UIC SAFETY PLATFORM

Classification of safety barriers to improve safety and interoperability

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INTERNATIONAL UNION
OF RAILWAYS

1. Introduction

Railway safety depends on the high-quality design of safety barriers and maintaining them during operation. In recent decades, many safety experts, such as Hollnagel and Reason, have reviewed and developed different methodologies for barrier management based on specific barrier taxonomies used by railways. Operational experience about barriers did not need to be shared, as every railway organisation both owned, and managed, their safety barriers in their own way.

But this model is no longer sustainable. With the ingress of technological solutions, in particular digital twins and the internet of things (IoT), the monitoring of barriers is becoming commonplace and modern railway undertakings, infrastructure managers and their subsidiaries depend on data sharing both internally and externally. Therefore, when it comes to interoperability for digital safety systems, it is imperative that consistent information formats are developed.

In January 2023, UIC published a generic definition for railway safety barriers underpinned by a machine-readable definition of safety barriers. To further support information sharing on a global level, UIC also formed a work group to develop a classification system for safety barriers. After discussing many aspects of barrier classification including existing and proposed legislation, existing safety management systems, barrier theories and various hierarchical arrangements of barriers, a simple system to classify safety barriers was decided upon. The classification is based on generally straightforward procedures, but does not introduce additional definitions. The working group members believe that this classification system will be useful because:

- Opportunities will be created for sharing experiences about railway safety barriers
- The understanding of interoperability between safety management systems and barriers will be improved
- It forms a basis for shared understanding of the subject by humans and computers
- It improves the quality of individual barriers, by linking them to the superstructure of the safety management system which also makes it easier to find opportunities to support barrier improvement processes following the PDCA-cycle.

Contents

2. Approach to the UIC barrier classification system

This paper sets out a classification system for railway safety barriers based on the UIC document "Common safety barrier definitions to improve safety and interoperability" (https://uic.org/com/enews/article/uic-task-force-has-achieved-a-common-understanding-of-a-safety-barrier;), which will be referred to as the "UIC barrier definition" hereafter.

As in the prior document, this paper abstains from selecting a specific risk assessment framework. The prime reason being that railway organisations across the world employ various effective risk control models for linking individual barriers. UIC wishes to facilitate global harmonisation, which requires a classification system that does not enforce particular risk models. In light of this objective, this paper abstains from references to:

a) How important a safety barrier is in relation to others

b) The origin or justification for the existence of the safety barrier

c) How well the safety barrier (should be) working

d) The origin or the quality of the safety barrier

UIC proposes a straightforward classification system comprising of three levels describing:

1. The safety management system (SMS)
2. Business processes of the safety management system
3. The railway safety barriers

The first level is a collection of classes in a safety management system. UIC proposes using these given classes throughout the classification system to ensure overall harmonisation on the highest abstract level of safety management. Section 3 proposes a list of relevant components.

The second level collates business processes linking to a class of the safety management system. The term is defined in the UIC barrier definition as the collection of activities performed by an organisation to maintain safety. This paper adds a procedure to assign business processes to safety management system classes and a specific format to describe business processes in section 4.

The third level "safety barriers" consists of collections of safety barriers that link to a business process. A single organisation may create a collection for their own purposes, but UIC believes that there is more value in pooling collections in the UIC barrier classification system. This paper outlines a procedure for adding safety barriers to a business process in section 5. The barrier description format is found in the UIC barrier definition and therefore is not further explained here.

3. The safety management system layer

The railways have incorporated safety barriers to ensure safety in all aspects of operation, with the help of elaborate safety management systems based on standards to systematically assess and ensure that these measures work as expected. The regulations and standards that railway organisations use are based on the Plan-Do-Check-Act cycle (PDCA), meaning that the safety management systems also follow this, even if the minutiae vary between companies.

Therefore, the PDCA cycle has been used as the blueprint for the classes in the first level of the UIC barrier classification, with the core PDCA elements being:

- Plan (often referred to as planning in the railway industry)
- Do (referred to as operation)
- Check (performance evaluation)
- Act (improvement)

Additionally, leadership and support are two transversal components that support various parts of the core PDCA classes, as seen in Figure 1.

