The FRA Risk Reduction Program: A New Approach for Managing Railroad Safety

On January 6, 2005, at Graniteville, South Carolina, a collision between two freight trains resulted in the release of chlorine gas, killing the locomotive engineer and eight other people. Over 5,000 people were evacuated from their homes and workplaces. The National Transportation Safety Board identified improper alignment of a switch as a factor contributing to the accident.[1] Similar incidents have occurred in the past; however, these incidents lacked the significant loss of life associated with this accident. Following this accident, the Federal Railroad Administration issued a safety advisory followed by Emergency Order 24 prescribing changes in actions employees must take in the operation of hand-thrown switches and developed a regulation to make permanent the changes required in the emergency order.

Introduction

The Graniteville, South Carolina, accident and its aftermath capture the traditional approach to the Federal Railroad Administration's (FRA) safety-related activities. In this approach, the FRA responds to a gap in safety, following a mishap, by requiring changes in railroad industry practice.

To complement its traditional approach to safety enforcement and compliance, the FRA has embarked on a new safety initiative called the *Risk Reduction Program* (RRP), which strives for safety excellence within the railroad industry by going beyond minimum safety standards and traditional safety enforcement measures. This initiative represents a new approach to safety that will enable both the FRA and the railroad industry to better manage safety through proactive methods.

The goal of this program is to build upon the significant improvements in safety that the industry has achieved. The FRA has been informally experimenting with a variety of new approaches, from partnering with the industry in the development of performance-based regulations through the Railroad Safety Advisory Committee (RSAC) process to trying out new programs for learning about risk, such as the Confidential Close Call Reporting System (C^3RS) and peer-based observations of at-risk behaviors in the Clear Signal for Action (CSA) program. While these efforts have produced positive impacts, they have been limited in their scope. The FRA seeks to develop a comprehensive approach to managing safety through partnerships with the industry that leverages the knowledge railroads have about their own operations. Other transportation modes (e.g., aviation, marine), industries (e.g., chemical process, energy), and countries (e.g., Canada, United Kingdom) have implemented similar approaches. The FRA seeks to learn from what these groups have done and adapt these methods and tools to the U.S. railroad industry.

As the FRA develops this program, it must educate employees within the FRA, as well as key industry stakeholders, of its merits. The paper is intended for FRA employees and industry stakeholders with key responsibilities for safety to help weigh the benefits and challenges of supporting this program.

The purpose of the paper is to:

- Explain why the FRA seeks a new approach to managing safety;
- Educate interested parties on the direction and approach this initiative will take;
- Explain how this new approach will complement existing methods and tools; and
- Solicit support to develop and implement the program by explaining the benefits and challenges of implementing this program.
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Background

What drives the need for change?

Regulatory agencies use several strategies to ensure the public's safety. One strategy is to enforce compliance with existing regulations, a second strategy is to develop new regulations and the third strategy is to introduce innovation to the industry through voluntary partnerships.

For the enforced compliance strategy to work, the agency must have a credible threat of sanction. Sanctions, in the form of monetary penalties, do little to improve safety) but impose a cost to railroad carriers. This approach can be adversarial and punitive. In the long run, carriers work to minimize these costs. The partnership strategy addresses safety through collaboration with railroad industry stakeholders. Partnership strategies reduce costs for both the carriers and the regulator through prevention or mitigation efforts that occur before harm occurs. This strategy helps identify aspects of railroad operations that, if managed effectively, will prevent incidents from happening in the first place.

The FRA uses enforcement-based tools such as voluntary agreements, mandatory agreements, nonpunitive citations, and civil penalties to correct the deficiencies and violations it identifies. The FRA also uses partnership-based tools such as education, coaching, grants, and field testing of innovations to introduce new technology and safety processes in the industry. Both of these strategies enforce compliance, and voluntary partnerships also may use tools that are not program-specific, such as education, incident analysis, and joint problem solving involving the regulator, carrier management, and labor organizations. When these voluntary partners use non-program-specific tools, they are using them to execute different strategies, but all in the service of improving public safety.

The enforced compliance approach provides benefits by codifying practices for minimizing harm to people, equipment, and the environment. Regulations provide guidance on known risks and indicate how to avoid them. When an organization or individual fails to comply with the regulations, the regulator may apply sanctions to achieve compliance with the regulations. By making the relationship between compliance and enforcement clear, the regulated parties can understand their responsibilities and the penalty they pay for noncompliance. The enforced compliance approach reduces the likelihood of the regulator being controlled by the parties they regulate and neglecting its primary mission.

To understand these challenges, it is helpful to understand how enforced compliance works, specifically within the railroad industry.

Figure 1 shows the current regulatory oversight model for managing safety. In this model, the FRA regulations address minimum standards expected of the railroads and its employees. Within the area of railroad operations, these regulations oversee the technology infrastructure, operating practices, and hazardous materials. The FRA also promotes safety at highway-rail grade crossings. FRA employees monitor the railroads' compliance with these regulations through inspections (direct observations and audits of the railroad records) and analysis of data (e.g., accidents, incidents, reportable events, etc.). Analysis of this data, along with information from FRA inspectors, contributes to the identification of gaps in the regulations. Knowledge about information gaps contributes to the regulation revisions.

