels, or are applied across particular levels in the organization, or are focusing specific themes across the entire organization.

It was noted that the Swedish Railway operations extend outside Sweden, as it is part of the European railway network. The increasing European Railway competition increases the demands on SRA regarding European co-operation on the supervision of transnational railway operations.

SJ

The SJ's activities as a traffic operator are clearly identified. They include traffic in own private management, and traffic on mission for another company. SJ's operational activities are clearly demarcated from other railway activities and do, for example, not include the operations of the track systems, or certain traffic control activities. All activities are to be carried out according to the agreement for rail traffic operations that SJ has with the SRA.

Regarding the core activities, both SRA and SJ have well-structured definitions of the boundaries of their operations. As for other features reported here, the essence of the core activities is stated in the regulations. From the well-defined organizational structures and the descriptions of the proceedings in both organizations, it is quite easy to identify the distribution of responsibilities across the organizational units.

One tentative theme to take into consideration when applying the systems approach to safety management of the operations is to make the organizations essential activities clearly identified and understood. The operational activities should be formulated both as general core activities and decomposed activities in regulations, in order to explain both general objectives and sub goals to accomplish the mission of the organization. The activities and the responsibilities should be clearly mapped on the organizational structure.

4.5 Safety strategy

SRA

SRA has a well-pronounced regulation strategy, which is clearly stated in the regulations.
In the interviews with SRA it was emphasized that the companies must provide a formal written safety policy in form of traffic safety goals. It is essential that the goals are decomposed into measurable sub-goals. It was noted that policies are often too generally formulated, and consequently difficult to measure and compare over time.

SJ
SJ's formal written safety policies are the Traffic safety goals according to a particular SJF. The goals relate to both secure and safe travelling, and to a vision that no one shall be injured or killed in SJ's operations. The documents stress the core value of safety in SJ's operations shall be prioritized at all stages of operations. The safety system and the instructions for the traffic safety work are governed by a safety order. Safety management on the other hand is said to regulate the responsibilities and powers, sees to that the activities are carried out accordingly. The approach to safety is clearly visible in the SJ's organizational structure and is clearly formulated in the internal regulations. Except the safety goals, various ideas that might resemble general company objectives can be read from the documents. The ideas include; a *Vision*, the *Mission*, the *Business*

idea, the *Financial goals*, a business *Strategy*, and a *Business plan*. From a systems perspective it is noteworthy that safety is not emphasized explicitly in any of these areas of ideas.

To conclude, the documentation and interviews with the organizations indicate that well developed safety goals exists and the SRA's and SJ's safety goals have a sufficient level of correspondence to each other. It was emphasized that goals often are too general in their formulations, and that it is very important to decompose goals to activities that are clearly measurable and comparable over time. A small reflection here, is that one in a higher degree should make clear what parts of the ideas about safety are related to strategies and objectives of various kinds, and clearly differentiate what is meant with the concepts and how they shall be regulated.

From the systems perspective of safety management, it may be fruitful to take the objectives of the organizations activities as a starting point for creating and/or reorganizing the structure and processes of the system. Based on the objectives, it is possible to formulate what structures and processes are needed in order to achieve the goals. The idea objectives may make an important contribution to the blueprint of the systems structures and processes are worth to take into consideration already in the initial phase of the creation of the system.

4.6 Threats to safety

4.6.1 Internal threats

SRA

One possible internal threat to SRA's activities was identified in the interviews. There exists a worry that the close-down of the local offices may lead to that SRA lose competence and insight on the local plane, which was in part depending on well established personal contacts. A number of internal threats to the companies' activities were identified in the interviews. For example:

- That the safety organization is not represented in the company board, and is therefore not part of the economical decisions that may be of vital importance for the safety work;

-Small companies cannot have all sufficient safety competencies within the own company;

-Personnel that have cost a lot to train internally may leave for the competitor who offers most; rule interpretations drifting towards the "minimum acceptable level" of a certain regulation in smaller companies with limited resources;

-Difficulties in assessing the competence level and training among personnel recruited or hired from other companies;

There was also a general worry that the companies may not identify safety matters enough from the perspective of economy or that safety considerations are separated the from the economical considerations.

SJ

The documents revealed no essential internal risks for deteriorating safety in the company. But, it was mentioned that there is often very little time available, and consequently there may be too much focus the most urgent problems.

4.6.2 External threats

SRA

In the interviews with SRA the economy was identified as one possible external threat to SRA's activities. The economy may influence the amount of safety work that can be done, and might lead to prioritizing the most urgent issues.

