

## The Precursor Indicator Model for Train Accident Risk.

### Train Accidents

Train accidents are rare. The rate of train accidents that resulted in passenger or workforce fatalities has been less than one per year over the last ten years. Because they are so rare, we can understand the risk properly only by looking at the underlying things that might cause them. These precursors can indicate the risk of accidents happening, even though they do not often result in an actual accident. RSSB has developed the Precursor Indicator Model (PIM) to quantify changes in that underlying risk over recent years.

To compare the harm arising from various incidents, we weight the outcome according to how severe they are. For example, we count one fatality as having the same statistical weight as ten major injuries, which means that we can make a meaningful comparison between different outcomes. Within the overall harm that rail passengers have suffered (expressed as these Fatalities and Weighted Injuries – FWI), the amount from train accidents is very small. (Chart 1).

**FWI by location since 2001/02**

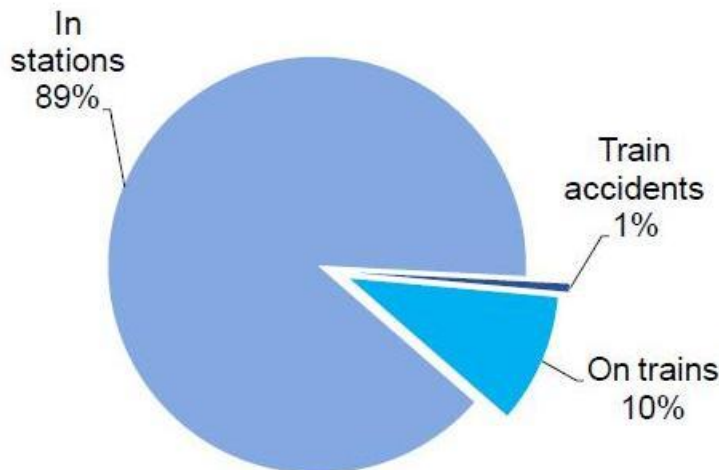


Chart 1: Proportion of Passenger harm (FWI) by location.

### How we model the changing risks

The PIM provides a month by month review of the main elements of train accident risk, which includes the risk of collisions, derailments and fires. It is normalised to take account of the increase in train-miles travelled over the time it has been measuring the risk.

We measure the frequencies of operational occurrences which have the *potential* to cause a train accident. These occurrences are called precursors in the model.

Each precursor has its frequency measured and is then weighted to place its relative contribution correctly within the total train accident risk. This involves referring to the Safety Risk Model (SRM), which is updated every few years in a

major reassessment of the industry's risks but, in the interim, the PIM provides a measure of how large an effect each precursor is having on train accident risk.

The PIM is a model of *risk change* and as such is rebased to a value of 100 at a convenient point in time. The benchmark point was chosen to be March 2002. To help present the results clearly, the 46 precursors are gathered into six groups.

Using data to the end of September 2010, the PIM indicator stood at **39.4** compared to 100 at March 2002. Chart 2 shows how it has changed since 1999, so it is clear where the major improvements have been achieved. Table 1 presents the changes in the indicator for each precursor group.

For example, it can be seen that the train accident risk from Signals being Passed at Danger (SPAD) reduced very greatly over a short period. This was largely due to the widespread introduction of an automated system that intervenes immediately to halt trains that pass a danger signal or are approaching one faster than might allow them to stop in time under normal braking. All the other groups have shown risk reductions, although the way people use level crossings (whether through violations or by accident) presents a risk that has proven slower to reduce.