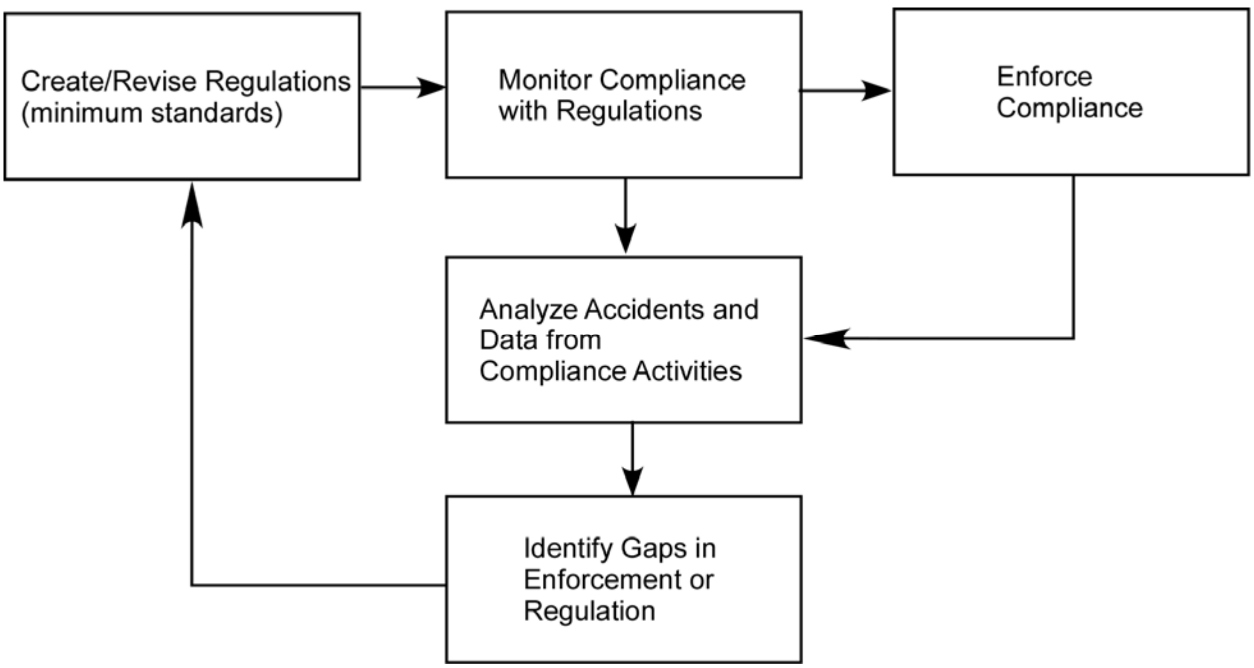


Figure 1. Model of FRA regulatory process for safety

The current regulatory model shown in Figure 1is a *feedback*-based process. The process for controlling safety is based upon a feedback loop that requires detecting a deviation from a desired state before making changes. Like all feedback-related processes, it is inherently a reactive process akin to driving a car by looking through the rearview mirror. It shows you where you've been, not where you are going.

Limits on a regulator's time and resources make it impossible to inspect and enforce all aspects of an industry that are covered by regulation. Due to resource limitations, the FRA only inspects about 0.2 percent of railroad operations. To make the most of limited resources, the FRA has adopted a risk-based approach to decide where to focus its monitoring and enforcement activities. This information includes accident investigations and incident data, the results of field inspections, and onsite audits. Currently, *the information that the FRA collects to inform its risk-*

based decisions, while valuable, gives an incomplete picture of risk. Much of this information focuses on front-line employees, and the data gathered often excludes upstream processes. Upstream processes include factors that are farther away in time and space from the unwanted event and include: design practices, policy and goal conflicts, and management and supervisory influences. As a result, the carrier and the FRA may lack information about how these other factors play a role when failures occur despite the barriers designed to protect the people, equipment, and the environment from harm. There is a need to capture information about how these upstream processes influence safety. Currently, the FRA's accident database lacks codes to enter these factors. As a result, the FRA may not be addressing important risk factors.

Legal action impedes the ability to learn from unsafe events.[2] Despite the many improvements made throughout the industry regarding safety, the litigious environment associated with the Federal Employee Liability Act (FELA) can act as a disincentive to problem solving and corrective actions. Within the railroad industry, FELA, a law passed by Congress in 1908, enables railroad employees the right to recover damages for any injury that results from the carrier's negligence, through court proceedings. However, FELA may exacerbate the desire to deflect blame and liability so that each party can make the case that the other party is responsible. When an unsafe event occurs that involves injuries, FELA encourages both parties to focus on protecting their legal interests at the expense of improving safety.

Regulations can't keep pace with rapid pace of change. The pace of technological change has quickened over time, with each cycle of change growing faster and faster. However, the pace of creating new regulations to address technological change, as is happening in other industries, has not kept up. For example, it took 3 years to approve the human factors operating regulation that the FRA created as a result of the Graniteville, South Carolina, accident. This rule involved the use of "older" technology. The standards for development and use of the processor-based signal and train control rule involving the use of new technology, approved in 2005, took over 8 years to put in place. The FRA and the industry would benefit from an alternative mechanism to monitor and manage safety to cope with the faster pace at which the industry is changing. The impact of modern technology has also resulted in growing complexity within the railroad industry. While the latest technologies have continually contributed to both safety and productivity improvements, the increasing complexity of railroad systems may provide more paths for failures to occur as well, making it more difficult to determine why they occur. Those responsible for assessing system safety must be knowledgeable about multiple disciplines, while individuals responsible for safe operation may understand only a portion of how the system interrelates with the overall system and related processes.

The railroads, like other transportation modes and high-hazard industries, use multiple barriers to prevent unsafe events from taking place. When an accident occurs, it is rarely the result of a single failure; normally, multiple barriers fail. However, the current FRA accident reporting regulation requires the railroad to identify only a primary and a secondary cause. The increasing complexity of railroad systems means that they may fail in ways that the designers or approving officials did not anticipate. High-profile accidents like the release of radioactive nuclear materials at Three Mile Island and the Exxon Valdez oil spill were prompted by situations that were unfamiliar to the workers involved and unanticipated by the designers. *FRA recognizes the* *increasing complexity of railroad systems and seeks tools to identify new risks that may emerge as a result of this complexity.*

Pressure from stakeholders outside the industry. Another factor driving the need for change comes from pressure by stakeholders outside of the railroad industry (e.g., the public, the media, and Congress). As safety has improved, these stakeholders have come to expect continued safety improvements. Figure 2 shows a chart of train accident rates from 1977 to 2007 as a function of train miles traveled and employee hours worked.[1] For both measures, the chart demonstrates that the industry has made significant progress in reducing accidents from 1978 until 1986. From 1987 until the present, accident rates go in different directions, depending upon the measure used. For train miles, the accident rate shows a small decrease from 1987 until 2007. For employee hours, the accident rate shows a larger increase between 1987 and 2007. Given the differences between these two measures, which one gives us a more accurate picture of risk?

