Taking Safe Decisions - How Britain’s railways take decisions that affect safety

Introduction

In the GB rail industry, almost every policy, investment or operational decision has an impact on safety. Taking Safe Decisions sets out the industry’s consensus view of how safety is taken into account when taking decisions. It describes the principles that companies apply to protect people’s safety, satisfy the law, respect the interests of stakeholders and meet wider commercial objectives. These are distinct from those that the state applies when it takes decisions, but the two sets of principles work in a complementary way to ensure the safety of the railway system as a whole.

Every organisation needs to understand and manage its risks, both on an ongoing basis and when it changes something. Risk management comprises three related activities, which ask questions about safety-related change:

(i) Monitoring. Is my operation safe or might I need to make a change?

(ii) Analysing and selecting options. What (if anything) should I change and can it be done safely?

(iii) Making a change. How do I make sure the change is safe?

These activities and questions form the basis of a unifying framework that runs through this guidance.

Taking Safe Decisions is primarily for decision takers working for transport operators and their suppliers. This is version 2.0; it replaces version 1.0, which was published in 2008. The fundamental principles are unchanged but the text has been updated to reflect industry experience of applying the guidance and changes to legislation.

In version 1.0, the framework for taking decisions that affect safety was set in the context of general safety legislation, such as the Health and Safety at Work Act (HSWA) and the Management of Health and Safety at Work Regulations (MHSWR). In this context, the legal criterion for taking safety-related decisions was always based on ensuring safety so far as is reasonably practicable (SFAIRP).

Since its publication, railway specific regulations from Europe have come fully into force. These include two Common Safety Methods that apply to transport operators (and can also apply to other railway companies):

- The Common Safety Method for Monitoring
- The Common Safety Method on Risk Evaluation and Assessment (CSM RA)

The CSM RA introduces three risk acceptance principles. In practice, applying these is equivalent to the SFAIRP test. However, because the risk acceptance principles from the CSM RA must be applied in certain circumstances, the framework that this document presents has been aligned to them.
Using this document

Taking Safe Decisions consists of two parts. **Part 1** describes the responsibilities and obligations of a railway company in GB. **Part 2** introduces a risk management framework that is used to describe how companies meet their responsibilities and obligations when carrying out the associated activities of safety monitoring, analysing and selecting options, and making a change. The document seeks to provide answers to a number of safety-related questions.

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Worked examples

A set of worked examples demonstrates how the framework described in this document can be applied in practice. The worked examples are based on real industry decisions but they have been anonymised and some of the details changed to better illustrate important principles.

The removal of fire extinguishers describes the removal of a risk control that is no longer providing an overall safety benefit. It illustrates a relatively simple decision made largely on the basis of qualitative analysis and expert judgement.

Final drive failures illustrates how risk assessment and safety monitoring can combine to support the iterative design and implementation of safety measures. It also provides an example of a company deciding to go beyond its legal safety requirements to reduce its reputational risk.

The provision of signal post telephones when adopting GSM-R illustrates the complexities of decisions involving multiple organisations. It discusses the psychology of decision making, in particular the importance of framing the decision in the right way.

The formation of an infrastructure manager / railway undertaking alliance shows how structured workshops can be used to evaluate risk and identify safety measures when making an organisational change.

1. Responsibilities and obligations of railway companies

2. The Taking Safe Decisions risk management framework
In the GB rail industry there are a number of overlapping roles and responsibilities. Many of these relate to safety. No one entity is responsible for making the railway system as a whole safe: instead the various companies, the regulator and others each play their part.

A company in the rail industry has commercial responsibilities. It also has legal obligations associated with the different roles it occupies, for example as:

- a corporate entity
- an employer
- a transport operator

Figure 1 illustrates the obligations and responsibilities that a transport operator in the GB rail industry might have and how they relate to each other. Some are general and apply to companies in any sector, but others are specific to the railway.

Some railway-specific obligations also apply to companies that are not transport operators. It is anyway important that companies in the railway supply chain understand them because they impact on the products and services that transport operators require.

Figure 1: Responsibilities and obligations of a transport operator in the GB rail industry
1.1 Commercial responsibilities relating to safety

Commercial decisions are taken to meet commercial objectives. Investment to meet these objectives may also provide an opportunity to improve safety: new technology and ways of working often bring benefits in terms of performance, efficiency and safety.

Most decisions affect safety, even where this is not the main intention. Therefore, safety should be considered when taking decisions and legal obligations must be met.

Safety makes good business sense so it might, in some circumstances, be sensible to reduce risk to a level below what is legally required. An accident can severely damage a company’s reputation, reduce passenger numbers, staff morale and shareholder perceptions, thus having a direct impact on the company’s value.

1.2 Legal obligations relating to safety

1.2.1 General safety legislation

A railway company has safety-related obligations under general safety legislation, for example as an employer, a corporate entity, an occupier of premises, or as a client for or contractor of construction work.

The overarching piece of domestic general safety legislation is the Health and Safety at Work Act. Examples of other general safety legislation that apply to transport operators are the Occupiers’ Liability Act 1984, which imposes a duty of care to trespassers, and the Construction (Design and Management) Regulations 2007, which define legal duties for the safe operation of construction sites.

The Health and Safety at Work Act imposes an obligation on employers to ensure the health and safety of people affected by their undertaking so far as is reasonably practicable. For transport operators, this covers their employees, passengers and others. The Management of Health and Safety at Work Regulations 1999 make more explicit what an employer needs to do to meet its obligations under the Health and Safety at Work Act, and include the need to carry out “suitable and sufficient” risk assessments.

The duty to ensure safety SFAIRP is sometimes expressed as a requirement to reduce risk to a level that is as low as reasonably practicable (ALARP). To discharge this duty an organisation needs both to monitor and control the risk in relation to on-going activities and manage any risk that arises from making a change.

Therefore, to determine whether a safety measure is reasonably practicable, its safety benefits (the “quantum of risk” averted) are compared with its costs (the “sacrifice involved”). Professional judgement is applied to determine whether or not the costs are grossly disproportionate to the safety benefits, paying particular attention to the degree of uncertainty in the assessment of costs and safety benefits.

In the GB rail industry, the concept of gross disproportion is taken as an acknowledgement that, because accidents and their consequences are difficult to predict, the estimation of risk is an inherently uncertain process: in some circumstances wide confidence limits need to be applied. The degree of uncertainty in risk estimates informs any judgment that they are used to inform.

Section 40 of the Health and Safety at Work Act says that “it shall be for the accused to prove… that it was not practicable or not reasonably practicable to do more than what was in fact done…” This is sometimes referred to as a ‘reverse burden of proof’. Anyone taking a decision not to introduce a safety measure needs to be confident that it is not reasonably practicable. This would imply that it would be sensible to consider any uncertainties in risk assessment very carefully when making the judgement.

An interpretation of reasonably practicable is provided in the judgement of the Court of Appeal in the 1949 case of Edwards versus the National Coal Board.