Regarding external risks from the surrounding world, terrorism might be a future issue particularly relevant for transportation of dangerous goods.

SJ

In the interview some security threats were identified mainly at stations, but also threat of violence directed to train personnel, and trespassing in computer systems was mentioned. SJ has no methods for measuring these kinds of risks, and there are no

existing safety indicators in this respect. The interview with SJ also mentioned the possibilities of future external risks for transportation of dangerous goods.

4.6.3 Threats to the market

SJ

The market threats are clearly identified in the documentation. One major threat is "unfair" competition from foreign operators on the Swedish market. SJ holds the position that competition shall always be on equal terms and that foreign railway companies with own government support shall not be allowed to compete on the Swedish railway net.

Also availability to high-speed railway operations in EU, put demands on investments on infrastructure on the national level is identified as a threat.

However not constituting immediate threats to safety, the *competitors* on the Swedish market are clearly identified in the documentation. The competitors on the Swedish railway market include both National and European railway actors, and also low-budget airlines. SJ identifies a number of measures to counteract the market threats

The documentation and the interviews with both SRA and SJ give illustrative examples of to the safety of the organizations, and also of possible external threats. In this study SJ identified some external threats to their operations at various levels and threats to the market. For market threats both implemented and planned actions to be taken were reported. SRA also identified threats, mainly in the companies. One reflection here is that authorities often are good at identifying threats in the companies they supervise, and this is logic following the objectives of their operations. On the other hand, authorities seem to be inclined not to consider internal and external safety threats to their own operations so much. This was also identified and discussed in a previous study by the authors (Svenson, Salo, and Allwin, 2005). In that study one example of negative future consequences for the authorities to carry out their mission was related to declining production figures that are indirectly related to the funding of the authority. However, in this study the SJ did not recognize internal threats either. If this is suggested to be a general problem of organizations in general, the question has to be investigated further. Reuctance to identify internal threats may lead to inertia for necessary organizational change.

From a systems perspective it is suggested that the detection and identification of both internal and external threats to the system safety of the own organization and its operations are essential for the possibilities create measures to counteract the events that are threatening to move the system from steady state. This comes often naturally in a technological context and includes the normal measures of operational system control of the technological subsystem. However, the threats for human/organizational subsystems are as important to recognize both stand alone regarding internal control, and as an integrated part of the human-technological system. Identification of threats to the system is in a way an essential part of system control.

4.7 Information management and feedback

4.7.1 System feedback

SRA
The interviews revealed that SRA has no formal indicators for changes in system safety. However ideas about safety indicators in relation to some other features indicative for safety was discussed. Such features are increase/decrease in number of complaints, which sometimes are audited, safety key-figures, and mini-themes.

SJ
SJ uses, mainly, two means for monitoring system safety, event reporting (summarized in a separate section), and auditing. As with other activities in SJ, the procedures for auditing are formalized in the internal regulations. The purpose with audits is to identify deviations in relation to SJ's control documents, to identify the potential for improving the traffic safety work, and to be a part of the basic data for decisions within SJ's safety management. There are both system audits focusing safety management and theme audits. Both the own activities and Suppliers to SJ are audited, suppliers basically by system audits.
SJ does not have a system of safety indicators. However, in the interview ideas about how features of existing systems can be related to the concept of safety indicator was discussed, for example how trends described in event reports, and some parameters in the SYNERGI [tm] system correspond to indicators.

4.7.2 Internal feedback

SRA
SRA has well-established formal procedures for internal information feedback mainly through scheduled meetings within the organizational units. Internal information and documentation is distributed by email. Information exchange by telephone is particularly important in the communication between Borlänge and the Stockholm office.
Informal meetings such as coffee breaks and morning meetings were, in the interviews, considered important for the communication of information. It was stressed that it is important to develop possibilities for communication at local offices that else are distant from the other colleagues in Borlänge. Videoconferences were tested for this purpose. This means that SRA has identified the communication problem with distant units and are actively evaluating new means in order to improve communication.