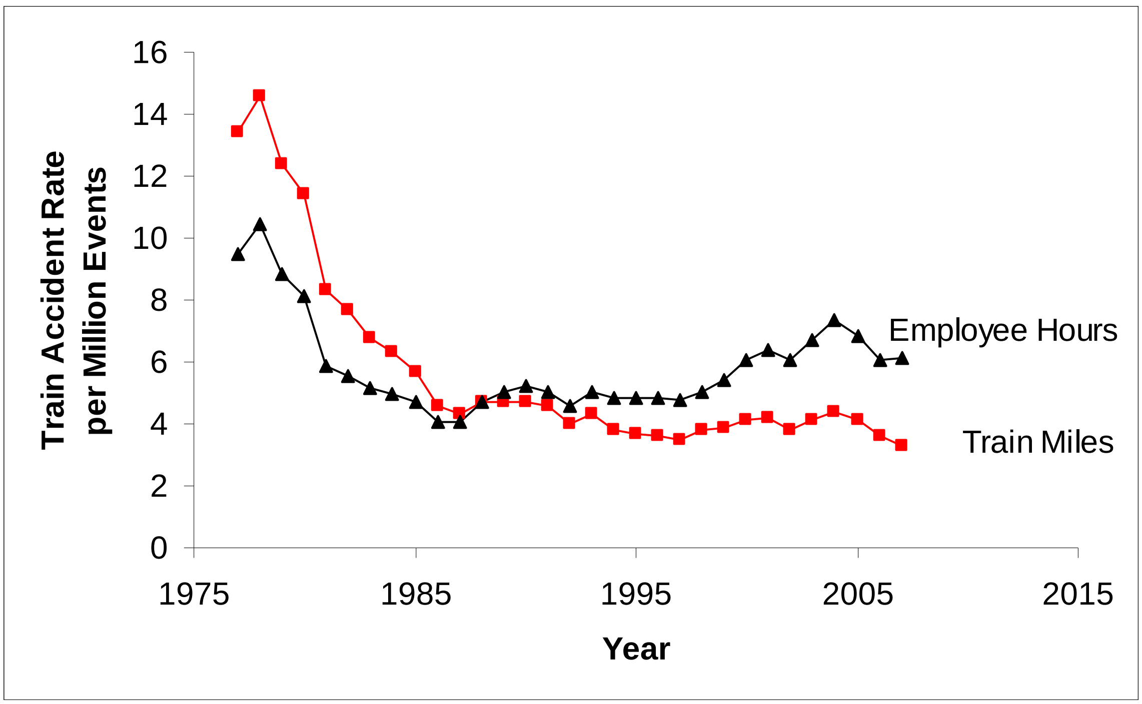


Figure 2. Train accident rate by train miles and employee hours

Implicit in the desire to improve safety is the focus by some stakeholders on counting failures as a measure of safety; safety is measured by the number of accidents the industry prevents. In this situation, safety is measured by the absence of unsafe events. How do we know how many accidents have been prevented? Accidents represent an imperfect measure of system safety. They represent a lagging safety indicator that tells us about the risks the system has already experienced. Studying accidents is still important to identify why they occurred, for the purpose of preventing future occurrences. However, accidents may not be predictive of future sources of risk. How do we predict where the next accident might be, so we can devote resources to prevent and mitigate

[1] The measures represent two ways to control for risk exposure in the railroad industry. Both measures address risk by controlling for the frequency with which an unsafe event may occur.

it? When accidents rates are low, as they are for train collisions, this information cannot help to identify new sources of risk.

When accidents do occur, these external stakeholders look to the FRA to hold the industry accountable. This accountability has manifested itself in a call to more strictly regulate the industry, by imposing more civil penalties, more inspections, and more regulations. For example, between 2004 and 2005, the New York Times wrote a series of articles and editorials that were critical of the FRA and industry efforts to reduce accidents at highway-rail grade crossings.[3] The New York Times recommended increased fines, while members of Congress called for more inspections of highway-rail grade crossings. The New York Times also criticized the partnerships between the railroad industry and the FRA.[4] The adverse publicity created pressure for the FRA to step up its regulatory and enforcement activities. However, there is no evidence to show that these actions, proposed by the media and Congress to hold the railroads accountable, actually improve safety outcomes over the long term. The media and Congress focused on the role of the railroad without adequately considering the role of motorists in contributing to these accidents.

Because the FRA can only monitor a small portion of railroad operations, it seeks innovative ways to monitor safety within the industry. *Given each railroad's more intimate knowledge about its own operations, it makes sense to assist and empower the railroads to more effectively manage safety with new accident and injury prevention alternatives within their own operations.*

The negative publicity of accidents like the one in Graniteville has the potential to punish the railroads economically. The release of hazardous materials that killed several people caused many cities to rethink whether they wanted trains to carry hazardous materials through their jurisdictions. Several cities (e.g., Washington, DC; Boston; Philadelphia; Baltimore; Cleveland; and Chicago) proposed bans on carrying hazardous materials that would have adversely affected the railroads' operations. In addition, the Pipeline and Hazardous Materials Safety Administration developed a new regulation, with advice from the FRA, that requires railroads to evaluate the safety and security risks for the primary and alternate routing of hazardous materials.[5]

Within the Government, there is a call for Federal agencies to demonstrate that their activities exert a positive measurable impact. However, the General Accounting Office and others judged that it was impossible to determine the extent to which safety improvements observed since the passage of the Staggers Act in 1980 were attributable to FRA regulatory and non-regulatory activities and how much of the improvements were attributable to investments by the railroads.[6] The FRA believes its existing methods for managing safety have made significant contributions to safety. *The FRA is also committed to supplementing existing methods with new approaches to manage safety in ways that the existing methods do not address*.

What are the challenges to the traditional methods for managing risk?