“‘Reasonably practicable’ is a narrower term than ‘physically possible’… a computation must be made by the owner in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other, and that, if it be shown that there is a gross disproportion between them – the risk being insignificant in relation to the sacrifice – the defendants discharge the onus on them.”
Uncertainty is likely to be substantial when trying to estimate the risk associated with high-consequence, low-frequency events such as train collisions. There are two reasons for this:

- These incidents are rare so there is limited relevant data to use to develop estimates of future risk.
- They can result in a wide range of consequences, the severity of which can vary significantly. For example, the Ladbroke Grove accident resulted in 31 fatalities. The accident at Southall was similar in many ways but resulted in seven fatalities.

Conversely, the risk associated with high-frequency, low-severity incidents is generally better understood because there is usually more historical data available to support risk estimation.

Reasonable practicability is an objective test and the specific circumstances of a company – for example, its financial strength or weakness – are not relevant to a court’s determination of what is reasonably practicable. Further details on the use of SFAIRP as a risk acceptance criterion when explicitly assessing risk are included in section 2.3.2.

1.2.2 Railway-specific safety legislation

In addition to the general legislative requirements, there are some requirements that are specific to the railway. The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended) set out requirements relating to:

- Safety management, including the need to maintain a safety management system
- Safety certification and authorisation
- Risk assessment
- Transport operators’ duty of co-operation
- Safety-critical work

Many hazards on the railway arise at the interface between different transport operators. These hazards can only be effectively controlled by the co-ordinated actions of more than one company. The duty of co-operation in ROGS requires companies to work together to manage risk. It applies at all stages of the risk management framework that is described in Part 2 of this document.

Further information about how companies work together to deliver system safety can be found in RSSB’s System Safety Guidance (in preparation). The Duty of Co-operation Guide, also produced by RSSB, summarises the co-operative arrangements that companies need to put in place to comply with the requirements in ROGS.
Legislation can also mandate specific safety measures. For example, the Railway Safety Regulations 1999 required the installation of a train protection system across the network and the removal of Mark 1 rolling stock.

Transport operators’ responsibilities are also defined in regulations setting out Common Safety Methods, which apply to mainline railways across Europe. In the event of conflict, law originating from the European Union has primacy over domestic legislation. However, the responsibilities set out in the CSMs are consistent with those defined in more general UK legislation, including the Health and Safety at Work Act.

Two of the CSMs apply to transport operators1 – the CSM for Monitoring and the CSM on Risk Evaluation and Assessment. These two CSMs can be thought of as structured ways of answering questions about safety, as set out below. There are four more CSMs and these are described in Annex 1, which discusses The safety-related responsibilities of the government.

Is my operation safe or might I need to make a change?

The CSM for Monitoring requires each transport operator to check the application and effectiveness of its own safety management system (SMS). Monitoring is a “repetitive and iterative” process that applies to ongoing operations and maintenance activities. A robust monitoring process will at times raise questions about whether the company’s operation is safe or whether there might be a requirement to introduce additional safety measures.

The monitoring process involves:

- Defining a strategy, priorities and plan(s) for monitoring
- Collecting and analysing information
- Drawing up an action plan for when non-compliance is identified
- Implementing the action plan when necessary and evaluating its effectiveness
- Recording evidence from the monitoring process

How do I make sure the change is safe?

The CSM on Risk Evaluation and Assessment applies once you have decided to change something. It sets out a risk management process that is mandatory if the change affects safety and is “significant” (as defined by the regulation). The regulation applies to technical, organisational and operational change.

The process involves:

- Defining the system to be assessed
- Identifying hazards and analysing the associated risk
- Identifying the safety measures required to reduce risk to an acceptable level
- Demonstrating that the safety measures have been properly implemented

The regulation places specific requirements on the proposer and it is the job of the proposer of a change to implement it safely.

When applying the CSM RA, the focus is on confirming whether or not the proposed arrangements manage risk to an acceptable level and not on making comparisons with the previous level of risk or proving whether a hypothetical safety measure is or is not required.

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1 The CSMs for Monitoring and on Risk Evaluation and Assessment apply both to transport operators (infrastructure managers and railway undertakings) and entities in charge of maintenance (the companies that maintain rail vehicles). The CSM RA also allows other organisations to act as the proposer of a change, particularly project entities and manufacturers who are leading projects to place new rolling stock or infrastructure into service. In such cases, this change is complete once the rolling stock or infrastructure has been placed into service and a transport operator would need to act as the proposer of a new change in order to put it into operational use.
Risk acceptance principles

The CSM RA defines three risk acceptance principles, which can be used, either individually or in combination, to demonstrate that the risk arising from identified hazards has been controlled to an acceptable level.

1. The application of codes of practice

The regulation defines a code of practice as a “written set of rules that, when correctly applied, can be used to control one or more specific hazards”. For example, the set of rules may be made up of clauses from one or more standards. The application of codes of practice can be a relatively simple way of closing out hazards. However, codes of practice are rarely written just to control hazards and there is often no explicit map between requirements and the hazards they control. There’s a need to assess whether safety measures derived from codes of practice are sufficient for controlling the risk, which is not the same as it being necessary to apply them.

2. Comparison with similar reference systems

Comparison with a reference system can also be an efficient means of identifying safety measures and reaching conclusions about the acceptability of risk. The reference system needs to be similar to what is being proposed in terms of its functions and operating environment. It also needs to have been “proven in use” to have an acceptable level of safety and be compatible with current good practice. Good practice does not stand still but evolves over time in response to incidents, better information, and new technology or techniques. A technology or method of working that was deemed safe in the past may, in some circumstances, no longer manage the risk to an acceptable level.

3. Explicit risk estimation

Explicit risk estimation tends to be the most time consuming and resource intensive of the risk acceptance principles to apply. It requires a more bespoke approach, based on qualitative or quantitative analysis. When explicit risk estimation is applied the risk acceptance criterion that is generally used in GB is to ensure safety SFAIRP, as defined in general legislation.²

² An alternative to this is that, under certain conditions and when mutual recognition of the safety acceptance of a technical system is being sought across European Member States, an absolute risk acceptance criterion based on defined failure rates can be applied. The requirements are defined in the CSM RA regulation.
1.2.3 Relationship between the CSM RA and the Health and Safety at Work Act

Application of the CSM RA risk acceptance principles is consistent with the requirement to ensure safety SFAIRP in the Health and Safety at Work Act, as demonstrated by Figure 2.

The safety measures contained in suitable codes of practice and applied in similar reference systems can be considered to represent good practice. Applying appropriate good practice is an established means of meeting the requirement to ensure safety SFAIRP.

The UK risk acceptance criterion of SFAIRP will be used in most cases where safety measures are being derived using explicit risk estimation. The supporting analysis is therefore equivalent to what was previously being done to meet the requirements of general safety legislation.

The basic elements in the CSM RA risk management process – defining the system, identifying its hazards, and putting in place the controls needed to reduce the risk from them to an acceptable level – were already well established in the GB rail industry as a means of satisfying the requirements for risk assessment in the Management of Health and Safety at Work Regulations.

The process set out in the CSM RA is scalable; that is, it can be applied to a depth appropriate to the complexity of the change. It therefore makes sense for a transport operator to choose to apply the risk management process defined by the CSM RA to all changes, including those that are not significant. This avoids the need to have duplicate risk assessment processes. If a change is not significant then there is no obligation to apply the full risk management process from the CSM RA and so some elements, such as the need for independent assessment, can be omitted.

