Quantitative Approach in Regulating Railway Safety

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Abstract

Railways Branch of the Electrical & Mechanical Services Department (EMSD) of the Government of the Hong Kong Special Administrative Region is the regulatory body for the railway operators, including Mass Transit Railway Corporation, Hong Kong Tramways, Peak Tramway and Hong Kong Airport Authority, in Hong Kong. Currently it has twelve professional engineers of electrical, mechanical, electronics and civil disciplines empowered by legislation to ensure the safety of millions of railway commuters in Hong Kong. The conventional regulatory approach is to carry out regular inspections, investigate into accidents, recommend possible improvement actions and monitor their implementation progress by respective railway operators. This conventional approach can no longer satisfy the expectation of all stakeholders who anticipate the regulator to act before accidents and stay vigilant at all time nowadays. This paper will give an overview how Railways Branch adapts a new quantitative approach to monitor the safety performance of the railway operator and formulate our regulatory regime.

Keywords
Railway Safety, Benchmarking, Safety Indicators

1. INTRODUCTION

The primary role of Railways Branch of the Electrical & Mechanical Services Department (EMSD) is to ensure railway safety in Hong Kong through the empowerment of Railways Ordinance (Chapter 519), Mass Transit Railway Ordinance (Chapter 556), Mass Transit Railway Regulations (Chapter 556A), Tramway Ordinance (Chapter 107), Peak Tramway (Safety) Regulations (Chapter 265A), and Airport Authority (Automated People Mover) (Safety) Regulation (Chapter 483C) of the Law of Hong Kong as well as the Operating Agreement reached between the Government and the MTR Corporation Limited (MTRCL).

Under the current regulatory framework, the Railways Branch (RB) of EMSD is vested with authority to oversee railway safety through undertaking of the following functions:

- assessing and approving new railways and major modifications;
- ensuring the adoption of appropriate safety practices by the railway corporations;
- investigating into railway incidents; and
- assessing and following up the railway corporations’ improvement measures.

The paper describes the conventional approach in formulating RB’s regulatory activities (particularly in respect of safety) for the railways in Hong Kong and the new quantitative approach by conducting risk based inspections and using the common safety indicators developed by European Railway Agency (ERA) to track the safety performance of railway operator so as to formulate our regulatory regime.

2. Conventional approach in assuring railway safety

EMSD regulates the safety of the railway systems by ensuring that MTRCL has addressed all the safety issues throughout the design, construction, operation and maintenance stages of the railway systems.

Although it is the responsibility of the railway operator to demonstrate to the satisfaction of EMSD that the railways are safe for use and their design standards are in line with international standards in the railway industry and appropriate for the situation in Hong Kong, EMSD has the role to assure the railway operator had exercised the due diligence to mitigate all the safety risks to an as-low-as-reasonably-practicable level when operating the railways.

Early in the design stage of a new railway line or extension, EMSD has to vet the submissions from MTRCL to ensure the statutory safety requirements are properly incorporated. EMSD has undertaken the chairmanship of two governmental committees, namely Safety and Security Coordinating Committee (SSCC) and the Trackside Safety and Security Committee (TSSC). SSCC covers design, layout, emergency evacuation strategy, emergency access strategy and emergency facilities of the stations, ancillary buildings, depots and other facilities. TSSC covers design, layout, emergency evacuation strategy, emergency access strategy, emergency provisions and measures for all railway trackside areas and associated facilities. SSCC and TSSC comprise Government departments.
including EMSD (as chairman), Buildings Department, Fire Services Department, Highways Department and Hong Kong Police Force.

Before the new railway line or extension is opened for public services, EMSD has to conduct inspections to ensure that the railway is safe and sound for public service.

During the operation stage, EMSD monitors the safety performance of railways based on the receipt of incident notifications from MTRCL. For safety-related incidents, EMSD conducts investigation, provides advice to MTRCL on preliminary identification of cause, immediate actions required and other areas that MTRCL needs to address, and monitors the progress of identification of root cause and implementation of the rectification measures.

Upon receipt of notification from MTRCL, EMSD acquires and records as much information about the incident as possible from MTRCL and considers whether site investigation is required. EMSD takes follow-up actions as necessary to ensure that MTRCL is taking the necessary remedial and preventive measures in relation to the incident. EMSD follows up with MTRCL as appropriate and may ask for an incident report.

To ensure MTRCL has followed the laid procedures and instructions to carry out the operation and maintenance activities, EMSD conducts regular inspections to different systems within the railway premises. Conventionally, the frequency of inspections was set in equal weight among different systems.

In addition, RB participates in emergency drills and exercises to verify the adequacy of rules and the competence of staff. As the majority of past railway incidents were related to passengers’ action, RB is keen on safety promotion to educate passengers on how to use the railway safely. In the area of safety promotion, RB explores suitable promotion programs and regularly joins MTRCL’s safety promotion campaigns, as to alert passengers not to rush through train doors and remind the elderly of safety when riding on the MTR.