To understand the challenges that the railroads face in managing risk, it is useful to describe the history of how the railroads, as well as other industries, have addressed the problem of managing risk in the past. Andrew Hale identified three paradigms common to high-hazard industries.[7] They include: use of technology, controlling human performance through operating practices, and system design. The first two paradigms are well entrenched in the railroad industry. The third paradigm has begun to play a role within the U.S. railroad industry.

Paradigm 1: Controlling human performance through the use of technology. The first paradigm for managing risk involves technology-based, problem-specific solutions (e.g., personal protection equipment, air brakes, and signal systems). In both of these cases, risk involves managing the variability in human performance. Technology was often seen as replacing a variable, error-prone process (human activity) with a less variable, non-error-prone process (technology). In the railroad industry, recent examples of technology include: positive train control, electronically controlled pneumatic braking, and remote control of locomotives.

The introduction of new technology presents several challenges. Traditionally, technology in the railroad industry must coexist with legacy systems; new technology is often introduced as an add-on to the existing technology and the operating practices supporting it (e.g., adding a signal system, such as centralized traffic control, that was previously controlled by automatic block signals). This limits the use of that technology, while adding complexity. The new system also inherits some of the failure modes associated with the legacy system, along with new ones that may not be evident from the interaction between them. For example, introducing a train control technology that will stop the train if the locomotive engineer exceeds his/her authority may change how the engineer handles the train. Depending upon the algorithm that determines the conditions under which the train is stopped, the engineer may engage in train handling practices that put train at risk of a derailment.

The reason for adopting this approach is, if the current technology fails, the system can revert to a previous version without compromising safety. However, the two technologies may interact in ways that are unanticipated. For example, introducing a positive train control system can change how the engineer controls the train. When the new system fails, the engineer's new train handling procedures may not be appropriate when using only the legacy system. The railroad environment, like other industries, changes continuously. For the technology solution to remain viable, continued changes to the technology or the larger railroad system itself may need to occur.

Technology has often been introduced by designers without fully considering how the employees would interact with it. For example, the use of cell phones has contributed to unintended consequences for motorists and locomotive engineers. Cell phones can distract the operator from focusing out the window on potential hazards and can contribute to accidents. The use of cell phones in motor vehicles and the phones' ability to distract the operator represents an unintended consequence.

Paradigm 2: Controlling human performance through operating practices. The second paradigm focuses on controlling variability in human performance through operating practices and discipline. Risk is partly controlled by minimizing uncertainty around human performance by prescribing rules of behavior. While operating practices help to control variability and contribute to safety, they also contribute to significant problems as well. These problems can either contribute to violations taking place or explain why violations took place. Table 1 lists some of the problems that the use of operating rules creates.[8]

Table 1. Challenges Posed by Use of Operating Rules
• Could be perceived as protecting management from accountability
• Pressure to trade off production needs against strict compliance (lack of management commitment)
• May be impractical to comply with, as written
• Employees violate rules for individual benefit
• Inadequate understanding of safety risks
• Not fully understood, too many rules, or too complex
• Out-of-date or irrelevant

Consider, for example, an organization that adopts a set of operating rules that all employees must follow to reduce or eliminate errors. When someone breaks an operating rule, the errant employee is punished. The goal is to provide for a regularity of process in which all employees behave in the same way. The carrier and the regulator view rule compliance as a prerequisite to predictable performance.[9]

The research literature suggests that when accidents occur, sometimes the organization analyzes the events to the point that it finds non-compliance with rules and applies discipline to the offending employees. If the employees broke no rules, new rules may be developed to protect against unanticipated problems or challenges. This may increase the number of rules without necessarily improving safety.

In this view, human error is perceived as the cause of a failure rather than a symptom of trouble within the system.[10] Accident analysis frequently reinforces this view through hindsight bias. In hindsight bias, the investigator asks what the employee should have done, given his/her view. The investigator explains the failure by finding incorrect decisions and inaccurate perceptions. The alternative is to understand the event from the perspective of the involved employee at the time of the event, as discussed in the next section describing a new approach to managing risk.

Moving to a Systems Safety Approach

Paradigm 3: System design. The third and most recent safety paradigm shifts the focus away from the individual and technology to system management. In this model, the organization considers the design and management processes as well and the impact of the front line employees and technology. The organization proactively identifies risks to people, equipment, and the environment, beginning at the design stage and continuing throughout the life cycle of the system (i.e., a railroad system). This approach focuses on proactive risk identification and control (i.e., before it has adverse consequences to the organization) as part of the overall management process, a learning organization that shares information broadly to inform its employees, and bottom-up participation to help identify and control those risks. The FRA and key railroad industry stakeholders are adopting this approach to safety.

Figure 3 shows the elements of a sociotechnical system. A sociotechnical system comprises technical, psychological, and social elements. Traditionally, the railroads and the FRA addressed two layers within the sociotechnical system: technology and the worker. They ignored the impact of organizational, regulatory, and societal factors on safety. However, the previous section illustrated how these different layers can impact safety. Current approaches to railroad safety place more emphasis on the risk of current operations and less emphasis on other parts of the lifecycle (e.g., design and maintenance). For example, railroad operations have been designed with limited concern for maintenance and have dealt with it as an after-the-fact disturbance to routine operations.[11] As a result, we see such risks as the close proximity of multiple tracks, making it difficult for maintenance crews to work on one track without affecting train movements on another. Positioning tracks farther apart so maintenance crews could work without affecting train movements would positively impact train movements as well as worker safety. New safety models include these elements as well as the more traditional components.