The framework presented in Part 2 is a generic one that is consistent with obligations under both general and rail specific legislation. However it is closely aligned with the requirements from the CSMs for Monitoring and Risk Evaluation and Assessment. In particular it includes the risk acceptance principles from the CSM RA because these are the principles that must be applied for significant change.

The regulation for the CSM RA includes additional mandatory requirements beyond those in general legislation. Other than providing an overview of the CSM RA risk acceptance principles Taking Safe Decisions does not describe its application in detail but instead refers out to more detailed Rail Industry Guidance Notes.

The Office of Rail and Road (ORR) concluded in its Policy statement on the relationship between the CSM for Risk Evaluation and Assessment and other risk assessment requirements that:

“…there is no conflict between the domestic requirements for a risk assessment to be suitable and sufficient and the level of risk assessment set out in the CSM RA.”

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Figure 2: Compatibility of the CSM RA and the requirement to ensure safety SFAIRP
Part 2 of Taking Safe Decisions describes how railway companies meet their responsibilities and obligations, which were introduced in Part 1.

It describes the activities of monitoring and making a change, which are embedded in the CSMs. It also describes the associated activity of analysing and selecting options: how to decide what to do when a problem or opportunity is identified. These are the activities that are required to meet general safety responsibilities under the Health and Safety at Work Act.

The relationship between the three activities is depicted in Figure 3.

The framework applies to all safety-related decisions but what is involved in each step will differ depending on the complexity and nature of the change being considered.

Most major changes are made to meet commercial objectives or requirements that are not primarily about safety. For example:

- New technology might become available that can improve a company’s performance
- Equipment might become life-expired, prompting decisions about how it should be renewed
- Operating conditions might change, presenting a company with commercial opportunities
- New legislation might be introduced
- Local complaints might draw a company’s attention to a specific issue

The need to change can also arise from concerns about safety that are identified during monitoring. In this case, the options might relate directly to the implementation of new safety measures.
In either case, the decision as to which option to pursue will be based on consideration of both:

- the business case associated with the change and
- the need to meet the legal obligation to reduce risk to an acceptable level.

The process of managing the risk associated with a change is iterative and begins at the conceptual stage. Options, including the implementation of safety measures, are analysed at progressively lower levels as the detail of the change is agreed. The risk acceptance principles from the CSM RA provide a useful framework for analysing risk during option analysis to provide confidence that the change can be implemented safely. If the change is significant then full application of the CSM RA would flow naturally from this initial assessment.

The stages of the Taking Safe Decisions risk management framework

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<td>What (if anything) should I change and can it be done safely?</td>
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<tr>
<td>Making a change:</td>
<td>How do I make the change sufficiently safe?</td>
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<tr>
<td>Monitoring:</td>
<td>Is my operation sufficiently safe or might I need to make a change?</td>
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Simple change example: introducing a new risk control

A spate of incidents involving passengers with heavy luggage falling on the station stairs is identified by routine monitoring.

Investigation reveals that many passengers are unaware of the lift. Improved signage is quickly identified as an effective way of tackling the problem.

The new signs do not impact any other hazards so are introduced without further risk assessment.

The effectiveness of the signs is monitored via staff feedback, regular reviews of accident data, and lift usage records.

Complex change example

There is an opportunity to redevelop the station, which is old and at capacity, as part of a wider local regeneration project.

There are many design options to consider. These are evaluated by a cross-disciplinary team to ensure that commercial objectives are met and the station is capable of being operated safely.

A detailed risk assessment is carried out on the selected option to identify what further measures are required to make the station sufficiently safe and to demonstrate that this has been achieved.

The monitoring strategy, priorities and plan are revised to reflect the changes to the station. Critical and vulnerable systems identified by the risk assessment are prioritised.

Figure 4 shows how the framework applies to two hypothetical changes. One comprises the implementation of a simple risk control in response to an issue raised by safety monitoring. The other is a more complex change that is being made to meet commercial objectives.

The remainder of Part 2 is structured around the Taking Safe Decisions risk management framework and takes a more detailed look at the steps within it.
2.1 Monitoring safety

A transport operator’s safety management system describes the processes it follows to review and manage safety effectively. Its monitoring strategy should prioritise critical and vulnerable safety measures and ensure that it can identify issues so that those who need to act can do so in a timely manner.

Different types of monitoring activity can identify the need to make a change. For example:

- An accident investigation might identify a weakness in company procedures.
- An incident might prompt a re-evaluation of the level of risk from a particular hazard.
- A periodic review of a company’s risk assessment for an activity or location might identify a new hazard or a change in the risk profile.
- Analysis might reveal that a particular group is exposed to a high level of individual risk.
- Safety performance indicators might show an adverse trend.
- A company audit might identify non-compliances relating to a safety measure.
- Benchmarking against another company (or another area within the same company) might show that what is being done no longer represents good practice.
- A change in operating conditions, new good practice or new technology might trigger a review, which concludes that the risk from a hazard is no longer being controlled to an acceptable level.

Monitoring is a continuous process and can be thought of as a recurring monitor / analyse / review cycle.

2.1.1 Monitor

This phase involves monitoring the effective application of the safety management system. This should be done in a prioritised way and therefore particular safety measures may be specifically targeted for more intense monitoring at certain times. Information collected for the purposes of monitoring might relate to the correct application of processes (such as the results of audits or surveys) or undesirable outcomes (such as data from incident reporting systems).

2.1.2 Analyse

When the information is collected it is analysed to determine where safety measures might be insufficient or ineffective. Safety concerns identified need to be further investigated. When determining the effectiveness of safety measures and determining appropriate actions, the accuracy, completeness and timeliness of the monitoring data should be considered. The results of the monitoring and analysis should be reviewed to answer the question: Is my operation safe or might I need to make a change?
2.1.3 Review

The monitoring strategy, the plan and the priority areas should be reviewed periodically to ensure that they provide actionable information and remain focused on the most critical and vulnerable safety measures or areas of operation and maintenance.

If monitoring does identify the need to make a change, it is usually possible to take a practical approach to scheduling safety improvements. For example, if a change is to be applied across a number of locations then its implementation would usually be prioritised according to risk. Unless there is an urgent need to correct a deficiency the change can be scheduled within the planned maintenance and renewal cycle. It is usually more cost-efficient to carry out work as part of a wider change, such as a re-signalling project or a train overhaul. In such cases, it is these costs that should be used in any cost-benefit analysis. If a change is made as part of a franchise change then any associated costs and benefits can be included in the franchise agreement.

RSSB has produced Safety Assurance Guidance, a practical aid for transport operators, which includes guidance on how to set a monitoring strategy. More specific information on the CSM for Monitoring can be found in the four-page guide to Understanding the new Regulation on the Common Safety Method for Monitoring.

Measuring Safety Performance, also published by RSSB, sets out the key steps for developing and managing safety performance indicators (SPIs). An online SPI toolkit provides additional resources to help organisations set up and manage an SPI programme.

The Railway Management Maturity Model (RM3) describes the criteria that ORR uses to assess an organisation’s ability to control health and safety risk. It assesses different elements of a company’s SMS using a five-point scale. It provides a potential means of monitoring the effectiveness of the SMS, and also defines what excellence looks like in terms of monitoring, audit and review.
2.2 Analysing and selecting options

Once the need for change has been identified, the options are identified and analysed.