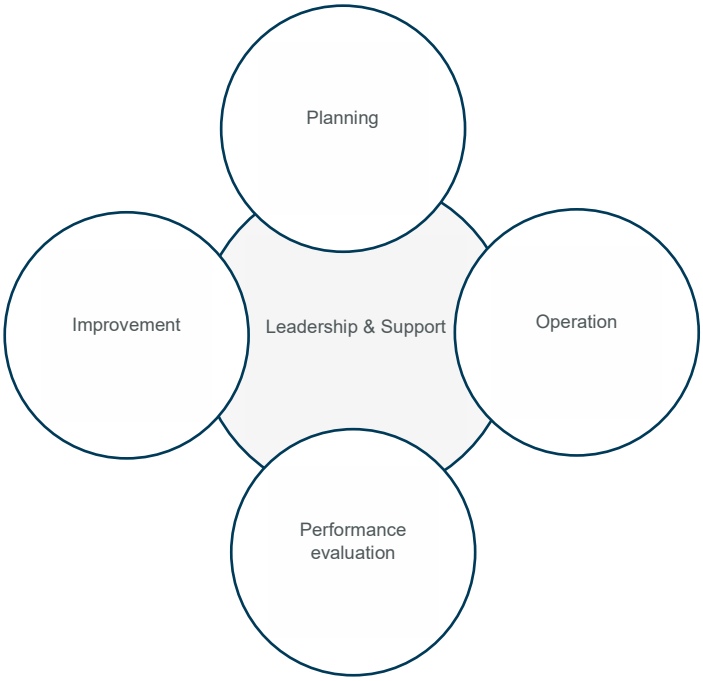

Figure 1: Components of railway safety management systems

These components along with the key requirements for the railway section are used to create the classes for the first UIC classification system level. These classes are “fixed”, meaning that they are intended to remain the same, and can only be altered or added to under exceptional circumstances.

SMS-classes are written in the “class format”, which consists of short title (not exceeding four words), and a description of a maximum of 100 words. The class format intentionally does not include a definition, as this would complicate how classes (or barriers) are assigned (see sections 4 and 5). Section 6 shows an example of an SMS-class description.

UIC proposes using the following SMS classes:

LEADERSHIP - Leadership and commitment
LEADERSHIP - Safety policy
LEADERSHIP - Organisational roles, responsibilities, accountability, and authorities
LEADERSHIP – Consulting staff and other parties

SUPPORT - Resources
SUPPORT - Competences
SUPPORT - Awareness
SUPPORT - Information and communication
SUPPORT - Safety management system documentation
SUPPORT - Creating and updating
SUPPORT - Checking documented information
SUPPORT - Integrating human and organisational factors

PLANNING - Risk assessment
PLANNING - Planning for change
PLANNING - Safety objectives and planning

OPERATION - Operational planning and monitoring
OPERATION - Asset management
OPERATION - Contractors, partners and suppliers
OPERATION - Managing change
OPERATION - Emergency management

PERFORMANCE EVALUATION - Monitoring
PERFORMANCE EVALUATION - Internal auditing
PERFORMANCE EVALUATION - Management review

IMPROVEMENT - Learning from accidents and incidents
IMPROVEMENT - Continual improvement

4. Business processes of the safety management system

Railway organisations design requirements put relatively abstract concepts in the safety management systems into practice. These requirements are laid down in a documentation system that is highly specific to each individual railway organisation and may also include practical procedures, specific methods and local operational plans. These documents are organised in interlinked documentation system that can be said to a “pyramid-shaped document structure”. The top of the pyramid is typically the SMS policy document, and the bottom of the pyramid prescribes specific methods or procedures to support individual safety barriers. The safety management business processes can be found in the requirement documents, which are closely linked to the SMS policy document. They are the documents that describe the activities of a railway organisation on a highly abstract level.

UIC proposes that the classes for the business process level are based on these high-level requirement documents. To ensure transparency and clarity, a class can be assigned to only one safety management system class (level 1). As every railway organisation will use different names, UIC proposes that novel business process classes be added. The process to assign policy areas to SMS elements, or to propose new ones, is as follows:

- Using the safety management system class description, identify which SMS-class the business model class is most strongly associated to.
- Use the requirement document titles to define a business class domain with a title not exceeding four words.
- Compare the titles with those recorded in the UIC barrier classification system, with the description being read and a decision being made whether the policy area is the same or resembles it.
    - If the description matches: use the existing area description to link the policy area to an SMS element and classify the safety barriers within the policy area.
    - If the description does not match, does the policy area description appear within another SMS element?
        - If yes, the area description from the other SMS element should be used.
        - If no, a class description of no more than 100 words (following the class format) should be written.
    - Does UIC agree that this is a new policy area?
        - If UIC agrees, the policy area is added to the SMS element for you and others to use in the classification system henceforth.
        - If UIC disagrees, you will be requested to use an existing policy area, even if it does not follow your internal governance structure.
    - If a situation remains contentious (e.g. you think a policy area should be associated with another SMS element), UIC requests that a change is put forward, with a letter supporting this position. UIC will take this into consideration when deciding whether to follow up on the request.

5. The safety barriers

Safety barriers come in many shapes and forms due to the different reasons for their development, varying from relatively simple components (such as a locking pin) to sprawling technical systems (such as axle-box overheating detector networks) and human-technical systems (such as the dead-man's switch). They may be ad-hoc safety measures that were developed following incidents or accidents, or may follow from strategic safety considerations stemming from the safety management system, from national laws, from a manufacturers' instructions or, may be installed for others reason.

