THE STATE OF RAILWAY SAFETY IN CANADA – AN ASSESSMENT

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1. Introduction

This study was requested by the *Railway Safety Act* Review (RSA Review) to assist it in assessing the current state of railway safety in Canada. The study also considered whether the data currently available allow for a meaningful understanding of the state of railway safety, as well as provide adequate support to Transport Canada (TC) Rail Safety in its risk-based planning and oversight activities.

Specifically, we were requested to address the following key questions:

1) Has railway safety improved since the last RSA Review, completed in 2007?
2) Where are the "most meaningful and impactful occurrences" happening, what are their causes, and where should resources be focused to improve rail safety?
3) Does the current data collection/governance framework allow Rail Safety to carry out its risk-based planning and oversight meaningfully and effectively?

This paper provides a summary of the research and findings.

This study is the product of desk research and consultations with key organizations. The focus of the desk research has been to develop a picture of the state of railway safety in Canada based on the Transportation Safety Board of Canada (TSB) accident and incident occurrence data, collected and housed by the TSB in its Rail Occurrence Database System (RODS). In the study this has been supplemented with other data and information, in particular the TSB's detailed railway accident investigation reports.

Organizations consulted included the TSB, Canadian National (CN) and Canadian Pacific (CP), the Railway Association of Canada (RAC), TC's Rail Safety and Transportation and Economic Analysis groups, and VIA Rail Canada. The main purpose was to elicit these organizations' views as regards questions 2 and 3 above.

Dangerous goods (DG), being outside the scope of the RSA Review, are given only limited consideration in this study.

All conclusions reached and presented here are those of CPCS.

2. Has Railway Safety in Canada Improved?

Any railway occurrence meeting the reporting criteria set out in the TSB regulations renders it reportable, and requires the reporting of the occurrence to the TSB. Operators are required to report significant information about any such occurrences. The TSB categorizes occurrences by type (e.g. derailments, collisions), location (e.g. main track, non-main track) and third party involvement (crossings and trespassers) among others. Measures typically cited are the number, frequency and severity of accidents

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including serious injuries and fatalities. An important drawback of the TSB data is that it does not cover the entire railway population but necessarily pertains only to federally regulated railways (or railways that voluntarily report to the TSB).

With regard to whether railway safety has improved since the last RSA Review, our main conclusion is that there have been improvements in major accident categories, though trespasser accidents remain a persistent issue.

Categories showing improvement include:

- Main track derailments
- Accidents involving third parties (crossing and trespasser accidents)
- Passenger trains involved in accidents
- Accident rates for freight railways, both Class 1 and shortlines

There has, however, been a marked increase in trespasser accidents since 2015.

Figure 1-4 below illustrate these trends.

Figure 1: Main Track Derailments and Collisions (number of accidents)

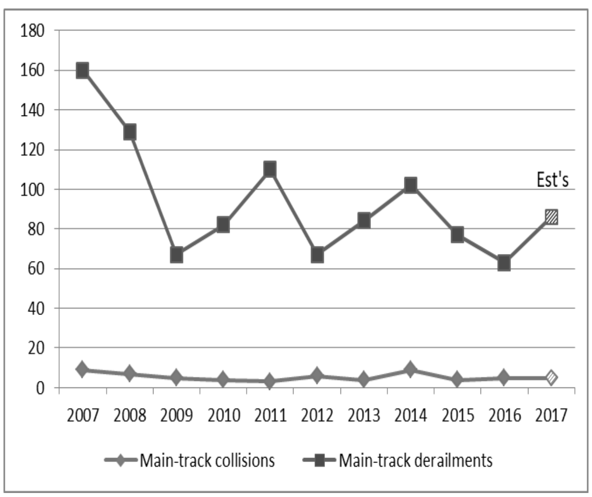
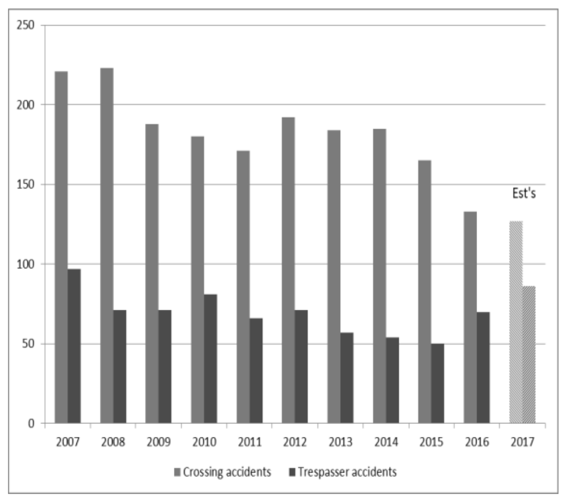