SJ
The flow of safety information is regulated internally primarily by SJF. In the interview it was noted that control directives are not distributed by email. The safety issues concerning email, mainly the uncertainties concerning the distribution, were discussed. Information about safety is published in SJF´s and time limited SJM's, that are distributed by means of the internal information management system Infonät. At the workplaces the same information is distributed to the drivers by a system of orderboards or orderboxes. The responsibilities for the information distribution are clearly defined in the internal regulations.
Safety information is also communicated at formal meetings at different organizational levels. The meetings are pre-scheduled and take place in sequence with one week delay

between meetings at different organizational levels in order to let information from one level be prepared to the meeting at the next level. The times and agendas for the meetings are partly controlled by internal regulations.
SJ make use of several different internal information management systems in their operations. The Designated purposes for each system and the formal use and responsibilities of managing the systems are stated in the internal regulations.
Important systems in this context are: *Infonät*, SJ's internal computer system where important information updates including SJF are published in electronic form. From a systems perspective it is noteworthy that the current valid originals are only available from Infonät; and *Synergi*^{TM}, a computerized system for reporting of accidents, incidents, and deviations belonging to SJ's operations. The results from Synergi^{TM} are published annually in SJ AB's traffic safety report.

4.7.3 External feedback

SRA
External feedback Between SRA and other authorities is formalized mainly by means of pre-scheduled meetings. It came up in the interviews that communication with other authorities was most common in relation to transportation of dangerous goods.
Banverket is the authority that SRA has most contacts with and formal meetings take place twice a year. Howeve,r meetings also take place following emerging situations, and there is a mutual information exchange between SRI and Banverket.
External feedback Between SRA and the companies is formalized mainly by means of the supervisory activities, mainly in relation to audits, investigations of accidents and incidents, and at company meetings. However, information from SRA to the companies concerning emerging safety deficiencies that has been identified, for example in technical equipment, sometimes occurs.

SJ
External information exchange with the SRA take place, during audits and company meetings, prior to the publication of new regulations, and in relation to approvals, and, in the case of accidents and incidents investigations in which SRA are part. Other authorities with relevance for the railway traffic safety also occur.
External safety information between SJ and other companies is handled in the same way as internal safety information. SJ has the traffic safety responsibility for the train traffic.

Both SRA and SJ have well-developed procedures and technologies for information management in their respective organizations. The information channels and their usage are formalized in the regulations, which is essential in order to safeguard that safety information becomes distributed properly. Both SRA and SJ make use various computerized information management systems in order to enhance the efficiency of safety information management. Information technology is also used for the purpose to create a higher degree of integration between distant parts of the organization and increase the level of availability. SRA or SJ have no formal safety indicators for deteriorating safety. However, identification of existing safety features corresponding to the idea of an indicator and the possibilities of making use of such was discussed.

The flow of information within and between system structures constitutes, beside the static features of system structures, the dynamic feature of the system. It is only by access to the information that the system in fact could be understood. It is of essential

importance that an optimal information flow in the system is guaranteed. Except the creation of system structures, which are well mapped to the idea of the systems operations, a mapping of the information flow to the system structures give necessary understanding about how actions performed at one point is propagated through the system, and how it is directed and gated. Information is necessary for all processes of the system, not at least in relation to system control. From a systems perspective it is of importance that the information systems are well established and regulated, easy to access and to understand to everybody. It is important that safety information always is guaranteed to be accessible through specified channels, even if it sometimes can be found elsewhere. One example resembling important features of such safety information management is SJ's use of Infonät. Except the internal information management it is important that there are clear interfaces for information exchange across the system boundaries to adjacent systems. One-way and two-way information channels including various modes of communication (i.e., simplex, duplex) shall be clearly identified and understood. Another important feature of the information systems is that feedback is guaranteed, especially for information systems critical for system control. In very safety critical applications redundancies in the information architecture can be considered in order to maintain information system safety in an optimal way. From a systems perspective, the integration of proper safety indicators into the information feedback system may be worth considering in the design of the system.

4.8 Incident and accident reporting

SRA

The procedures for the reporting of accidents and incidents are clearly stated in the regulations. Information feedback regarding accidents and incidents in companies is demanded from the SRA. In a following step, SRA is demanded to report back to the government how the activities have contributed to fulfill the goals for the railway area. The scope and times for the reporting are clearly formalized. There is clear formal interface for accident and incident input (emergency call center). There are clear formal procedures for picking up the information and the following processing. The responsibilities for the different related tasks are clearly defined.
Depending on the seriousness of the event a number of different possible actions of investigation is defined. Such measures imply more or less SRA vs. company involvement in the investigation. In some cases expertise is hired for the investigations. Following the analyses, SRA produces proposals to further actions and follow-ups.