When considering a change appropriate resource must be devoted to identifying and exploring options at an early stage. This is so that incorrect options are not chosen by default when projects are initiated and early work begun. The additional cost associated with introducing a new safety measure late in a project when it could reasonably have been identified at an earlier stage should not be used to justify not implementing the measure.

2.2.1 Scope problem

The first step is to understand the nature, size and complexity of the problem and the resources that are needed to resolve it.

Figure 5 shows some of the factors to consider when scoping the problem, their influence on how the decision should be taken, and whether any change is likely to be significant.

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<th>Nature of the decision</th>
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<td>Risk owner</td>
<td>Owned by one organisation</td>
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<td>Worst credible case consequences</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Operational experience</td>
<td>Extensive</td>
</tr>
<tr>
<td>Technology</td>
<td>Mature</td>
</tr>
<tr>
<td>Complexity</td>
<td>Very simple</td>
</tr>
<tr>
<td>Ability to monitor and act post change</td>
<td>Can identify problems and resolve quickly</td>
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Approach for making the decision

- More likely to be categorised as significant
- More senior level decision taking
- More consultation
- More extensive and detailed analysis
- More time to agree and implement the decision

Figure 5: Considerations in problem scoping
Who should take the decision?

Decisions should usually be taken by whoever is closest to the problem with sufficient authority and expertise. Many routine decisions are, and should be, taken by frontline staff. They usually understand the risk well and there may be established good practice. At the other extreme, some decisions are of a scale and scope that affect the industry as a whole and are taken collectively.

Potential decision takers should know the scope of their authority and the company’s principles for taking decisions that affect safety so that they can delegate decisions to the appropriate level. The questions that they need to ask to determine whether they have suitable authority to take a decision are illustrated in Figure 6.

2.2.2 Analyse options

The next step is to analyse the options. Analysis informs decisions and provides evidence to show that they have been soundly and consciously taken.

The options analysed should cover all possible choices of action, including doing nothing. The decision to do nothing should be recognised as a conscious choice, rather than the default outcome of inaction.

At this stage, there is a need to analyse each of the options to the extent that is necessary to identify which one to pursue. The analysis will need to consider various criteria to ensure that the selected option is compliant with requirements, commercially sound and safe.

Rules and requirements

Some decisions are explicitly required by law or mandated in standards.

Standards are designed to provide for a cost-effective, efficient, compatible and safe railway system. They apply at one of four levels:

- European, for example Technical Specifications for Interoperability (TSIs)
- National, for example Railway Group Standards (RGS)
- Company
- Project

Some standards set out accepted ways of managing risk and it is efficient to consider the extent to which mandatory standards control the risk early in a change process.

Where standards relate to specific requirements associated with technical systems, such as rolling stock or signalling equipment, then compliance with standards will very often reduce the risk from relevant hazards to an acceptable level. However, this should not be presumed and some consideration of the hazards and the risks arising from them is always necessary: a standard generally only relates to a component or process within a larger and more complex operational system. When a system has been authorised for being placed into service many hazards will have been addressed, as long as the technical system is used appropriately. In this case, further safety measures associated with putting that system into use will generally relate to its maintenance and operation. Nevertheless, it is ultimately the responsibility of the organisation putting the system into use to ensure that
the risk from all hazards is at an acceptable level.

Information on the different types of standards that are used by the industry and the process for changing them or seeking permission to do something different can be found on the RSSB website.

**Commercial criteria**

Many decisions in the rail industry are taken for commercial reasons. Taking Safe Decisions does not provide detailed guidance on how to take such decisions. Instead, it stresses that the criteria for taking them are distinct from those applied to meet legal obligations and will depend on the company’s policies, values, priorities and resources.

A commercial decision is likely to be based on a consideration of factors such as:

- The cost of implementing the change (and the resulting change in operation and maintenance cost).
- Performance benefits
- Alignment with long-term corporate strategy
- Business reputation (which might be affected by levels of societal concern)
- Industrial relations
- Corporate social responsibility
- Project risk

For decisions with broad scope or a high degree of complexity or novelty, strategic analysis could be worthwhile. This involves looking at the decision in the round, taking into account the broad interests of the company or companies involved and of the railway in general.
Safety criteria

At this stage in the change process the company needs to be confident that an option will, when delivered as a project, include safety measures that reduce risk to an acceptable level.

For any reasonably large project, such as the station redevelopment example in Figure 4, there are likely to be design details that are not agreed until after the decision to proceed has been taken. When analysing options, the decision taker undertakes a high-level assessment of the risk using the available information.

Major change is often taken to meet commercial objectives. However, even if it is not the main driver, safety needs to be considered early on because it provides the opportunity to design in safety enhancements which will ultimately reduce risk to an acceptable level: additional requirements become increasingly expensive the later in the project life cycle they are identified. This is illustrated in Figure 7. The options need to be specified and analysed in sufficient depth to provide confidence that costly new requirements will not materialise later in the project. It is not acceptable to argue that a measure is not necessary to ensure safety SFAIRP on the basis of excessive cost if that measure could and should have been identified at an earlier point in the project when its implementation would have been required.

High-level risk analysis carried out at this stage will include some consideration of the extent to which the hazards will be covered by standards and, where there is existing operational experience, the way in which risk is managed in similar circumstances. Once an option has been selected, this early analysis leads into the risk management process for making a change that is described in section 2.3.

For a small and well understood change, it might be possible to clearly define all the required safety measures at the option selection stage. If the change is being made in response to a concern raised by safety monitoring – such as the simple change example in Figure 4 – then the decision is likely to be about whether or not to introduce additional safety measures. In this case, the options and additional safety measures are essentially the same thing, although it will still be necessary to plan how to make the change and assess any adverse effects on other hazards.

Figure 7: Project maturity and the increasing cost of additional safety measures
Engagement

It is useful to involve stakeholders in the decision taking process because:

- it is often only possible to understand the full scope and implications of a change by identifying the affected parties and understanding their various perspectives.
- if stakeholders are consulted and their views discussed, regardless of what the ultimate decision is, they will tend to be more willing to accept the decision thereby easing its implementation.

The level of engagement should reflect the scope and complexity of the problem, and might range from local discussions through to cross-industry consultation.

Sometimes a change can only be introduced with support from interfacing organisations because it might fall on them to implement some of the required safety measures. ROGS imposes a ‘duty of co-operation’ on rail companies, which requires them work together to manage risk (see section 1.2.2).

If the similar reference systems risk acceptance principle is applied, then establishing a good working relationship with the owner of the reference system is useful for understanding the system and its safety measures.
2.2.3 Select options

Commercial responsibilities and legal obligations

The choice of which high-level option to pursue will often be primarily a commercial decision. The decision will be made by a company’s board or managers based on their acumen and judgement and informed by analysis. The analysis might take the form of a balance sheet of pros and cons or a business case cost-benefit analysis (CBA). Decisions taken for commercial reasons are voluntary and the criteria for taking them are distinct from those applied to meet legal obligations.