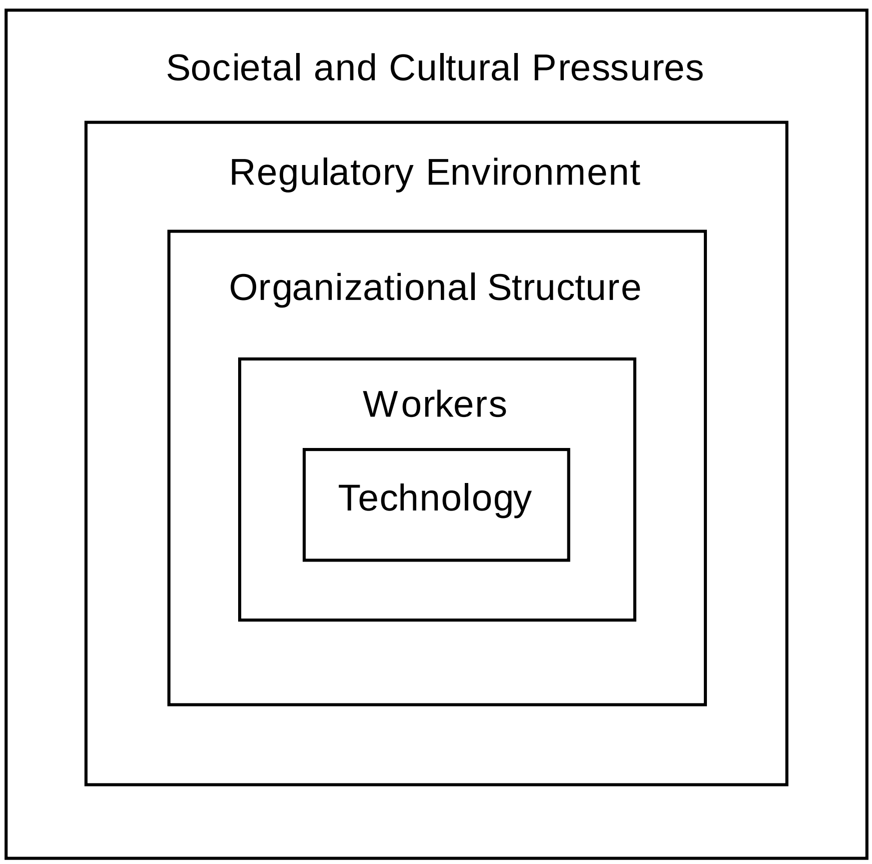
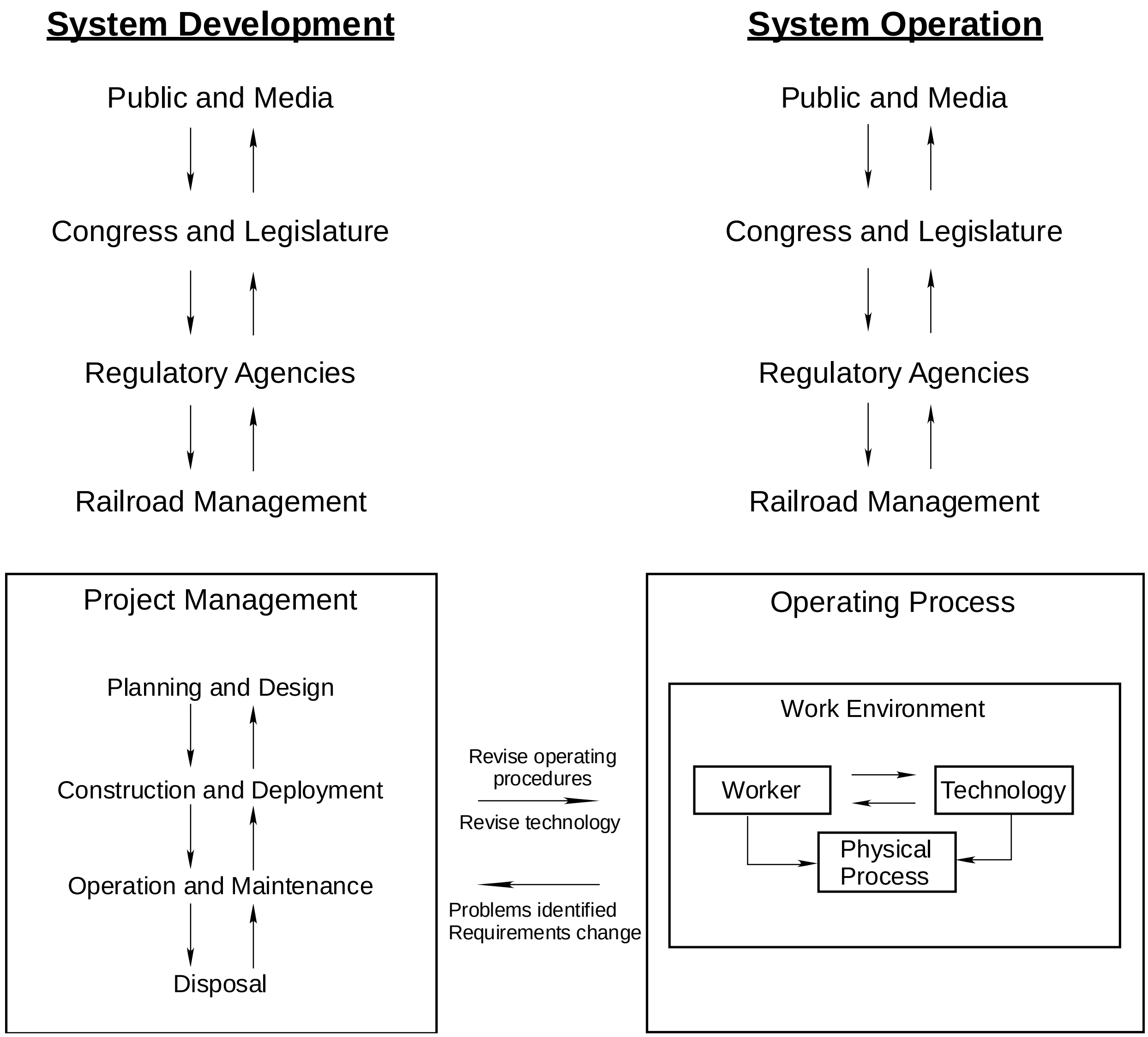


Figure 3: Elements of a sociotechnical system.

The traditional safety procedures and practices used in many industries and regulatory agencies address known risks by reacting to events after a hazard is identified. The concern or hazard is analyzed to determine why it occurred and corrective actions are taken to address it. *The FRA would like to supplement this reactive approach with proactive processes that will enable the FRA and the industry to anticipate risks and manage the changes needed to prevent or minimize these risks*. The goal is to think about risk, from the initial design all the way through operations, maintenance, and disposal as well as considering the impacts of technology, people, and organizations. Impacts from the public and the media, Congress and State legislative bodies, and regulatory agencies should also be considered.