SJ

SJ AB distinguishes between three types of events: *accidents*, *incidents*, and *deviation*s. Depending on the type and severity of the event different formalized channels are used for the initial reporting, SOS-alarm, the SJ traffic safety emergency call center, or the manager of the operational unit in concern. The routines for the reporting and persons responsible for reporting are clearly stated in the regulations, including the responsibilities for reporting an event to the SRA and other relevant authorities. SJ make use of an event handling information database into which the events shall be fed and subsequently utilized for various purposes during and after the investigation of the event. It is stated that SJ always shall make an own investigation of events related to SJ's even though other companies or authorities efforts in investigating the event. This responsibility is well adjusted to the demands of information feedback management rising from a system approach to safety.

Each year a compilation of accidents, incidents, and deviations is published. The report presents various accounts including the event category, categories of people killed/injured, and the accomplishment of the traffic safety goals, and the safety programs. The MTO perspective is included as an item in the investigation reports. It is noteworthy that only a fraction of all events that are reported to SRA. Its such things that SRA has defined as obligatory, for example dead and collisions.

The formal procedures for event reporting are well established and regulated both internally and externally. There are, however, some ambiguities with the procedures. Regardless of that SRA demands the companies to report accident and incidents and to perform investigations following the events, only a small part of all events are reported. There are formulations of what events that must be reported, but the decision and the responsibility of what to report still lays at the companies. There were indications that some companies may not have the formal knowledge of what to report, and that the criteria of reporting/not reporting may be too fuzzy. It was reported that there were indications of that the interpretation of the criteria sometimes moves to its minima. On the other hand, SJ has an own event reporting information management system into which all internally reported events are fed. This system is used for various purposes during and after the investigation of an incident and also for preparing the annual statistics of accidents, incidents, and deviations in relation to the safety goals. The ambiguity may have its origin in the fact that SRA demands the companies to report and investigate depending on the severity of the event or its implications for safety. There is an imaginable risk that only the events with immediate implications for safety, and of course, the events that fall above the severity criterion are reported.

From a system perspective event reporting, and accident investigations, is part of the general information feedback system. The systemic aspects of information feedback discussed above are also applicable here. Event reporting sees to that information about events that have occurred is fed back to the organization and utilized in the safety work. From that perspective event reporting are information that serves as means of controlling and keeping the system within the defined boundaries of steady state. Following the discussion above, one tentative theme for safety management in this context is to have very clear criteria for which events that are to be reported. Otherwise, there are risks that the external feedback information may become diluted to the degree that it is difficult to use in relation to safety objectives, at least from the perspective of the authority that are responsible for monitoring that safety is maintained according to the regulations.

4.9 Measurement of safety

SRA

Safety in companies is based on formal methods of safety and risk analyses. In the interviews it was emphasized that it is the operators (trafikutövare) that are demanded by SRI to carry out risk analyses if there have been changes in materials or in the organization, and SRA controls that it has been carried out during supervision. At the time of the interviews, SRA had recruited new competence in the areas of risk analysis and MTO.

From this point of view there is a worry over that the increasing entrepreneur-market makes it difficult to access and measure the competence of the entrepreneurs. Another

indication was that companies seem to have difficulties in assessing when risk analyses shall be done.

SJ

There are formalized procedures for when risk analyses and assessments shall be carried out. Risk analysis and assessment becomes relevant prior to changes in technology, organization, work methods, training etc. with implications for traffic safety. Results from the risk analysis and risk assessments shall be included as part of the data used for the decisions preceding the change. SJ also makes continuous economical risk evaluations and action plans for unexpected events.

Companies are demanded to make risk analyses prior to changes in technology, organizations and procedures. There are formal procedures for this in SJ. From a system perspective the safety procedures that are used can be formulized in a way that allow quantification, sequensing, qualitative accounts, or in some other way systematized so that they become easy to measure and, accordingly, easily accessible for safety analysis.

5 Concluding remarks

In this report two important Swedish railway organizations have been analyzed, The Swedish Rail Agency, the inspecting agency of railway operations, and SJ, the largest actor on the Swedish railway market. In the initial chapter, a general system theoretical framework outlined in previous studies by the authors (e.g., Svenson, Salo, and Allwin, 2005) was revisited and concretized. In preceeding studies by the authors the general system theoretical framework has been applied on a couple of organizations, either part of the authority, or part of the market. In the present contribution, for the first time, a complete analysis of a system consisting of both the regulator and the licensee was carried out, in the above respects. The indications for safety management in the results are considered as highly relevant for nuclear safety management but also for other technological areas.