Figure 2: Crossing and Trespasser Accidents (number of accidents)



Source: CPCS analysis of TSB data

Figure 1 shows the number of main track derailments and collisions since 2007. Although accounting for a small number of total railway accidents, these have the greatest potential for serious or catastrophic consequences. While main track collisions are infrequent (consistently fewer than 10 per year), the number of main track derailments is considerable. Important, therefore, is the downtrend in these derailments, from 160 in 2007 to 63 in 2016, a drop of about 60 percent. Moreover, over the period 2009-2016, main track derailments averaged 82 per year and have, except for two years, been consistently below 100. This contrasts with the findings of the previous RSA Review where main track derailments were seen to number consistently between 100 and 200 over 1989-2006, and where the Panel expressed concern that there had not been sufficient reduction in main track derailments.[1]

Figure 2 shows the number of reported crossing and trespasser accidents annually for 2007-2016, and including estimates for 2017 based on the TSB monthly data through July. Crossing accidents show a clear downtrend from 221 in 2007 to 133 in 2016. Moreover, this is a continuation of the downtrend observed by the previous RSA Review, which noted how crossing accidents had declined from 469 in 1989, when crossing accidents accounted for half of all railway accidents, to 248 in 2006.[2]

Regarding trespasser accidents, there is also some evidence of improvement with these declining from 97 in 2007 to 50 in 2015. However, since 2015 they have taken a marked upturn which should raise concern. In addition, it should be noted that the previous RSA Review found little evidence of any trend (down or up) in trespasser accidents between 1989 and 2006

These trends notwithstanding, we stress that crossing and trespasser accidents have been persistent issues over the years. Both the *Railway Safety Act* Review Committee in 1994 and the *Railway Safety Act* Review Advisory Panel in 2007 recognized the special problems associated with these types of accidents, devoting separate chapters in their reports to this subject.[3] In particular, the RSA Review in 2007 spoke to the growing problem of railway/municipality proximity issues as a source of crossing and trespasser accidents. The current RSA Review has also recognized this as a key issue for consideration.[4]

Figure 3 shows the trend in total passenger trains involved in accidents, in numbers and as normalized by millions of train miles, with both shown in index form (2007=100). Both series show a clear downtrend in the number of passenger trains involved in accidents, which has been due mainly to fewer trains involved in crossing and trespasser accidents.[5] After 2011, some of the decline is due to a decline in train miles reflecting in part cutbacks in VIA Rail long haul services. Most of the decline over the period, however, can be attributed to a declining accident rate.

Figure 3: Passenger Trains Involved in Accidents (indexes, 2007=100)