In Figure 4, the enclosed box on the left displays the system development lifecycle, from planning and design through disposal. At each step, someone must identify the risks to the system so they can be managed through prevention and mitigation. Risk prevention represents the system defenses or barriers put in place to prevent an unwanted consequence (e.g., a train collision). Mitigation measures occur after an unwanted consequence takes place to minimize the severity of the consequences. The challenge for the railroad is deciding how to allocate limited resources to a large number of risks. The enclosed box on the right in Figure 4 displays the interactions between the different components of the system during its operation. Given the dynamic environment in which railroad operations take place, risk changes continually. The challenge is to identify the current risks facing the system so they can be managed. Over time, the ever-changing environment in which the system operates leads to changes in the design of the system. New components may be added or removed. These changes, in turn, contribute to changes in the operation of the system. Factors outside the system influence both design and operation. These factors include the public and the media, Congress and State legislative bodies, regulatory agencies, and railroad organizations. This influence is bidirectional, as feedback from the design and operation influences how these parties think about the system.



Adapted from Leveson (2004)

Figure 4. Sociotechnical model of a railroad system

This approach to managing risk also shifts the focus from human error as a cause of unsafe events to human errors as a symptom of problems within the system. The goal changes from assessing blame to either the front-line employees or management to identifying sources of variability and learning how to manage it. This approach attacks the problem rather than the people. Human error is connected to the individual's tools, tasks, and operating environment.[12] The challenge is to find out how the tools, tasks, and operating environment create the potential for unwanted consequences (e.g., an accident or injury). Human error is part of the human condition and cannot be completely eliminated. However, organizations can manage human error by designing the system to accommodate errors. Designers can adapt technology to address human limitations. Similarly, railroads can create operating practices that recognize human strengths and weaknesses. Identification of recurrent human errors in a railroad system indicates the need for changes in the system so that the errors do not result in harm to people, equipment, or the environment.

A New Approach to Managing Risk: From Reactive to Proactive

Measuring the processes that contribute to safety. This new approach to safety includes more than thinking about railroad safety from a systems view. This approach considers safety in terms of the proactive processes that take place as well as the reactive processes. While railroads benefit from investigating why accidents happen to understand what went wrong, they also benefit from identifying and measuring the processes that contribute positively to safety and contribute to accident prevention. Traditional safety measures focus on lagging indicators (e.g., accidents, violations, activation failures, false proceeds) of events that organizations don't want to occur. In contrast to collecting safety measures that reflect only the absence of unsafe events (e.g., accidents or incidents), this approach will consider developing positive measures of safety as well.

Employees respond to failures and gaps by reacting and adapting to these events. They anticipate problems and develop solutions. The FRA and the industry lack performance metrics that capture these constructive behaviors. The FRA and the industry also need to collect information on accident precursors. Precursors include lagging indicators such as reports of close calls as well as leading indicators that anticipate the likelihood of risk, so the FRA and the industry can act to maintain safety within acceptable levels (e.g., the percentage of safe behaviors observed).

What is the distinction between risk and safety? Traditionally, risk and safety have represented two sides of the same coin. Risk is defined as the probability of an unwanted outcome, as measured by the likelihood of an unwanted event times the severity of that event. Risk models focus on why accidents and incidents occur. Safety can be defined as the absence of risk.[13] In this view, risk and safety both involve preventing something bad from happening or protecting against its consequences. The problem with this definition of safety is that it is difficult to measure. How does one measure something that is not there? If safety measures (e.g., accidents) are extremely low, as they are in nuclear power and commercial aviation industries, how do we measure changes in safety over time?

There is an alternative way to think about safety alongside the traditional one. In this view, safety represents the processes for preventing or mitigating harm. Safety is measured by some positive event, for example the number of safety audits conducted or the percentage of substandard conditions identified and corrected. In this view, safety increases as the number of positive events increases.[14] In moving toward a proactive approach to safety, this method directs our attention to the positive processes that contribute to safety.

Both methods are useful in managing safety. As the railroad industry succeeds in reducing the number of accidents (e.g., train collisions), the absence of unwanted events (e.g., accidents or incidents) does not mean that the safety process is under control. Positive measures of safety provide a way to continue to measure safety when our traditional measures become uninformative.

Safety is an emergent property that changes over time. Safety is not something that an organization has, nor does it remain static over time. Instead, safety represents an emergent property of the railroad system that continuously changes as a function of how it operates.[15] Safety changes continuously as a function of internal and external sources of variability. For example, the railroad industry is undergoing a generational change with the retirement of thousands of older employees and hiring of new employees. This turnover in labor will impact safety in ways that will need to be carefully monitored. The organization's challenge is to keep their processes under control by managing these sources of variability. While many sociotechnical systems focus on staying in control by managing variability associated with human performance, other sources of variability play a role as well, such as human performance, technology, and organizational factors. Table 2 lists some of the sources of variability that influence system performance.

Table 2. Sources of Variability that Affect System Performance

Human Performance:	Efficiency–thoroughness trade-off
Technology:	Design flaws and failures during operation
Organizational:	Negligent safety culture
Missing Barriers:	Unanticipated consequences and limited maintenance
External Sources:	Suppliers, contractors, customers
Environmental Factors:	Weather, workplace conditions

Hazardous events like accidents emerge not simply from human or technological failures, but from the operation of normal systems under pressure. These pressures may be economic, social, and political. How do we manage safety, when the same forces that contribute to safety also contribute to failure?[16]

An aspect of the new approach is to use data other than safety occurrences (lagging events) to monitor safety. When trying to manage safety through a traditional feedback-based control system, eliminating all variability in a measured process means that the system has no information on which to react. The absence of negative events (e.g., accidents) can also result in a reduction in investment in safety management due to the belief that the process remains under control.[17] Therefore, other indicators of safety are needed and they help to manage variability.