When a decision affects safety there is a legal obligation to manage risk to an acceptable level. Identifying the necessary safety measures generally takes place in the ‘making a change’ stage of the process. However, when selecting the option to implement, there is a need to understand broadly what needs to be done because the cost of the safety measures might impact on the business case.

Figure 8 summarises the information that informs decisions, the criteria that are applied, and the distinction between decisions that are taken to meet legal obligations and those that are taken voluntarily to meet commercial objectives.

<table>
<thead>
<tr>
<th>Evidence and information</th>
<th>Legal criteria</th>
<th>Business criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Legislation</td>
<td>Is there prescriptive legislation?</td>
<td>Are the measures sensible for the business based on:</td>
</tr>
<tr>
<td>• Codes of practice</td>
<td>Are the measures judged necessary</td>
<td>• Performance benefits</td>
</tr>
<tr>
<td>• Similar reference systems</td>
<td>to reduce the risk to an acceptable</td>
<td>• Business reputation</td>
</tr>
<tr>
<td>• Safety benefits of measures</td>
<td>level (based on application of the risk</td>
<td>• Long-term success</td>
</tr>
<tr>
<td>• Costs associated with measures</td>
<td>acceptance principles)?</td>
<td>• Corporate social responsibility etc.</td>
</tr>
</tbody>
</table>

Additional information such as:
• Public attitudes / societal concern
• Stakeholder opinion
• Environmental impact
• Available funds
• Project risk

Figure 8: Evidence and information that support industry decisions and the legal and commercial criteria applied
When explicit risk estimation is applied to determine whether a safety measure is required to reduce the risk to an acceptable level, a SFAIRP CBA is sometimes used. This is different from the business case CBA, and takes into account a narrower range of costs and benefits. When a decision is primarily about safety, a SFAIRP CBA can also be used to inform the comparison of options. Section 2.3.2 provides further information and RSSB has also published Guidance on the use of cost-benefit analysis when determining whether a measure is necessary to ensure safety SFAIRP.

CBA is only an input to the decision and is used to inform a judgement. If the gross cost associated with a safety measure or option (excluding any performance benefits) is substantially higher than its safety benefit then the decision taker might make a judgement that safety is not the key driver and base the decision on other business criteria. For example, the industry decision to implement the European Rail Traffic Management System (ERTMS) in the UK has a positive business case and is predicted to reduce train accident risk. However, it is accepted that the implementation of ERTMS has not been taken on the basis that it was required to reduce risk to an acceptable level. The expenditure is far in excess of the financial value of any safety benefit and therefore it is accepted that the safety benefit should not drive the decision making process in these circumstances.

Sense-checking the decision

Before implementing a decision, it should be subject to a sense check. This is to ensure the option selected is sensible and appropriate.

The decision and the way it was reached should be recorded. This ensures transparency, avoids any doubt as to what was decided and provides an evidence trail if the decision is subsequently challenged or reviewed, for example following an accident, by the regulator or in court.

It is important to record the reasoning on which a decision is based. Analysis might be as simple as the development of a reasoned written argument expressing judgements about risk levels and appropriate responses based on professional experience.

For a complex decision, although all of the analysis that justifies it should be retained, it is often useful to summarise the reasoning on a single page. Striping away the detail can help bring clarity.

This serves as a sense check for the person making the change and allows the rationale behind the decision to be explained to interested parties, such as interfacing organisations, passengers, the public and the regulator. Describing the problem in a suitable way can make others more likely to view it rationally and objectively, thereby helping to achieve stakeholder buy-in and manage reputational risk. An appreciation of psychological influences, as discussed below, can be useful when communicating decisions.

Before implementing the change, an organisation might decide to analyse one or both of:

- Individual risk levels for people affected by the change.
- The overall change in risk that a project is predicted to introduce.

Usually these considerations do not relate directly to particular safety measures and therefore are not of themselves risk acceptance criteria. However, the organisation might decide to use this information to:

(i) Prioritise efforts to identify additional safety measures and implement any that are found to be required to reduce the risk to an acceptable level.

(ii) Evaluate any impact on reputation, which might affect the wider business case for the change, or prompt the implementation of further safety measures.

(iii) Discuss the proposal with the regulator.

Such information is likely to help with the early identification and rectification of potential safety problems. If a change is expected to lead to increased activity (for example more passenger journeys) then it is quite possible that the absolute level of risk will increase. However, this may not be cause for undue concern if the normalised risk (for example risk per passenger journey) does not show the same pattern.
The principles of good decisions

The choice of which option to pursue should be informed by evidence and analysis but ultimately the decision taker needs to make a judgement. When making judgements, people tend to be prone to a number of cognitive biases that have the potential to result in illogical or flawed decisions. Some of these are of particular relevance to safety management in the railway industry. An awareness of these can be useful for ensuring that decisions are rational and based on objective criteria. Annex 2 presents further information about psychological influences on decision taking.

The final step in this stage of the framework is to ask whether the decision is:

- Rational, meaning that it has been taken for sound reasons and not arbitrarily.
- Equitable, meaning that due regard has been given to everyone’s interest.
- Defensible, meaning that it can be explained if challenged.

A simple question for the decision taker to ask is: How would the decision sound if it were challenged by a hostile journalist, at a shareholders’ meeting or during cross-examination in Court? If any of the reasoning on which the decision is based is unsound, these challenges will find and expose the weaknesses.

Practitioner-level guidance on applying the CSM RA, including on the use of cost-benefit analysis to support decision making, is referenced throughout section 2.3.
2.3 Making a change

This stage of the framework describes how the selected option is safely implemented.

The risk management process described here should flow naturally from the analysis carried out at the option selection stage. It can be applied to any change and is consistent with the risk management process set out in the CSM RA.

If the selected option represents a significant railway-related change then the risk management process from the CSM RA must be applied in full. The regulation contains a number of specific requirements that must be met, including the appointment of an independent body to assess the application of the process and the need to develop a plan for how the risk management process is to be applied.

A good plan helps to ensure that the risk management process is applied efficiently and with effective co-ordination between the parties involved. It takes into account the dynamic nature of the process: several iterations are likely to be required for all but the simplest of changes.

2.3.1 Define change

A good definition helps to confirm understanding of the change and identify who else will need to be involved in delivering it. It is important to get the definition right because it provides the basis for hazard identification and subsequent risk management work.

The definition describes the system after the change has been made, including information about its purpose, functions, interfaces and safety measures. Some of this information will be known from the earlier analysis carried out to support option selection. Further details are agreed as the risk assessment progresses. These are reflected back into the definition, which is a live document that serves as a repository for safety measures and assumptions.
2.3.2 Determine safety measures

Hazard identification

An important step in any risk assessment is to systematically identify the relevant hazards. If a hazard isn’t identified then it is unlikely that it – and the risk it creates – will be controlled effectively.

An initial consideration of hazards will have informed option selection. Once the change has been defined, more rigour may be needed to ensure that all reasonably foreseeable hazards have been identified so they can be analysed to an appropriate degree.

There are various approaches to identifying hazards. The best one to use depends on the novelty and complexity of the proposed change.

Desk based approaches to hazard identification are typically applied by a single person and – where there is relevant operational experience – can be as simple as reviewing data or an existing hazard list.