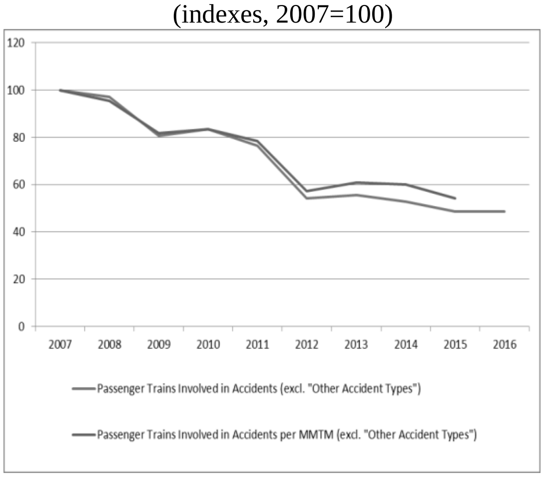
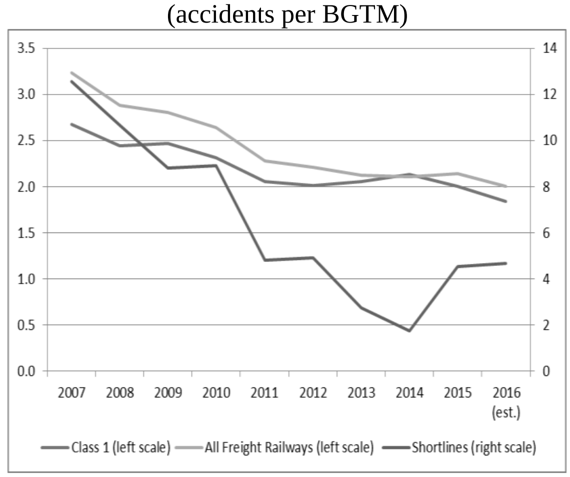


Figure 4: Freight Railways Accident Rates (accidents per BGTM)



Source: CPCS analysis of TSB data (passenger) and RAC data (freight)

Figure 4 presents data on accidents in the freight sector, which of course is the dominant sector. Data are shown for both the Class 1s and shortlines, and are measured as accidents per billion gross ton miles (BGTM). This data, from the RAC, includes the railways that do not report to the TSB and represents a larger population. The accident rate for the shortlines, it will be noted, is much higher than for the mainline railways.

Canadian rail freight gross ton miles declined in 2008 and 2009 along with the deep global economic recession. Likewise, the number of freight rail accidents declined between 2007 and 2009, but at a generally faster rate resulting in the accident rate also declining over those years as seen in Figure 4. Following the recession, rail traffic grew at an overall healthy rate, although the shortline traffic showed much greater variance, in particular rising very sharply in 2013 and remaining at a high level in 2014, primarily the result of mining activity.

Despite the traffic growth since 2010, the numbers of accidents remained more or less steady. As a result the accident rate, as seen in Figure 4, has shown a more or less continuous decline. Overall, the accident rate for freight railways declined from 2.6 per BGTM in 2010 to 2.0 per BGTM in 2016. A particularly notable feature of this recent history, however, is the halving of the shortline rate, from 8.9 in 2010 to 4.7 in 2016. (The very sharp drop in the shortline rate in 2013 and 2014 reflects the aforementioned temporary spike in the shortline traffic.)

3. Where Are the Most Meaningful and Impactful Occurrences Happening?

We were requested to assess where the most "meaningful and impactful occurrences" are happening, considering "deaths and serious injury, economic and environmental costs, etc." While there is substantial data on deaths and serious injuries in rail accidents in Canada, there is no similar comprehensive data regarding economic and environmental costs.[6] We therefore undertook an analysis based on cases indicative of the location, type and possible magnitude of impacts associated with railway accidents, starting from the TSB's rail investigation reports.[7]

To select the cases, we first identified the railway occurrences classified as "Class 2" under the TSB's Occurrence Classification Policy.[8] A Class 2 occurrence:

. . . shall be investigated when

1. there is a high probability of advancing Canadian transportation safety in that there is significant potential for reducing the risk to persons, property, or the environment; or
2. the Governor in Council so requests (pursuant to Section 14(1) of the *CTAISB Act*).

While classification as Class 2 is not due to the severity of the accident, we consider this a proxy for identifying "meaningful and impactful occurrences." The definition refers to "significant potential for reducing the risk to persons, property, or the environment." Typically, risk is defined as a function of the probability and potential severity of an occurrence. For there to be "significant potential" for reducing risk, the occurrence must be one of high probability of recurring and/or high severity. Based on CPCS' experience and consultation with the TSB, we believe the Class 2 pool to be a useful source for illustrating the issues and impacts of concern.

We considered all Class 2 occurrences from 2004 to 2017. There were 17 in total, most of which (12) were main-track derailments. The second highest type was crossing accidents (4). Notably, over half of the occurrences (9) had DG cars involved. Five of these involved the release of DG, of which three have occurred since 2013. Of the accidents considered, Lac-Mégantic involved the most fatalities (47). In terms of serious injuries, two occurrences had ten serious injuries each.

