

## Developing risk models that are resilient and responsive to rapid change

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One of the key challenges that risk models face is being resilient and responsive to rapid change. This is particularly challenging when such models consider relatively rare events and/or are based on exposure rates as rapid changes can in some circumstance start to break down the key assumptions that these models are based on. The Rail Safety and Standards Board Safety Risk Model estimates the underlying risk from the operation and maintenance of the Great British mainline railway. The use of normalizers in the model is key, as it enables comparisons across years and apportioning of the risk to more granular levels (such as train operator or geographic region). Such localization of estimates is not without challenges and recent experience of how the Great British rail network reacted to the COVID-19 pandemic has led to a need to better understand how best to normalise risk and performance indicator models such as the Safety Risk Model. The aim being to make them more adaptable and responsive, and therefore more representative of the risk as it changes.

*Keywords:* railway safety, resilience, risk modelling, normalization, train accidents.

### 1. Introduction

The Safety Risk Model (SRM), owned and managed by the Rail Safety and Standards Board (RSSB), is one of the most mature and well-established risk models in the EU railway sector according to a survey (ERA, 2015). The main objective of the SRM is to estimate the underlying risk arising from the operation and maintenance of the Great British mainline railway (Gilchrist & Harrison, 2021).

The risk outputs from the model are normalized so that they can be used as a tool by railway stakeholders to understand their risk profile and manage or invest appropriately. This allows users of the model to apportion risk based on their operation, for example by renormalizing an estimate based on national passenger train kilometres travelled using the number of passenger train kilometres for their operation.

### 2. Response of SRM to rapid change

During the COVID-19 pandemic, from late March 2020 onwards, the operation of the GB railway network was significantly affected by a sudden

reduction in the number of trains operating and the number of passengers using them. As GB emerged from the pandemic the opposite happened, albeit not as sudden and more of a gradual increase. What became apparent during this period was that the risk models and monitoring tools based upon them were not resilient and responsive to such rapid changes in the underlying normalization. This breakdown of some of the modelling assumptions led to the outputs of the model needing to be carefully interrogated, interpreted and explained to users. To achieve this a number of issues needed to be resolved and specific actions were taken to address them.

### 3. Development of more responsive models

One such step is the development of more responsive normalizers that can track what is happening in real time. Currently the risk from a signal passed at danger (SPAD) and train collision are normalized using train kilometres. This has some significant drawbacks (Harrison et al, 2022), and in recent years a data-driven system (Red

Aspect Approaches Towards Signal, RAATS) has been developed to provide a better understanding of the probability of SPAD at different levels (including national, regional, and operator levels).

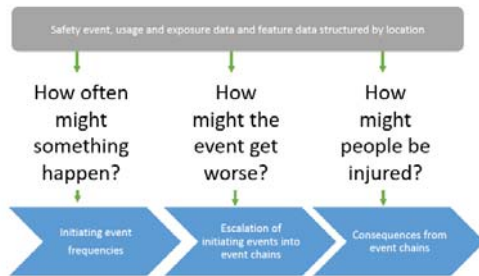


Fig. 1. Overview of the risk modelling process used in the Safety Risk Model

RSSB has also recently updated and redeveloped the SRM. Figure 1 provides an overview of the modelling process and the steps undertaken to estimate the risk on the Great British rail network.

In this latest development of the SRM, RSSB investigated the feasibility of normalizing SPAD and collision risk using the more responsive train approaches to a signal, rather than train kms. The advantage being that such a metric tracks what is happening in real time more closely and enables more representative normalization of the risk estimates to be made.

#### 4. Conclusions

Understanding how risk models perform in a rapidly changing environment is key to making them more resilient. The COVID-19 pandemic presented a unique set of circumstances that tested the assumptions underlying some of RSSB's key risk modelling tools and techniques. This has led to new approaches being explored that can be used to better normalize and understand rapid changes as they occur and the effect they have on risk estimates, and more generally how to make the risk models more responsive and resilient to rapid changes.

#### References

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