One approach to managing variability requires determining the boundary within which the organization can perform safely and controlling the sources of variability so that performance remains within this envelope. This approach is captured in the notion of resilience. Erik Hollnagel defines resilience as the intrinsic ability of an organization to maintain a dynamically stable state in the presence of continuous stress or to regain a dynamically stable state, which allows the organization to continue operations after a mishap.[18] Resilience refers to an organization's capacity to learn and adapt to constantly changing conditions. Resilient organizations look for sources of strength as well as weakness. They seek to manage failure by anticipating paths to failure and addressing them. They constantly seek out information about how work is actually being performed (compared to the imagined view) and the state of the system's defenses. They also seek out what makes work difficult and develop strategies to meet new demands.

Create accountability through adoption of a learning culture. Accountability is still important at both the individual and organizational levels. However, holding people accountable does not mean punishing management or the employee closest to the event. *Instead, accountability means identifying the factors that contribute to the problem and using these failures as learning opportunities to correct them*. The goal is to work towards a just culture. A just culture seeks openness and transparency, but does not tolerate all behavior. The stakeholders strive for consensus on what is within the boundaries of acceptable behavior and what is outside those boundaries.

Accountability has different implications for different parts of the organization.[19] Individual employees have a responsibility to identify and disclose safety issues. At all levels of the organization, individuals have a responsibility to examine their own roles in contributing to the situation–why did they follow a particular course of action? Organizations have a responsibility to identify the conditions or environments that contributed to unsafe situations, identify ways to resolve these conditions, and implement corrective actions to address them. When an individual or group implements corrective action, someone bears the responsibility to determine the action's effectiveness. The organization also bears a responsibility to share this information broadly so that everyone has an opportunity to learn from it. It requires open conversation between parties to resolve conflicts that arise.

Constructive ways to improve the culture towards more learning, accountability, and making vulnerabilities more transparent exist and are being used. One example of this process is the C^3RS demonstration project. C^3RS represents a cooperative effort between the railroad industry and the FRA to identify system vulnerabilities through employee reporting of close call events. Another example is the CSA project, which empowers employees to observe each other in order to identify at-risk behaviors and provide feedback to correct them in a nonpunitive way. These projects enable the railroads to identify safety issues in a way in which they can keep sensitive information confidential, yet still share safety-related information so that the stakeholders can learn important lessons.

Benefits of Participation

The previous two sections provided a conceptual framework for the RRP. The actual programs implemented will be decided upon by mutual agreement between the FRA and the participating stakeholders. Examples of existing programs that could fit within this framework include the behavior-based safety programs like CSA and Safety Through Employees Exercising Leadership (STEEL), the C^3RS, and the Track Quality Index Program (real-time performance-based track geometry inspection).

The RRP provides an opportunity for the FRA and industry to jointly explore innovative ways to improve safety beyond the current methods. The FRA has adopted the following criteria, shown in Table 3, to use in guiding projects to include within the RRP. The criteria foster the spirit of the joint partnership the FRA seeks with the industry in moving towards safer operations described in the previous section.

Table 3. Criteria for Project Selection

- Commitment and engagement from all key stakeholders
- Voluntary non-punitive participation
- Collection and use of “upstream” predictive data
- Systematic and objective data gathering, analysis, and reporting
- Problem solving and corrective action
- Creation of long-term sustaining mechanisms

While railroads are free to implement these kinds of projects on their own, the FRA recognizes that these projects take a significant effort to operate effectively. In developing this program, the FRA seeks to support and promote the industry as they engage in these efforts. Under the Rail Safety Improvement Act of 2008, the FRA was granted authority to protect information collected under this program from release due to Freedom of Information Act (FOIA) requests. Further, the FRA will study the ramifications of protecting Risk Reduction Program data from legal discovery. The FRA recognizes that disclosing information that other stakeholders use to assign legal liability inhibits the collection and the use of this information to positively impact safety. The FRA can also support trust-building activities through the use of third parties, as occurs with C^3RS.

The FRA is prepared to provide resources in terms of staff, funding, and where appropriate, relief from existing regulations. The FRA may involve FRA support staff or contractors to provide expertise where the stakeholders need support. The FRA may indirectly provide funding through a contractor to support project startup and implementation activities, as well as to support project evaluation activities. Where there is a lack of knowledge about how to implement a risk reduction project that has been applied in other industries or on other railroads, the FRA can provide resources to assist the carrier during implementation. The CSA project represents an example of this type of support. Through its Office of Research and Development, the FRA will continue to test and evaluate new methods for managing risk. It will facilitate technology transfer from other transportation modes and industries to the railroad industry.

The FRA believes it is essential to measure the impact of these projects on safety to demonstrate benefits to industry stakeholders. The FRA will provide program evaluation support to assist in maximizing the effectiveness of RRP programs and to evaluate their impact. Information on how to improve the implementation and on the method’s impact can provide objective evidence that it contributes to safety and helps decisionmakers to justify continued participation and to encourage other railroads to consider participation. The FRA believes RRP projects will contribute to an improved safety culture in which labor, management, and the FRA all work together more cooperatively. It will contribute to greater trust and sharing of information that will benefit safety. Finally, participation in an RRP project will benefit individual employees and the carrier through identifying and taking action proactively to address safety before an unsafe event occurs.

In addition to the direct benefits of working with the FRA that are described above, the railroad industry can achieve the following benefits in practicing proactive risk reduction methods:

- Identify risks before they result in harm
- Reduce the potential consequences of a mishap
- Build trust and stronger relationships industrywide
- Create more cooperative relationships between stakeholder groups
- Decrease the need for enforcement actions
- Decrease the need for new regulations
- Decrease safety-related costs.

Challenges to Moving Forward

There are a variety of challenges to implementing the RRP. One of the challenges participants will face is the tension between the enforced compliance approach and the partnership approach. The concurrent use of both enforced compliance and voluntary partnership approaches has the potential to confuse employees and carriers. How does the carrier reconcile the use of enforcement activities that involve penalties, while participating in safety initiatives in which the FRA provides regulatory relief? This tension creates confusion with respect to the level of commitment by management in these new programs and makes them more difficult to implement. How do employees participate in programs in which safety culture is being improved, and they are still being subjected to punitive discipline policies when not operating within the boundaries of the RRP? The FRA will address conflicts and tensions that arise through communications within the FRA and with its industry partners.