Based on these cases, several were analyzed using information from the investigation reports and other sources to illustrate the type and range of impacts. These included occurrences illustrative of: accidents involving flammable liquids; accidents documenting environmental impact; accidents involving geotechnical factors; and crossing accidents.

Based on the cases examined, and the RODS data, our conclusions may be summarized as follows:

- Main track derailments, especially involving DG, crossing accidents, and trespasser accidents have the potential for the most serious consequences. Crossing and trespasser accidents remain the cause of almost all railway accident fatalities and serious injuries. Main track accidents, the vast majority of which are derailments, are the most serious in terms of financial loss, risk to the public and environmental consequences.

- The most consequential accidents tend to occur in/near population centres, especially if there is a DG release. However, they can also occur in remote, environmentally sensitive areas. Studies show that the challenges in responding to accidents in such areas mean that they result in disproportionately higher costs. This is particularly so with accidents caused by geotechnical factors.

- The most severe accidents can have billions of dollars of impacts, affecting persons, property, and the environment. However, the full impact can be difficult to quantify, and may not be known until years afterwards, often requiring further study.

- Current RODS statistics do not capture the full economic and environmental costs, nor necessarily distinguish adequately the smaller from the more significant accidents. *A*nalyses that use proxies for severity, such as numbers of fatalities, cars derailed or volumes of DG released, do not capture the full human, economic and environmental consequences. Also, there is virtually no distinction between the most benign and severe occurrences as it relates to economic and environmental impact.

4. What Are the Causal Factors of Accidents?

The TSB collects data indicative of the causal factors of railway accidents, referring to these as “assigned factors” and grouping them into environmental, equipment-related, track-related and “actions” (e.g. failure to use equipment properly, inadequate/inappropriate maintenance, operating at improper speed) and other.

Figure 5 shows the distribution of assigned factors for main track derailments. Most notable is the decline in track and equipment, and the persistence of human actions, since 2007 as causal factors. Together, track and equipment have declined by approximately two thirds, driven by investments made by the railways in technologies and processes that enhance safety. In contrast, actions as assigned factors remain at the same level as in 2007. With the declines in track and equipment as causal factors, accidents involving human “actions” have grown in terms of importance.

Figure 6 shows the distribution of assigned factors for non-main track derailments. Non-main track derailments are the largest component of railway accidents (approximately 50 percent in 2017). As Figure 6 shows, these are mainly associated with human actions, followed by track-related factors. As with main track derailments, actions have remained persistent while track and equipment factors have declined.

Figure 5: Assigned Factors in Main Track Derailments
(number of assigned factors)

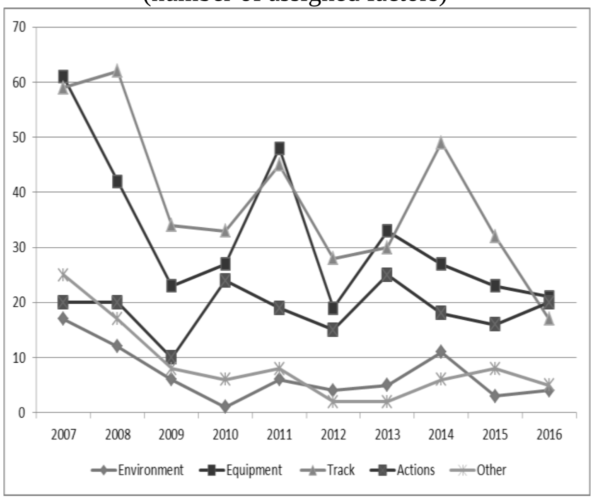
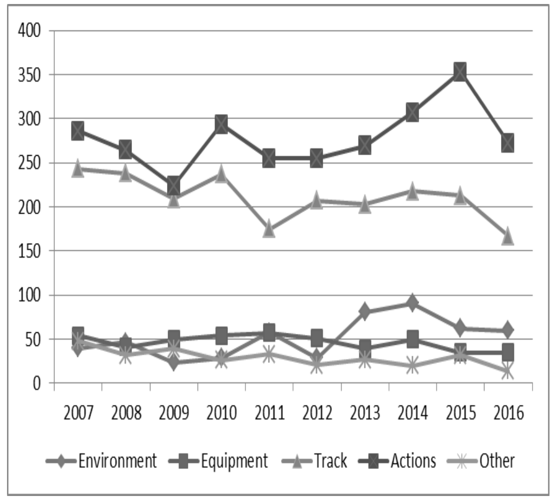