The GB railway industry has extensive experience of identifying and managing hazards on railway change projects. Information to support the efficient identification of hazards might already exist in the form of checklists, hazard records from previous projects, or bow-tie models. However some degree of project-specific analysis and validation will always be necessary for a significant change. Care needs to be taken that hazard identification based on pre-existing material does not become an unthinking tick box exercise in which hazards might be missed.

A workshop-based approach can help to ensure completeness by drawing on the collective experience of a group of experts. A workshop can be run as a structured Hazard and Operability (HAZOP) study or a more informal brainstorming exercise.

GE/GN8642 Guidance on Hazard Identification and Classification includes an example generic hazard list for the introduction of rolling stock, advice on running hazard identification workshops, and guidance on using risk matrices to classify hazards in order to help prioritise effort.
Identifying required safety measures using the risk acceptance principles

The safety measures required to control the risk from each hazard to an acceptable level are identified by applying one or a combination of the three risk acceptance principles that were introduced in section 1.2.2. The depth of analysis needed to support a change is usually commensurate with its novelty and complexity.

Codes of practice and similar reference systems potentially provide the most efficient means of closing out hazards. Explicit risk estimation is most often used when applying the other principles is impractical or is not sufficient for identifying the safety measures required to reduce the risk from all hazards to an acceptable level. In the latter case, a hybrid approach that combines explicit risk estimation with one or both of the other principles can be followed.

The CSM RA contains specific requirements around the identification and analysis of hazards and the assessment of risk. Thinking about these during option analysis will make for a more efficient application of the risk management process once the change has been determined.

Using explicit risk estimation to demonstrate that safety has been ensured SFAIRP

When explicit risk estimation is used, decisions can often be based on expert judgement without any need for quantification. There are established techniques for eliciting risk estimates and hazards. These often involve the use of experts in structured workshops, but for simpler decisions that may not be necessary.

A quantitative approach using formal CBA can be useful when a decision cannot be based on good practice or qualitative reasoning. This is often the case for decisions where there is technical or operational complexity, uncertainty in risks, and trade-offs of risk and cost associated with the various options being considered.

In a quantified CBA, the different elements – which might include financial costs, performance and safety – need to be expressed in the same units and it is usually most convenient to use a financial measure. The rail industry converts safety consequences to an equivalent monetary value using the Value of Preventing a Fatality, which is published by the Department for Transport and uprated annually by RSSB.

Further information on the use of CBA to inform decisions that affect safety is available in RSSB’s Guidance on the use of cost-benefit analysis when determining whether a measure is necessary to ensure safety SFAIRP.

The latest Value of Preventing a Fatality for use on the GB mainline railway is published on the RSSB website.

Section 1.2.1 quoted the ruling of the Court of Appeal in the case of Edwards versus the National Coal Board, which established that it is necessary to implement a safety measure unless its cost (the “sacrifice involved”) is “grossly disproportionate” to its safety benefit (the “quantum of risk” averted). Gross disproportion was discussed further in that section.
When assessing whether or not it is necessary to introduce a measure to ensure safety SFAIRP, the “quantum of risk” is measured in terms of collective safety risk, where:

- **Safety risk** is a combination of frequency and consequence: how often an event is expected to occur and the potential consequences – in terms of fatalities and injuries – when it does. In the rail industry, consequences are quantified using the measure fatalities and weighted injuries (FWI), in which injuries are weighted according to their relative severity.

- **Collective risk** is a measure of the risk associated with a particular scenario, control measure or hazard. It is aggregated over all exposed groups, which might include passengers, staff and members of the public.

**Individual risk** is not used to determine whether or not a particular safety measure is required to ensure safety SFAIRP. This is because it is a measure of the risk to which a hypothetical representative of a group of people, such as a train driver or a regular commuter, is exposed, aggregated over all the potential sources of harm on the railway. In other words, it is not the “quantum of risk” associated with a safety “measure”. Individual risk estimates can be useful for helping a company to understand its risk profile and to prioritise safety management effort. If an organisation discovered that a particular group was exposed to a high level of individual risk then it would focus attention on first ensuring that existing controls were being properly applied and then identifying potential new risk controls. New controls would be implemented if analysis were to show them necessary to reduce collective safety risk to an acceptable level.

**Societal concern** is also not relevant to determining reasonable practicability although, as discussed in section 2.2.3, a company might decide to respond to societal concern for commercial reasons: loss of reputation can damage profitability and performance.

The government can and does take societal concern into account when making policy decisions. Annex 1, covers the safety-related responsibilities of the state.

When applying the CSM RA, the onus is on identifying the safety measures required to control the risk arising from each hazard to an acceptable level. Frequently, a risk control affects more than one hazard, just as each hazard is managed by more than one risk control. Therefore, when applying explicit risk estimation to determine whether or not a risk control is needed to reduce risk to a level that is reasonably practicable, the assessment is based on its overall effect across all relevant hazards.

### 2.3.3 Demonstrate compliance

#### Safety requirements and hazard management

A hazard record is used to track progress towards the closure of hazards. It contains all identified hazards and, for each, links to related information including:

- An initial assessment of the risk from the hazard.
- The safety measures that will be implemented to manage the risk arising from it.
- A justification as to why these will reduce the risk to an acceptable level.
- The means by which compliance with the required safety measures will be demonstrated and, once achieved, evidence that it has been done.

The use of hazard records, which are sometimes known as risk registers or hazard logs, is well-established in the GB rail industry.

Compliance with the required safety measures can be demonstrated by testing, inspection, analysis or a combination of these things. If the safety measures are contained in codes of practice then there may already be processes in place for demonstrating compliance with them. For example, the Railway (Interoperability) Regulations require certain projects to comply with Technical Specifications for Interoperability and to appoint a Notified Body to check this. GE/GN8644 Guidance on Safety Requirements and Hazard Management provides further information, including a hazard record template.
Assessment

The organisation making the change is responsible for its safety. Primarily, it needs to assure itself that the risk has been reduced to an acceptable level. An assessment of the correct application of the risk management process by someone with an appropriate degree of independence from the project is often useful. If the change is significant then the CSM RA requires the organisation making the change to appoint an assessment body to review its application of the process.

If an independent assessment is necessary it is sensible to engage the assessor as early in the process as possible and ideally before the project scope has been fixed.

2.4 Reviewing the change

When the change has been implemented, any company whose operation has been affected by it will need to update its safety management system to incorporate information from the change project’s hazard record.

The company will therefore need to review its strategy, priorities and plans for monitoring so that it continues to focus on the most critical and vulnerable systems. Initially, there may also be specific aspects of the change that need monitoring to address concerns that were identified or validate assumptions that were made in the risk assessment.

The Taking Safe Decisions risk management framework (Figure 3) is a closed loop: the process of change leads back to the continuous cycle of monitoring that was described in section 2.1.
Annex 1. The safety-related responsibilities of the government

Government policy decisions are distinct from those taken by transport operators and are based on a different set of principles. This annex describes the government’s responsibilities with respect to safety and how the safety of the railway system as a whole is achieved.

Government policy and societal concern

The government can mandate safety measures through legislation if it judges a risk to be intolerable. This judgement can be based on the consideration of societal concern – the attitudes and opinions of the public that it represents – in addition to an understanding of their impact on risk.