Another challenge requires overcoming resistance to change. Trying a new approach carries risks and may challenge the conventional ways of doing things. In some cases, trying a new approach may require giving something up. Without the knowledge that this new approach will work, some stakeholders may be reluctant to try something new. Overcoming internal resistance to change will require champions within each stakeholder group to explain the benefits of trying these new approaches to safety. To address resistance from outside the industry requires demonstrating the benefits of the approaches with objective safety data. We must demonstrate to those stakeholders outside the railroad industry that the new safety approaches merit our consideration.

Another challenge we face in implementing these approaches is the bias for action in favor of reflective thinking and time necessary to show that the new tools work effectively. With the traditional safety methods, we respond to problems with the existing toolkit of regulations, operating rules, and company policies. However, the new approach with its view of railroad operations as a complex system offers solutions that are more difficult and time consuming to implement. Teaching employees to use some of the new approaches will require training and an iterative approach to tailor the new safety approach to the railroad environment.

Next Steps

An Executive Steering Committee consisting of representatives of senior FRA leadership will serve as a decisionmaking body to guide the development of this initiative. A new division within the FRA, the Risk Reduction Division (RRS-xx) will lead the program. FRA employees will develop the framework with support from experts in other industries and stakeholders within the railroad industry. As part of this work, the FRA will examine its own processes for managing safety and explore new ways to manage safety more effectively. The FRA will identify how the RRP will operate, decide how it wants to measure risk in the future, and develop communication mechanisms for sharing information about this program with all industry stakeholders. The FRA will communicate with its employees so they understand how the program works and how it may impact them. The FRA also will reach out to the industry to discuss ways to partner with the railroad industry stakeholders in this effort. As part of this effort, the FRA will use a Broad Agency Announcement as a procurement vehicle for supporting RRP-related projects. Current information about the RRP can be found on the FRA's Web site at: www.fra.dot.gov.

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[1] National Transportation Safety Board. (2005). *Collision of Norfolk Southern Freight Train 192 With Standing Norfolk Southern Local Train P22 With Subsequent Hazardous Materials Release at Graniteville, South Carolina January 6, 2005*. NTSB/RAR-05/04, Washington, DC: Author.
[2] Dekker, S. (2008). *Just Culture: Balancing Safety and Accountability*. Burlington, VT: Ashgate.
[3] Bogdanich, W. (July 11, 2004). *In Deaths at Rail Crossings, Missing Evidence and Silence*. New York: New York Times; Bogdanich, W. and Nordberg, J. (December 30, 2004). *Questions Raised on Signals at Rail Crossings*. New York: New York Times; Bogdanich, W. (March 8, 2005). *Railroads to Pay over Violations at Crossings*. New York: New York Times; New York Times (February, 7, 2005). Deadly Trains. New York: Author; Bogdanich, W. and Nordberg, J. (February 18, 2005). *Oversight Is Spotty on Rail-Crossing Safety Projects*. New York: New York Times.
[4] Bogdanich, W. (November 7, 2004). *For Railroads and Safety Overseer, Close Ties*. New York: New York Times; Bogdanich, W. (February 10, 2005). *U.S. Audit Faults Federal Regulators on Rail Safety*. New York: New York Times.
[5] Federal Railroad Administration. (April 16, 2008). Federal Register Notice. 49 CFR Parts 172, 174, and 209 Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments; Railroad Safety Enforcement Procedures; Interim Final Rule and Proposed Rule.
[6] Government Accountability Office, ibid.; Savage, I. (1999). Railroad Safety and Public Policy. *Journal of the Transportation Research Forum*. Vol. 38 (1), 56-63.
[7] Hale, A. (2000). Railway Safety Management: The Challenge of the New Millenium. *Safety Science Monitor*. Vol. 4 (1).
[8] Mason. S. (1997). Procedural Violations – Causes, Costs and Cures. In *Human Factors in Safety-Critical Systems*. Eds. Redmill, F. and Rajan. J. Oxford: Butterworth-Heinemann, 287-318.
[9] Grote, G. (2004). Uncertainty management at the core of system design. *Annual Reviews in Control.* 28, 267–274.
[10] Dekker. S. (2002). *The Field Guide to Human Error Investigations*. Burlington,VT: Ashgate.
[11] Hale, A.R., Heijer, T. and Koornneef, F (2003). Management of Safety Rules: The Case of Railways. *Safety Science Monitor.* Vol. 7.
[12] Dekker. S. (2002). *The Field Guide to Human Error Investigations*. Burlington,VT: Ashgate; Reason, J. (1997). *Managing the Risks of Organizational Accidents.* Burlington,VT: Ashgate.
[13] Hollnagel, E. (2008). Risk plus barriers = Safety. *Safety Science*. 46 (6) 221-229.

[14] Hollnagel, E. (2008). Safety Management – Looking Back and Looking Forward. In *Resilience Engineer Perspectives: Volume 1: Remaining Sensitive to the Possibility of Failure*. Eds. Hollnagel, E., Nemeth, C.P. and Dekker, S. Burlington,VT: Ashgate, 63-77.
[15] Ibid.
[16] Perrow, C. (1999). Normal Accidents: Living with High-Risk Technologies. Princeton, NJ: Princeton University Press.
Hollnagel, E. (2008). Safety Management – Looking Back and Looking Forward. In *Resilience Engineer Perspectives: Volume 1: Remaining Sensitive to the Possibility of Failure*. Eds. Hollnagel, E., Nemeth, C.P. and Dekker, S. Burlington, VT: Ashgate, 63-77.
[18] Hollnagel, E. (2006). *Resilience Engineering: Precepts and Concepts*. Burlington,VT: Ashgate.
[19] Paul, M. (1997). Moving from Blame to Accountability. *The Systems Thinker: Building Shared Understanding*. 8 (1).