Figure 6: Assigned Factors in Non-Main Track Derailments
(number of assigned factors)



Source: CPCS analysis of TSB data

4. **Where Should Resources be Focused?**

A key question is where resources should be focused in order to improve railway safety. Space precludes going into details, but based on our research and consultations we identified the following as priorities for where resources should be focused:

- Addressing challenges around residential land use planning and development in proximity to railway operations,
- Improved data collection and investigation on railway trespasser fatalities due to suicides,
- Enabling more shortline investment in safety enhancing technology,
- Better understanding of the contribution of human actions to occurrences, and policies to help eliminate, reduce or control hazards created by human action (or inaction),
- Continued emphasis on policies to drive the adoption and maturity of Safety Management Systems (SMS),
- Policies to address the items on the TSB Watchlist (in addition to SMS), i.e. following railway signal indications, on-board voice and video recorders, and fatigue management.

4. **Is the Current Data Collection/Governance Framework Adequate?**

As noted, we were also requested to consider whether the current railway safety data collection/governance framework allows TC to conduct its risk-based planning and oversight meaningfully and effectively.

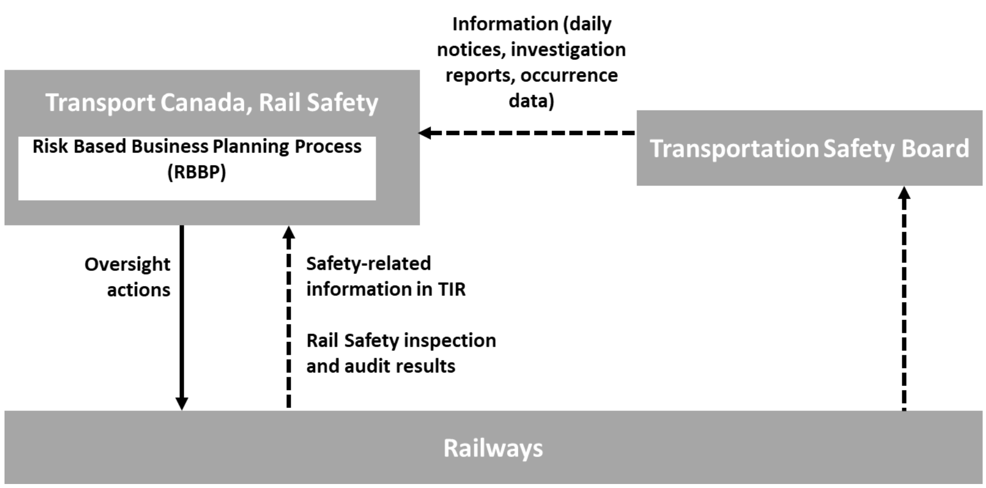
As described by TC Audit and Advisory Services,[9] Rail Safety's Risk-Based Business Planning Process is the process to identify, assess, monitor and mitigate safety issues and related program management issues. The process is designed to identify issues for which an intervention may be required, as well as to aid in prioritizing inspection activity. It also allows for gathering information (e.g. TSB data) prior to selecting an intervention.

The annual process begins with the collection of data and information from external and internal sources. External sources include information on commodities, TSB incidents and accident reports, operational information from the RAC, and leading indicator data provided under the Transportation Information Regulations (TIR).[10] Internal sources include inspection results, enforcement actions, inspector observations, and complaints and inquiries. All issues are assessed and risk-ranked based on their probability and severity of adverse consequences.