Societal concern is not taken into account by companies when deciding whether a safety measure is required to meet their legal obligations with respect to safety. Where the government intervenes on the basis of societal concern, the cost of meeting additional requirements would usually be funded by public money.

As an example, the specific requirements in the Railway Safety Regulations 1999 were introduced in response to a series of accidents in which trains had passed signals at danger and the crashworthiness of Mark 1 rolling stock.

The government’s responsibilities

The Railway Safety Directive requires Member States to:

‘ensure that railway safety is generally maintained and, where reasonably practicable, continuously improved.’

Specific duties are embedded within four Common Safety Methods, which can be thought of as providing structured ways of answering two questions about railway safety.

Is the railway system safe or does the state need to intervene?

The CSM for assessment of achievement of safety targets establishes a method that is used by the European Railway Agency to ensure that safety levels in each member state are at least maintained and that minimum levels of safety are met. If the assessment reveals a ‘probable deterioration of safety performance’ then the member state is required to submit a Safety Enhancement Plan to the European Commission.

The CSM for supervision by national safety authorities requires the ORR, as the national safety authority in the UK, to monitor, promote, enforce and – where appropriate – develop the framework of safety regulation.

What must the state require transport operators to do so that their railway operation can be made safe?

The CSM for supervision by national safety authorities also requires the ORR to ensure that transport operators have suitable SMSs and that they monitor their application and effectiveness.

The CSM for assessing conformity with the requirements for obtaining a railway safety authorisation and the CSM for assessing conformity with the requirements for obtaining railway safety certificates provide procedures and criteria for the ORR to apply when assessing applications from infrastructure managers and railway undertakings respectively.

System safety

The requirement to at least maintain safety (as specified in the CSM for assessment of achievement of safety targets) applies at the national level and is a requirement placed on the Member State.³

The management and regulation of the railway is designed to ensure that – if each transport operator meets its obligations with respect to the safety of its own operation and the state also fulfils its duties – then the sum of the parts will lead to a whole that is safe.

³ Common Safety Targets and National Reference Values should not be construed as an additional risk acceptance criterion or an obligation on individual transport operators in GB to ensure that the risk after a particular change project is at least as low as it was before the change. Risk acceptance is determined by application of one or more of the three risk acceptance principles in the CSM RA.
Annex 2: The psychology of decisions

Section 2.2.3 discussed the need to be aware of psychological influences on decision taking both as a means of:

- Preventing cognitive biases leading to flawed decisions, and
- Presenting decisions in a way that is likely to be viewed objectively by stakeholders.

This Annex describes some of the psychological traps that are particularly relevant to risk management in the GB rail industry.

**Hindsight bias** is the inclination to see past events, such as accidents, as more predictable than they really were. Major accidents in the railway industry generate press coverage and societal concern. This in turn leads to pressure on the government, regulator and industry to act in a way that may not be proportionate to the risk. If such events are seen as being predictable – an accident waiting to happen – this places great importance on the ability of a transport operator to argue that they had appropriate safety measures in place.

Ensuring that a recognised approach has been followed is one form of protection against the potentially damaging effects of hindsight bias. The framework presented in this document, which encompasses legal duties with respect to safety, describes such an approach.

**Loss aversion** refers to people’s tendency to strongly prefer avoiding losses to acquiring gains. In safety management, this can affect the way people regard the removal of risk controls.

If a new technology is being implemented that improves safety and significantly reduces the reliance on existing controls, these existing controls might not need to be retained if they are no longer providing a material safety benefit. The question to ask is not *Can I remove the control?* but rather *In my new system do I need the control?* Consideration should therefore be given to the correct framing of the decision or analysis: too narrow a framing might lead to the retention of safety controls that are not required to reduce risk to an acceptable level. An example of such a decision is included in the worked example on the provision of signal post telephones when adopting GSM-R.

**Narrow framing** refers to people’s tendency to view problems in isolation, rather than taking a broader view. Especially if combined with loss aversion, the likely outcome is that decisions that a transport operator makes on a problem-by-problem basis will not combine to provide a rational and coherent way of managing the safety of its operation as a whole. The framework set out in this document, and in particular the industry approved approach to CBA that it references, seeks to standardise the rules around developing analyses to support decisions. This should make it possible to view a set of seemingly unrelated analyses as a portfolio to help understand and interpret each and reach a better set of decisions over time.

Transport operators need to be aware of opportunity cost. The money (or other costs) required to retain a control that is demonstrably reducing risk below the level required by law could potentially be used to provide a larger risk reduction elsewhere.

More general observations that can improve the quality of decision taking include:

- Problems can be over-analysed, resulting in information overload. It is not necessary to undertake detailed analysis in support of all decisions. Competent people can make good sensible decisions on the basis of available information very effectively. Frequently, this is the way to proceed. However, the decision taken and the rationale behind it still need to be recorded.
- If the decision is highly emotive, then an individual’s instincts may not serve them well. To take good decisions they need to be wary not to overemphasise the facts that support the option they already suspect is the best. A useful way to protect against this is to seek to identify information in support of alternative options.
- The more people invest in something the more commitment they feel towards it. This is known as the sunk cost fallacy. To avoid letting this phenomenon influence a decision, it is useful to acknowledge that it might, in some circumstances, be sensible to accept that a project is not likely to achieve its original objectives and that bringing it to a close is the sensible option.
This document stresses the need for decisions to be supported by agreement and discussion between different experts and stakeholders. In a workshop, like-minded individuals sometimes talk themselves into extreme positions. In situations where everyone is in agreement, it can be worth playing a devil’s advocate role to challenge the consensus of the group.

Social pressure can influence decisions. In such circumstances, arguments in support of a position should be tested to ensure that the decision is sound.

Daniel Kahneman and Amos Tversky published a number of seminal papers on the psychology of decisions that cover in more detail some of the concepts described above. For example:


The popular psychology book Thinking, fast and slow by Daniel Kahneman (2011) summarises the author’s research in this area.
### Glossary of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceptable level of risk</strong></td>
<td>The CSM RA defines <em>risk acceptance principle</em> to mean: “the rules used in order to arrive at the conclusion whether or not the risk related to one or more specific hazards is acceptable”. It also defines <em>safety measures</em> to mean: “a set of actions either reducing the frequency of occurrence of a hazard or mitigating its consequences in order to achieve and/or maintain an acceptable level of risk”. In this document when the term <em>acceptable</em> is used with reference to the term <em>risk</em> it is used according to these definitions and in this context.</td>
</tr>
<tr>
<td><strong>As low as reasonably practicable (ALARP)</strong></td>
<td>The obligation to ensure safety <em>SFAIRP</em> is sometimes expressed as a requirement to reduce risk to a level that is as low as reasonably practicable. Although <em>SFAIRP</em> and <em>ALARP</em> are different in law, they are used interchangeably in the GB rail industry and are regarded as representing the same health and safety legal test.</td>
</tr>
<tr>
<td><strong>Cost-benefit analysis (CBA)</strong></td>
<td>A systematic approach to comparing the costs and benefits associated with a decision. It is useful to distinguish between a business case CBA, which can inform a decision taken to meet business objectives, and a <em>SFAIRP</em> CBA, which can be used when applying <em>explicit risk estimation</em> to inform a decision as to whether it is reasonably practicable to implement a <em>safety measure</em>. In either case, CBA is an input to the decision that is used to inform a judgement.</td>
</tr>
<tr>
<td><strong>Codes of practice</strong></td>
<td>One of the three <em>risk acceptance principles</em> set out in the CSM RA. The regulation defines it as “A written set of rules that, when correctly applied, can be used to control one or more specific hazards.” For example, the set of rules may be made up of clauses from one or more standard.</td>
</tr>
<tr>
<td><strong>Collective risk</strong></td>
<td>A measure of the risk associated with a particular scenario, safety measure or hazard. It is aggregated over all exposed groups, which might include passengers, staff and members of the public. Collective risk is the safety metric used when <em>explicit risk estimation</em> is applied to determine whether a <em>safety measure</em> is required to ensure safety <em>SFAIRP</em>.</td>
</tr>
<tr>
<td><strong>Common Safety Method for Monitoring</strong></td>
<td>Commission Regulation 1078/2012. Further information about the CSM for Monitoring can be found on RSSB’s website.</td>
</tr>
<tr>
<td><strong>Explicit risk estimation</strong></td>
<td>One of the three <em>risk acceptance principles</em> set out in the CSM RA. It typically requires a more bespoke approach to risk assessment than the other <em>risk acceptance principles</em>, and can be qualitative or quantitative. When <em>explicit risk estimation</em> is applied the risk acceptance criterion that is generally used in GB is to ensure safety <em>SFAIRP</em>, as defined in general legislation.</td>
</tr>
<tr>
<td><strong>Fatalities and weighted injuries</strong></td>
<td>A combined measure of risk or harm in which injuries are weighted according to their relative severity. For example, a major injury is deemed to be statistically equivalent to one-tenth of a fatality. Appendix A of RSSB’s <em>Guidance on the use of cost-benefit analysis when determining whether a measure is necessary to ensure safety SFAIRP</em> defines the different injury degrees and their weightings.</td>
</tr>
<tr>
<td><strong>Gross disproportion</strong></td>
<td>Case law states that it is <em>reasonably practicable</em> to implement a <em>safety measure</em> unless the associated costs are grossly disproportionate to the safety benefits. Professional judgement is applied to determine whether this is the case, and particular attention is paid to the degree of uncertainty in the assessment of costs and safety benefits.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Individual risk</td>
<td>A measure of the risk to which a hypothetical representative of a group of people is exposed, aggregated over all the potential sources of harm on the railway. It is not used to determine whether a particular safety measure is required to ensure safety SFAIRP but can help a company understand its risk profile and prioritise safety management effort. The regulator may use measures of individual risk to help inform judgements about whether or not it thinks risks are tolerable.</td>
</tr>
<tr>
<td>Mutual recognition</td>
<td>The principle that an assessment undertaken in one Member State will be recognised in other Member States providing the same application conditions apply and the risk acceptance criteria are equivalent.</td>
</tr>
<tr>
<td>Reasonably practicable</td>
<td>See gross disproportion.</td>
</tr>
<tr>
<td>Risk acceptance principles</td>
<td>See acceptable level of risk. The CSM RA defines three risk acceptance principles: codes of practice, similar reference systems and explicit risk estimation.</td>
</tr>
<tr>
<td>Safe</td>
<td>The CSM RA defines safety as “the freedom from unacceptable risk”. A system is safe if its risk has been reduced to an acceptable level.</td>
</tr>
<tr>
<td>Safety measure</td>
<td>See acceptable level of risk.</td>
</tr>
<tr>
<td>So far as is reasonably practicable (SFAIRP)</td>
<td>The Health and Safety at Work Act imposes an obligation on employers to ensure the safety of people affected by their undertaking so far as is reasonably practicable.</td>
</tr>
<tr>
<td>Significant change</td>
<td>The CSM RA must be applied in full if a change is significant. This is determined by judgement based on its failure consequence, novelty, complexity, the ability to monitor and intervene, and additionality. See the Regulation and ORR guidance on the application of the common safety method (CSM) on risk evaluation and assessment for more information.</td>
</tr>
<tr>
<td>Similar reference system</td>
<td>One of the three risk acceptance principles set out in the CSM RA. The regulation defines it as “a system proven in use to have an acceptable safety level and against which the acceptability of the risks from a system under assessment can be evaluated by comparison.”</td>
</tr>
<tr>
<td>Societal concern</td>
<td>The concern and anxiety that the public feels about different types of risk. It might not reflect the true level of risk and can fluctuate based, for example, on media coverage. It is not relevant to a company’s legal obligations but reputational damage can impact on profitability. The government can and does take societal concern into account when making policy decisions.</td>
</tr>
<tr>
<td>Value of preventing a fatality (VpF)</td>
<td>The factor that the GB rail industry uses to convert safety consequences to an equivalent monetary value when carrying out cost-benefit analysis. It is based on an estimate of people’s willingness-to-pay to reduce fatality and injury risk. The figure is published by the Department for Transport and uprated annually by RSSB.</td>
</tr>
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Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ALARP</td>
<td>as low as reasonably practicable</td>
</tr>
<tr>
<td>CBA</td>
<td>cost-benefit analysis</td>
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<tr>
<td>CDM</td>
<td>Construction (Design and Management)</td>
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<tr>
<td>CSM</td>
<td>Common Safety Method</td>
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<tr>
<td>CSM RA</td>
<td>Common Safety Method on Risk Evaluation and Assessment</td>
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<tr>
<td>DOO(p)</td>
<td>driver-only operation (passenger)</td>
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<tr>
<td>ERTMS</td>
<td>European Rail Traffic Management System</td>
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<tr>
<td>FWI</td>
<td>fatalities and weighted injuries</td>
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<td>GB</td>
<td>Great Britain</td>
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<td>GSM-R</td>
<td>Global System for Mobile Communications – Railway</td>
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<tr>
<td>HAZOP</td>
<td>hazard and operability</td>
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<tr>
<td>HSWA</td>
<td>Health and Safety at Work Act</td>
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<tr>
<td>MHSWR</td>
<td>Management of Health and Safety at Work Regulations</td>
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<tr>
<td>ORR</td>
<td>Office of Rail Regulation</td>
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<td>PSO</td>
<td>Public Service Obligations</td>
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<td>RGS</td>
<td>Railway Group Standards</td>
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<tr>
<td>RIR</td>
<td>Railway (Interoperability) Regulations</td>
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<tr>
<td>ROGS</td>
<td>Railways and Other Guided Transport Systems (Safety) Regulations</td>
</tr>
<tr>
<td>SFAIRP</td>
<td>so far as is reasonably practicable</td>
</tr>
<tr>
<td>SMS</td>
<td>safety management system</td>
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<tr>
<td>SPI</td>
<td>safety performance indicator</td>
</tr>
<tr>
<td>TSI</td>
<td>Technical Specification for Interoperability</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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</table>

Feedback

We plan to review Taking Safe Decisions and associated guidance in 2015 in the light of industry experience of using it and of applying the Common Safety Methods.

We would be grateful for your feedback. If you would like to provide comments or suggestions please email risk@rssb.co.uk. All comments will be taken into consideration in the review.