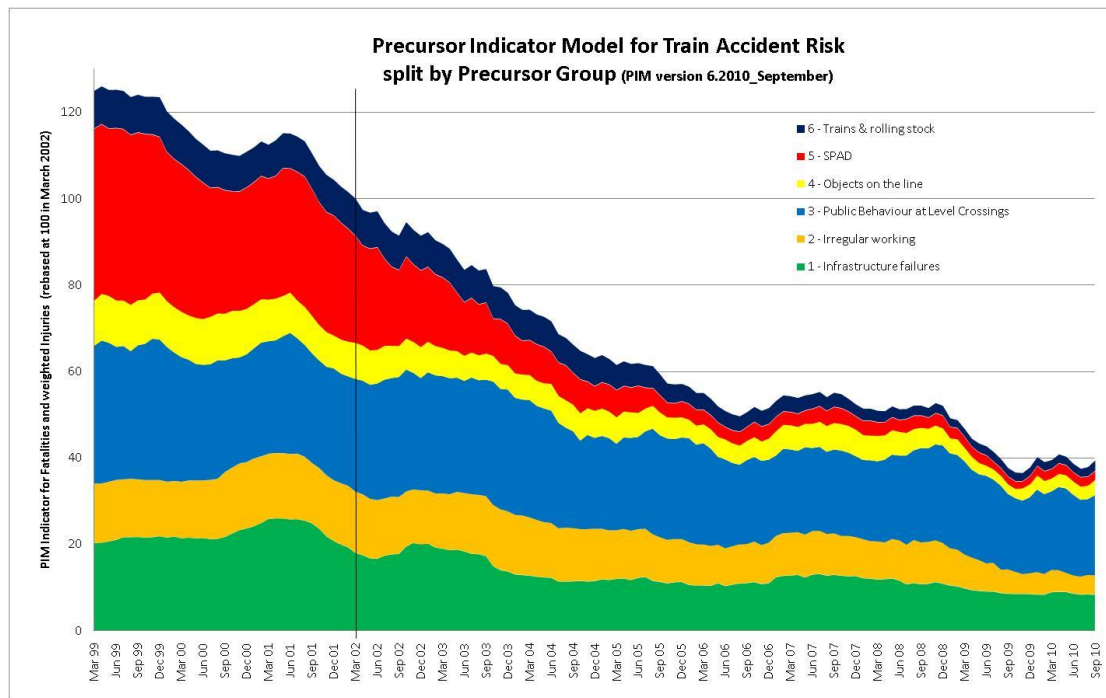


Chart 2: The PIM indicator (v6.2010\_September)

	March 2002 baseline	September 2010
1 - Infrastructure failures	18.0	8.4
2 - Irregular working	14.2	4.5
3 - Public Behaviour at Level Crossings	26.1	18.5
4 - Objects on the line	8.5	3.7
5 - SPAD	24.7	2.0
6 - Trains & rolling stock	8.6	2.4
<b>PIM Indicator</b>	<b>100.0</b>	<b>39.4</b>

Table 1: PIM Indicator groups, comparing the baseline and this release.

## Who is at risk and how are their risks changing?

Much of the train accident risk is to members of the public – that is, people who are neither passengers nor employees. This is particularly so in relation to accidents at level crossings. Some collisions between trains and road vehicles derail the train and lead to many passengers being harmed, but almost all will lead to the road vehicle and its occupants suffering a very severe outcome.

To illustrate clearly the part of the risk that is borne by passengers, the PIM has been divided by person type. The “Passenger PIM” is presented as a subsection of the overall PIM, retaining the benchmark value as the whole PIM indicator (being 100 at March 2002) but showing the precursor groups as they relate just to passengers. The overall shape of the chart remains visible, but now only the risk to passengers is broken down into the six precursor groups.

The Passenger-risk PIM is shown in Chart 3.

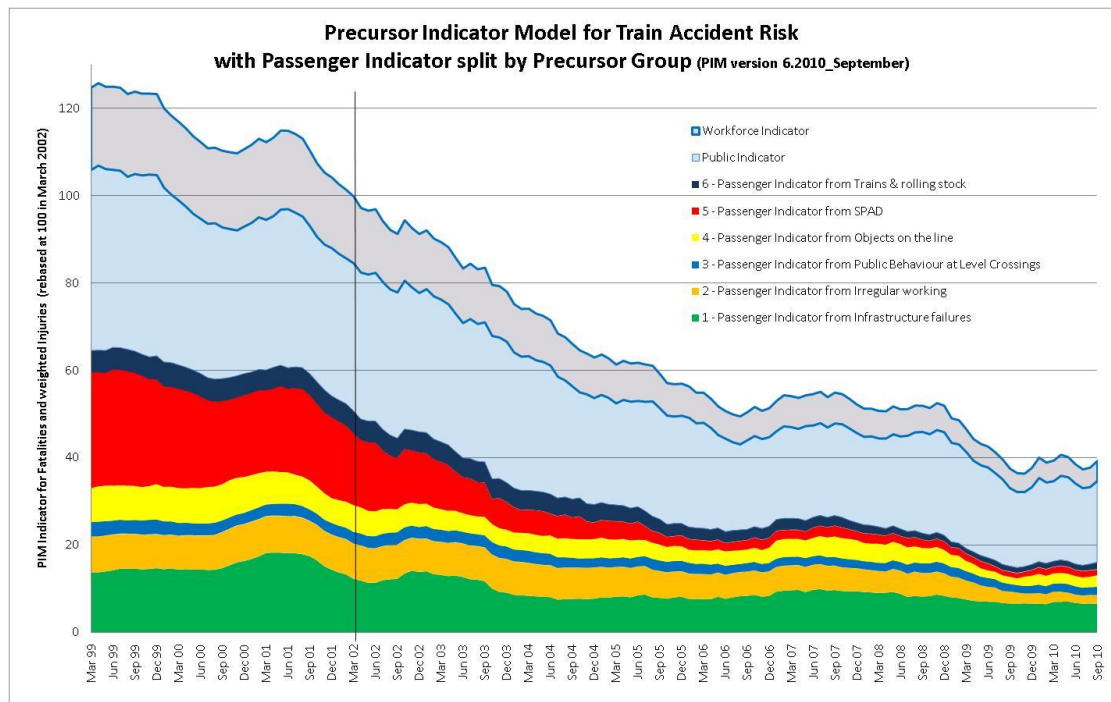


Chart 3: The Passenger PIM indicator (v6.2010\_September)

It is clear from the red sections of Charts 2 and 3 that the big reduction in risk from SPADs has been particularly beneficial in terms of the passenger risk.

Although the risk at level crossings has reduced by a lesser proportion, comparing the light blue sections of Charts 2 and 3 shows how small a part of that risk is borne by passengers.

Reductions in the risk to passengers from the other areas, such as infrastructure failures (faults with the track or signalling) and rolling stock (faults with the trains themselves), are also clear from examining the passenger PIM.