Safety barriers constitute the third level in the UIC safety barrier classification, and have to be assigned to a single business process class. Safety barrier descriptions yield the highest learning potential if they are written by individual organisations, and therefore, UIC does not, in any way, adjudicate in the safety barrier descriptions save for enforcing the format which is recorded in the UIC barrier definition document. Additionally, UIC does not prescribe to which business process a safety barrier should be linked. That is at the discretion of the railway organisation. Nevertheless, UIC may alter barrier linkages as part of a quality control process.

The procedure for assigning safety barriers to business process classes is as follows:

- A safety barrier description is written following the safety barrier definition, if one does not already exist.
- Using business process class descriptions, a single class is identified in which the safety barrier fits best. Here, a number of different strategies may be appropriate:
  - Linking it with the business process class that the barrier is most strongly associated with in the organisation's own safety management system.
  - Linking it with the business process class in which many similar safety barrier descriptions are found.
  - If an additional business process class is required, or an existing one needs changing, a new business process class following the procedure in section can be proposed, with the barrier being linked to the new class.
  - If the barrier description is associated in equal strength to two or more business process classes, the one in which similar barriers are already found should be chosen.
- Updating the safety barrier description with a field that declares with which business process of the safety management system it is linked.

6. Examples of safety barrier descriptions and explanations

Example 1: Safety management system class description

Name	OPERATIONS – Asset management
Description	Assets are physical objects that are used purposefully during railway operations, including stationary and moveable assets and the physical parts of infrastructure, such as rolling stock, tracks, signalling systems, stations, bridges, depots, power stations, and level crossings. Assets do not include people, data and the non-physical parts of information systems, funds and investments, management, or procedures for management.

Example 2: Business processes of safety management system class description

Name	Rolling stock authorisation
Description	Business processes that gather requirements from 2018/545 to establish the practical arrangements for railway vehicle authorisation and railway vehicle type authorisation processes.
SMS class	OPERATIONS – Asset management

Name	Competence management
Description	Business processes to ensure the provision of training programmes and arrangements to ensure that staff have the appropriate and up-to-date training. This may include, but is not limited to, certifications and physical and psychological fitness tests.
SMS class	SUPPORT - Competence

Name	Normal track maintenance
Description	Normal track maintenance involves the planned or scheduled maintenance required to keep railway tracks in an adequate condition. This may include, but is not limited to, visual track inspections, ultrasonic railhead testing, grinding, tamping, track repairs, vegetation management, and the replacement of track fastenings.
SMS class	OPERATIONS – Asset management

Name	Station maintenance
Description	Station maintenance is the planned maintenance required to ensure that stations remain safe for the public to use. This may include, but is not limited to, cleaning, painting, small repairs including lighting, gritting in winter, assisting shops, trespass and vandalism prevention, ticket machine maintenance, and passenger services.
SMS class	OPERATIONS – Asset management

Example 3: Updated safety barrier description

Name & Purpose	Platform markings (yellow line): the purpose being to indicate that passengers should not come closer to the platform edge to prevent them from falling off the platform or colliding with passing trains.
Subclass and Type	Platform markings are passive barriers alongside the length of the platform to make passengers aware that they are standing too close to the edge of the platform.
System description	The technical component is an integrated yellow line and tactile paving at 760 mm from the platform edge, when the risk is low and there is enough space behind the line for customers to wait. A 100 mm wide yellow line at 1400 mm when there are non-stopping passenger services over 160 km/h, freight services over 70 km/h, or any other major aerodynamic risk, such as the wind from a passing train pulling people or objects across the platform, or having sufficient space behind the line for customers to wait. Tactile paving should be installed in the standard 760 mm position from the platform edge but in a colour as similar as possible to that of the platform. {https://www.transport-network.co.uk/RSSB-research-provides-platform-for-rail-safety/15224) {https://www.networkrail.co.uk/communities/safety-in-the-community/station-safety/} The organisation can increase the correct use of the platform markings with practical actions including: 1. Placing awareness posters in areas frequently used by wheelchair and pushchair users, such as in lifts 2. Relocating platform furniture, ticket machines, on-platform retail outlets, and information screens to lower the risk and encourage lower risk behaviour 3. Creating tailored, public address system announcements on platforms and trains that are at higher risk locations Station staff (human component) need to be made aware of the barrier and may intervene when people are standing across the line.
BP class	Station maintenance
SMS class	OPERATIONS – Asset management
Validation	Installation and maintenance procedures on platform markings are recorded as evidence that the marking has been placed correctly, and platform markings are a recurrent training objective for platform staff.

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