The report has in large parts focused various aspects of organizational safety and safety management in each organization. Three important objectives with the study were to:

- give qualitative descriptions of safety management in the organization studied collected from both documents and found in interviews.
- map important features and concepts from the system theoretical framework on the safety relevant features found in the qualitative descriptions of the organizations.
- derive suggestions to general themes for system safety management from the mapping of system concepts

In a first step qualitative descriptions about the different features of safety in each organization found in the available documentation and in interviews were presented. In a second step the qualitative descriptions were summarized and mapped on a number of features relevant for system safety, and concepts derived from the general system theoretical framework. Finally, suggestions to generalizations derived from the mapping of safety features to system concepts were presented. These generalizations should be considered more as a tentative attempt to illuminate possible themes for knowledge transfer of system safety management to other contexts. The possibilities for knowledge transfer will be developed further in a ongoing project in which the system approach to safety management is applied to the context of nuclear power production.

It was interesting to study these two organizations that both have the same origin in the former national railway company - Statens Järnvägar. At that time the SJ all railway activities were collected under the same roof, and SJ was considered both regulator and regulated. During the last decade the Swedish railway scene has changed dramatically. In that process the regulative duties was first released from the former SJ 1988, in the creation of Banverket, including the railway inspection SRI. In 2001 the Railway market was deregulated and SJ was divided into 6 different companies. Partly as a consequence of the free railway market and following demands on market orientation, and harmonization to EU, The new railway-inspecting agency SRA was created 2004. The same year SJ carried out still another reorganization. Nevertheless, despite the recent turmoil in the Swedish Railway area, which largely is attributable to external demands on change, both SRI and SJ has chosen to take the opportunity to make improvements to their organizations.

To this background it is understandable that the both organizations have a lot in common, not at least comparable conceptualizations of important features of safety management. The railway legislation, SRI's regulations, and SJ's internal regulations have a good correspondence to each other. From such a change-perspective, there are a number of appearing issues that would be interesting to pick up in future studies. One such question is the influence of culture on safety in organizations following organizational change, and how the culture itself is affected in the change process.

SRA's definition of safety management implies all activities performed in order to comply with the railway legislation and regulations. SJ has adapted SRA's definitions and defines the safety organization as the organization as a whole. The definitions used by SRA and SJ are in a high degree related to that of system safety management outlined in the general framework, which is supposed to cover all aspects of the system.

The Swedish railway activities are highly controlled by regulations, and there are almost always both external and internal regulations for each area of operations controlled. Both SRI and SJ emphasize a system approach to their operations that is clearly visible in the structuring of their organizations. Processes, responsibilities and system feedback features are sufficiently mapped to the system structures. The boundaries for the operations of each organization are clearly demarcated and the core activities at each system level are clearly identifiable. From this perspective, a highly relevant issue is to find out to what extent various degrees of rule reliance influence how organizations cope with occurring uncertainties regarding safety, and unexpected safety threats.

It is important that the companies have not only general safety goals for their core activities, but also decomposed goals mapped on lower level procedures. In order to maintain safety the decomposed goals have to be measurable, and so also the procedures related to goal achievement. It was questioned to what extent some companies, who more or less use SJ's regulations understand how the safety goals relates to their operations. There is a general issue of how well the understanding of goals permeate organizations, and how the understanding is related to the degree of goal achievement. The question applies to both organizational learning and culture and ought to be investigated further.

Threat detection was considered as an important theme for system safety management. The systems capability to identify internal and external threats in advance gives an opportunity to create a system preparedness to encounter the events. Both SRI and SJ identified threats to their activities. Internal threats to the own organizations were not identified to the same degree as external threats. It was discussed that it is natural from the perspective of an authority to look at threats for licensees, but perhaps not to have an inward look. Question has a general relevancy, not only for the issue of threat detection. The authorities abilities to monitor the safety of their own system ought to be investigated further.

Both the general procedures for information management and for event reporting are directly related to system control by means of feedback, and are consequently of immediate importance for system safety. The understanding of the system structures and processes mapped to the structure, only become understandable through information. From that point of view the availability to relevant information at the right time is

crucial for carrying out safety management. Both organizations had well developed systems for information management, well adapted to a systems approach for the operations. Safety indicators were not implemented by the organizations studied. We suggest that the possibilities to develop and implement integrated safety indicators should be investigated further. One distinctive feature of the interactions between SRA and SJ, compared to other areas of activities, was that the railway company is demanded to report events that fall into some given criteria of severity. The decision to report, however, always falls back to the company and there may be reasons to consider how such procedures shall be formalized to guarantee sufficient information. One has to keep in mind that this information is one of number of means for external feedback authorities have available for their control of companies.