3. Quantitative approach in assuring railway safety

3.1 Risk Based Inspections

Railway is a complex system collaborating with different electrical, mechanical and civil systems, including rolling stocks, signaling and telecommunication, traction power supply, tunnel ventilation, via-ducts, tracks and foundations. To make this complex system works safely, it needs a professional team of operating staff to operate the systems in accordance with a set of well established operation procedures and instructions. Any mishap in the equipment or procedures may results in incident.

Since the establishment of RB in 2008, instead of conducting routine inspections to different railway systems, for effective resource utilization, a new risk based approach was introduced to formulate the inspection strategy. The inspection frequency has been adjusted to focus on those systems which are prone to significant consequence upon failure. The risk level of a railway system or equipment was weighted by both qualitative and quantitative methods. Qualitatively, engineers in EMSD base on their experience from the past incident investigations and engineering judgement for the likelihood of an equipment or system failure and the associated consequence. Meanwhile, the quantitative risk determination is based on the list of Safety Critical Items (SCIs) provided by MTRCL. MTRCL’s classification on the risk rating has determined the occurrence frequency of a system or equipment failure with reference to the past operational data, reliability engineering calculation, reference failure rate quoted from reliability handbooks or factory data from suppliers. Taken into account the consequence associated with the failure, the risk rating of an equipment or system failure can be weighted by MTRCL’s risk matrix. To further determine if an equipment or system should be classified as SCI, it has to consider the degree of consequence that will be resulted from a single or combination of failures. These SCIs mainly cover components on door systems, signaling systems and permanent ways. Accordingly, EMSD has allocated resources for conducting specific inspections to the maintenance works for these SCI items to ensure the works are carried out in accordance with the procedures and by competent personnel.

3.2 Benchmarking with ERA Common Safety Indicators

Driven by European Union in 2004 to facilitate the monitoring of railway safety performance among all the State Members, European Railway Agency (ERA) developed a set of common safety indicators (CSIs), common safety targets (CSTs) and common safety methods (CSMs) for benchmarking among EU countries. The purpose of both CSI and CSM aims to build a common platform with the same gauge to assess and monitor the safety performance among EU member states, calculate economic impact of accidents and evaluate economically sustainable safety performance. After years of discussions, ERA has finalized the following seven categories of CSIs.
- Indicators relating to accidents;
- Indicators relating to dangerous goods;
- Indicators relating to suicides;
- Indicators relating to precursors of accidents;
Indicators to calculate the economic impact of accidents;
- Indicators relating to technical safety of infrastructure and its implementation; and
- Indicators relating to the management of safety.

Among these indicators, EMSD selected five indicators to monitor the safety performance of MTRCL. These five indicators include Risk to Passenger, Risk to Employee, Derailment, Collision and Signal Passed At Danger (SPAD). In particular, SPAD is an indicator relating to accident precursors. Accident precursor is an event that may result in an accident when it occurs in combination with other system defects. Timely taming of the precursor accidents can minimize the risk of the major accident. For instance, SPAD is an accident precursor of train collision. By monitoring and minimizing the cases of SPAD, the risk of collision can be reduced.

Compared to European railways, Hong Kong’s railway network is very small, with only 218 km of total track length, some 80 stations and nine railway lines, but the daily patronage is over 4 million. Besides, the operation mode of Hong Kong railways as a domestic metro system is also different from the inter-state operations in European countries. As such, by using ERA’s common safety indicators to make a direct comparison on the railway performance between European countries and MTRCL should only be used for reference. Nevertheless, through these safety indicators, ERA has demonstrated how the railway safety performance can be quantitatively measured.

On the other hand, ERA’s common safety indicators are good for benchmarking in time domain to keep track on MTRCL’s own safety performance, especially when the railway network in Hong Kong is going to expand in coming years. Since ERA’s common safety indicators came along with specific relative factors, the incident data can be fairly normalized so as to avoid skewed output upon network expansion.

Currently, MTRCL has adopted the safety indicator developed by Community of Metros (CoMET) for measuring the safety performance. CoMET was a programme made up by a consortium of large metro systems from around the world for international railway benchmarking. It has common indicators to measure the performance of their members. For safety, there is only one indicator that is the number of fatality per million passenger journeys. The number of fatality has taken into account all the incidents happened in the railway. ERA’s common safety indicators, on the other hand, can provide other perspectives for further in-depth monitoring on specific types and causes of railway incidents.

4. Conclusion

With a team of 12 engineers in RB to assure the safety of over 4 million commuters using MTRCL’s railway network daily, RB effectively allocates resources to ensure all the hiccups happened every day in our railway network are properly tackled by the railway operator before any mishap.

By referencing the quantitative approach of ERA’s CSIs, the portrait of MTRCL’s safety performance can be fairly depicted. In addition to the risk classification for the safety critical items, EMSD can base on these objective references to formulate the inspection programme for different railway systems in terms of frequency and depth.

Certainly, a safety regulator’s ultimate aim is “zero incident”. At the same time, we are also aware of the community’s expectation of a very high level of reliability. We shall continue work with the railway operator to achieve these dual goals.

Reference