Once safety and program management issues are identified and assessed, Rail Safety develops a plan which monitors or mitigates the issues. In cases where further information is required, research and analysis may be conducted or additional lines of inquiry will be integrated into the inspection regime. Throughout the year, Rail Safety reviews the results of its activities, and at year end determines if additional or continued action is required. In some cases issues are carried forward, while others are closed.

Figure 7 illustrates the overall data collection and governance framework.

Figure 7: Railway Safety Data Collection and Governance Framework



Source: CPCS analysis

Basically, TC has access to two data sets essential to its risk based planning and oversight, the RODS data and TC's own inspection data consisting primarily of inspection and audit results. The TSB data are the result of the railways reporting on occurrences. The inspection data are developed internally and derived from three components: inspections undertaken on the basis of random sampling; targeted inspections by functional area or discipline (equipment; engineering- grade crossings; engineering- signals; engineering-track; engineering- bridges; engineering- natural hazards; operations; occupational health and safety; and Safety Management Systems); and inspections in response to unanticipated developments including accidents.

With respect to the data collection/governance framework, the study identifies a number of issues but we emphasize here the following:

- Based on information from TSB reports and consultations with TC, some basic gaps were noted in data required to support risk-based planning and oversight, in particular incomplete rail network and traffic data.

- While more and better data might enable more effective risk based planning and oversight, ensuring the timeliness of the information that is available is a key issue and is equally, if not more, important.

- Even with more or better data, TC will always have to contend with finite resources and the significant element of randomness in where accidents occur. Although they have their shortcomings, the TSB RODS data, and the new TC Rail Safety leading indicators, can be helpful in mitigating risk but cannot predict where the next occurrence will happen.

- Shortcomings in the RODS data include: they do not effectively identify underlying management system issues that may have led to an accident; they contain no information on suicides, which are a major factor in rail accident fatalities; and they are very scant on providing information on severity.

Despite railway safety having generally improved, strategies to address these issue areas, such as use of qualitative safety management system maturity frameworks, increased data collected related to suicides, and new measures of severity, could help to achieve more gains in coming years.

Endnotes

[1] *Railway Safety Act* Review Advisory Panel, *Stronger Ties: A Shared Commitment to Railway Safety* (November 2007) pp. 14-15.

[2] *Railway Safety Act* Review Advisory Panel, *Stronger Ties: A Shared Commitment to Railway Safety*, op. cit., p. 16.

[3] See *Railway Safety Act* Review Committee, *On Track: The Future of Railway Safety in Canada (1994)* Chap. 6, and *Railway Safety Act* Review Advisory Panel, *Stronger Ties: A Shared Commitment to Railway Safety*, op. cit., Chap. 7.

[4] Government of Canada, *Railway Safety Act* Review 2017-18, *Consultation Guidance Document*, https://letstalktransportation.ca/3725/documents/6802.

[5] The data in Figure 3 exclude the category "other accident types" as these numbers were affected by a change in the reporting regulations. Starting in 2014, accidents involving only minimal or cosmetic damage became reportable when previously they were not.

[6] For accidents involving dangerous goods, TC's Dangerous Goods Accident Information System does contain some information regarding the potential costs associated with such occurrences. Statistics Canada, *D. G. A. I. S Dangerous Goods Accident Information System*. http://www23.statcan.gc.ca/imdb-bmdi/document/7503_DLI_D1_T22_V1-eng.pdf.

[7] Transportation Safety Board of Canada, *Rail investigation reports*. http://www.tsb.gc.ca/eng/rapports-reports/rail/.

[8] Transportation Safety Board of Canada, *Occurrence Classification Policy*. http://www.bst-tsb.gc.ca/eng/lois-acts/evenements-occurrences.asp.

[9] Transport Canada Audit and Advisory Services, *Audit of Risk-Based Business Planning in Safety and Security* (February 2017), p. 26. https://www.tc.gc.ca/media/documents/corporate-services/audit_risk-based_business_planning_safety_security.pdf.

[10] In 2014, the TIR were amended to provide for the collection of "leading indicators" to help TC be more proactive in analyzing safety deficiencies and mitigating risk.