5.1 Safety management in the context of nuclear power production: suggestions for relevant themes

Themes for what might be relevant to consider when applying a systems approach to safety management in nuclear- and other contexts was suggested. However, the issue of knowledge transfer between different areas is still tentative, and will be concretized further and tested in coming contributions. The most important are summarized below:

- To facilitate safety management in the interaction between authorities and companies, by finding a good correspondence between the authority's and the licensee's regulations.
- To create organizational structures that correspond to the safety operations of the organization, has clear counterparts in the system structures and the regulations, and are easy to grasp. The system structure and the processes mapped on those structures should, ideally, be sufficient enough for understanding the purpose and the control of the system.
- To clearly define the degree of various subsidiaries and temporary organizational units' contribution to the safety system.
- To take the opportunity for system improvements in relation to reorganization. This implies restructuring of system structures and mapping of processes to the system structures, by means of clarifying the operations and responsibilities of organizational units and the formal procedures for maintaining safety, but also mapping regulations to actions, both in response to new organizational demands, and as means for safety improvements in general.
- To formulate the operational activities both as general core activities and decomposed activities in regulations and in practice, in order to explain both general objectives and sub goals to accomplish the mission of the organization. The activities and the responsibilities should be clearly mapped on the organizational structures.
- To make use of core objectives in the formulation of structures and processes are needed in order to achieve the goals. Objectives may make an important contribution to the blueprint of the systems structures and processes, both at the initial construction of the system and during restructuring of the system.
- To facilitate detection and identification of threats to the system both for technological and human/organizational subsystems, regarding both internal control in sub systems, and as an integrated part of the human-technological system.

- To create information systems are well established and regulated, easy to access and to understand to everybody. It is important that safety information always is guaranteed, and accessible through specified channels. The communication modes and purposes should be clearly distinguishable among the channels.
- To make sure that the criteria for event reporting is very clear and understood, in order to protect external feedback information from becoming diluted and that the information given is appropriate to use in relation to the safety objectives monitored by the event reporting system.

5.2 Suggestions for future research

In the previous studies a general framework for studying safety management has been outlined. The framework has been applied to non-nuclear contexts of regulators and regulated organizations. Tentative suggestions for relevant themes for knowledge transfer between different organizational contexts have been suggested. Accordingly, the next steps of this research involve transfer and application on the nuclear context. As a continuation to this and preceding reports, two studies are already planned. In the first study, characteristic of system safety management in nuclear contexts will be studied. The results from nuclear safety management will be modeled according to the general system theoretical framework and reflected against the results from non-nuclear contexts. Important areas for system safety management are the organizational structures, operations, safety threats, and information feedback systems, and are also in focus for the investigation.
In the second study organizational safety and safety management reflected in licensee event reports (LER) will be studied. The LER system is considered important not only regarding external system information feedback to the authorities, but also as a publicly available probe serving for societal awareness of nuclear issues. Organizational safety and safety management is expressed in LER's, will be systematized. Suggested areas with relevance of organizational system safety are definitions of safety measurement and scaling both in the organization studied and in the nuclear area in general, criteria for reporting, systemic features in LER's and information feedback according to the LER's. There are positive experiences from the methods of prior LER studies, and methodological issues will be elaborated further.

In the sections above some interesting themes for further investigations were indicated they are:

- Influence of culture on safety in organizations following organizational change, and how the culture itself is affected in the change process.

- To what extent various degrees of rule reliance influence how organizations cope with occurring uncertainties regarding safety, and unexpected safety threats.

- Organizational learning and culture influence on how the understanding of safety goals permeates organizations, and how the understanding is related to the degree of goal achievement.

- Factors influencing the capability and efficiency of self-monitoring of safety in the own organization.

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List of Abbreviations

AEIF	Associacion Européenne pour l'Intéroperabilité Ferroviaire (European Association for Railway Interoperability)
ATC	Automatic Train Control
DG TREN	Directorate-General for Energy and Transport
ERA	European Railway Agency
RRV	Riks Revisions Verket (Swedish National Audit Office)
SIKA	Statens Institut för Kommunikations Analys (Swedish Institute For Transport and Communications Analysis)
SJ AB	Swedish State Railways Co. (From 2001 not an abbreviation of Statens Järnvägar!)
SKI	Statens Kärnkraft Inspektion (Swedish Nuclear Power Inspectorate)
SRA	Swedish Rail Agency (Järnvägsstyrelsen)
SRI	Swedish Railway Inspectorate (Järnvägsinspektionen)
TEN-T	Trans-European Transport Networks
TOC	Train Operating Companies
TSI	Technical Specifications for Interoperability (Tekniska Specifikationer för Driftkompatibilitet - TSD)
TSS	Trafik Säkerhets Samordning (traffic safety coordination)

Appendix

General structure for interview questions, formulations for the interviews with SJ AB in *italics*. In the original questionnaires the word "organisation" (e.g. in headline 2) was replaced with the name of the interviewed organizations.

(1) Organisationsstruktur och säkerheten. Struktur:

1.1 Järnvägsinspektionen håller på att omorganiseras; Vilka speciella problem för kontrollen av järnvägssäkerheten fanns i den tidigare organisationen?

Har SJ nyligen genomgått någon form av omorganisationsprocess?

1.2 Efter omorganisationen 2004-07-01, vilka kommer de viktigaste effekterna för säkerhetsarbetet att vara?

Vilka områden av organisationen var berörda av omorganisationen?

1.3 Vilka var de viktigaste anledningarna till omorganiseringen av Järnvägsinspektionen /*SJ*?

1.4 En omorganisering tar ofta tid i anspråk. Kan du/ni berätta något om vad er omorganisation kostade i tidsförlust för säkerhetsarbetet?

Vilka var de viktigaste effekterna för säkerhetsarbetet efter omorganisationen

1.5 En omorganisering kan vara resurskrävande Vilka hot kan detta medföra för säkerhetsarbetet (som i och för sig inte behövt inträffa)?

1.6 Från ett säkerhetsperspektiv, vad är bra i den nya organisationens struktur?

1.7 Från ett säkerhetsperspektiv, vad är mindre bra i den nya organisationens struktur?

1.8 Finns det ytterligare förbättringar som ni ser kan göras för att öka säkerhetsarbetet?

(2) Hot mot järnvägssäkerheten och hur dessa hanteras av organisationen:

2.1 Vilka är de väsentligaste interna riskerna för sämre säkerhet hos bolagen som ni själva upplever det?

2.2 Vilka är det väsentligaste externa riskerna hos bolagen som ni själva upplever det?

2.3 Riskbilden kan ha förändrats på senare tid i och med omvärldens förändring (ekonomi, terrorattacker, etc.). Påverkar det säkerheten i ert arbete? På vilka sätt?

2.4 Har ni någon metod för att mäta dessa risker?

2.5 Vilka indikationer på förändrad säkerhet finns det?

2.6 Finns det en risk i ert arbete att ni fokuserar för mycket på de mest akuta problemen och skjuter på det långsiktiga arbetet för att förebygga andra problem.

(3) Systematisk återkoppling och säkerhetshantering. Återkoppling inom organisationen:

3.1 På vilket/vilka sätt förmedlas informationen om säkerhet mellan organisationens enheter? Sker informationsgången på samma sätt mellan alla enheter.

3.2 På vilket sätt förmedlas informationen om säkerhet mellan de geografiskt olika lokaliserade enheterna?

3.3 Vilken roll spelar informella möten, t.ex. kafferaster, morgonmöten?

3.4 Hur sker kommunikationen mellan Järnvägsinspektionen och Banverket (andra myndigheter relaterade till järnvägstrafik)?

3.5 Vilken är den formella gången då en incident inträffat?

3.6 Skiljer sig detta från den formella gången så en olycka/haveri inträffat?

Extern Återkoppling: Egna organisationen – Bolag - Myndigheter:

3.7 Hur sker informationsutbytet mellan er organisation och andra bolag / myndigheter?

Hur sker kommunikationen mellan SJ och andra bolag relaterade till järnvägstrafik, (Skånetrafiken, Green Cargo, etc.)?

3.8 Finns det olika sätt att se på säkerheten hos bolagen (SJ, Skånetrafiken) och Järnvägsinspektionen, vilka är i så fall det största skillnaderna och svårigheterna med dessa olikheter?

Finns det olika sätt att se på säkerheten hos SJ, och Järnvägsstyrelsen, vilka är i så fall det största skillnaderna och ev.svårigheter med dessa olikheter?

Finns det olika sätt att se på säkerheten hos SJ, och andra bolag som ni säljer järnvägstrafik till (Skånetrafiken, Green Cargo, etc.) vilka är i så fall det största skillnaderna och ev. svårigheter med dessa olikheter?

3.9 Vilka andra myndigheter har betydelse för järnvägsverksamheten (t.ex. Naturvårdsverket)?

3.10 Hur ser kommunikationen ut mellan Järnvägsinspektionen och andra myndigheter, (t.ex. Naturvårdsverket)?

3.11 Vilka olika departement har ni kontakt med?

Säkerhetsanalys:

4.1 Befinner sig järnvägsverksamheterna i en ständig utveckling eller är verksamheterna relativt stabila över tid?

4.2 Finns det behov av kontinuerliga riskanalyser av järnvägsverksamheten t.ex. för att identifiera nya risker?

4.3 Utförs dessa på ett formellt eller informellt sätt?

4.4 Finns det en formell skriven säkerhetspolicy inom bolagen (*bolaget*)?

4.5 Hur är bolagens (*SJ's*) säkerhetspolicies relaterade till ert säkerhetsarbete?

4.6 Vad upplever du som viktigast i dessa policies (*SJ's policies*) och hur efterlevs de i verkligheten?

4.7 Efterlevs dessa policies på alla nivåer inom bolagens organisationer, samt hos enskilda
individer?

Incidentanalys:

5.1 Vilka metoder/modeller för analys används vid incidenter?

5.2 Beskriv händelseförloppet för rapportering av en incident.

5.3 Vem skriver dessa incidentrapporter?

5.4 Vad har rapportörerna för utbildning och erfarenheter?

5.5 Hur ser dessa rapporter ut? Finns det möjlighet att ta del av en rapport?

5.6 I rapporterna, finns det utrymme för indikationer för orsaker till incidenten människa, teknik, organisation?

5.7 Är ”människa, teknik och organisations” perspektivet något som uppmärksammas i er verksamhet?

5.8 Finns det ett klassifikationssystem när det gäller orsaker en incident?

Olycka/haveri

5.9 Beskriv händelseförloppet för rapportering av en olycka/haveri?

5.10 Vem skriver dessa olycks-/haveri- rapporter?

5.11 Vad har dessa rapportörer för utbildning och erfarenheter?

5.12 Hur ser dessa rapporter ut? Finns det möjlighet att ta del av en rapport?

5.13 Finns det utrymme för indikationer om orsaker relaterade till människa, teknik, organisation i olycks-/haveri- rapporterna?

5.14 När ett olycka/haveri inträffat skrivs en rapport. Tar Statens Haveri Kommission del av rapporten och/eller deltar i utredningen?

5.15 Vid en olycka/haveri, sker då även vidarerapportering på internationell nivå?

5.16 Hur skiljer rapporteringen av en incident från en rapportering av en olycka/haveri?

5.17 Inom kärnkraftsindustrin finns händelser benämnda ”near misses”. Finns dessa upptagna även inom järnvägssäkerheten och hur rapporteras dessa i Sverige?

5.18 Skickas dessa ”near misses” incidentrapporter till Statens Haveri Kommission eller utreds de endast av er på Järnvägsinspektionens eller endast av bolagen.

5.19 Hur utvärderas dessa rapporter av er som myndighet (*SJ*)?

5.20 Ge exempel på konsekvenser som kan följa på utvärderingen av en incidentrapport.

Reglering av aktivitet:

6.1 Har Järnvägsstyrelsen någon uttalad regleringsstrategi, i så fall, hur skulle ni själva beskriva denna strategi?

Human resource management inom organisationen:

7.1 Hur ser arbetsbördan ut för personalen inom organisationen, vilka uppgifter hinner personalen med och vilka uppgifter görs i mån av tid?

7.2 Kan ni ge exempel på arbetsuppgifter som är säkerhetsrelaterande och som ”släpar efter”?

7.3 Är alla tjänster tillsatta hos er idag?

7.4 Finns det behov av att utöka personalstyrkan, men som man pga. olika omständigheter (ekonmiska etc.) inte har möjlighet till att genomföra?

Human resource management inom bolagen:

8.1 Har ni identifierat problem som är relaterade till personaladministration eller andra personal åtgärder inom bolagen som i sin tur kan påverka säkerheten? Vilka är problemen och hur påverkas säkerheten?

Begreppet säkerhetshantering (safety management):

Finns det en uttalad definition på begreppet säkerhetshantering (safety management) inom er organisation?

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