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SNCF: Risk analysis methodology and prioritisation of safety investments

SNCF has developed a methodology enabling quantification of the number of potential victims of death or serious/minor injury to have been saved from injury or death in operational and workplace accidents. Thanks to this methodology, investments in safety can now be ranked objectively for stakeholders (executive and financial management, the State as a shareholder and social partners). Having applied this methodology to investment in level crossing safety, an in-depth review of budgetary priorities for level crossings has recently been carried out, moving away from reactive, largely politically-motivated decisions that are taken after each accident in favour of an objective, proactive analysis of the cost-effectiveness of proposed solutions.

Specifically:

- The various potential scenarios that may result in an accident are presented in a risk matrix of frequency x severity. They are ranked in terms of acceptability: unacceptable, tolerable or acceptable.
- Proportionately cost-effective measures are sought for "tolerable" scenarios and are evaluated according to the ALARP ("as low as reasonably practicable") principle.
- Using a single scale based on the "victim weighting" (Vw), the consequences of these scenarios can be evaluated. Five categories of consequence have been established in accordance with the number of deceased or injured persons and the material damage.
- A different weighting is used for four categories of potential victim:
  - ➢ Cat. 1: careless and malicious persons and those who violate regulations: weighting 0.2
  - ➢ Cat. 2: certain users exposed to risks, company personnel: weighting 1
  - ➢ Cat. 3: customers and passengers: weighting 1
  - ➢ Cat. 4: third parties and local residents: weighting 5
- An increasing "risk aversion" coefficient can be used: the higher the number of victims, the more the coefficient increases. The decision on whether to apply the coefficient is taken at company level.
- Risks are ranked using the following evaluation formula:
  R = frequency per year x weighted victims x category of potential victim x risk aversion coefficient.
- Cost-effectiveness is defined as:
  Annual implementation costs (€/year)/victim weighting (potential victims spared) (Vw/year)
  This ratio allows the benefit of the proposed measure to be quantified more objectively.

This methodology has recently been applied to safeguard investment in level crossings. After being ranked and mapped according to their level of acceptability, the risks were studied in terms of measures taken to reduce them. The measures compared were:

- Level crossings (LC) with St. Andrew's Cross:
  - Removal (without flyover)
  - Conversion into simplified, next-generation SAL (automatic light signalling) level crossing

- SAL level crossings (SAL2 and SAL4):
  - SAL fully replaced by flyover
  - Conversion from SAL2 to SAL4
  - Obstacle and radar detection
  - SAL2 with radar detection only
  - Stickers indicating "breakable barriers" + LEDs on barriers + signage on the ground
  - CCTV
  - CCTV + issuing of warnings to offenders
  - Roadworks projects to implement traffic islands

In summary, this study has challenged popular opinion and has brought about changes to the investment policies that have traditionally been implemented.

In particular, it shows that the money invested by the French state over the past number of years to replace level crossings with flyovers (bridge or underpass under the railway line) has not been a good investment of public funds in terms of cost effectiveness. In many cases, level crossings are removed for other purposes such as urban planning. The criteria for financing of such initiatives by the French state and by SNCF will therefore be reviewed.

In the same vein, obstacle detectors - which are very often recommended by local government officials - are of benefit only on level crossings with greater traffic momentum (in this context, "momentum" = the number of road vehicles x number of trains by day).

New video surveillance technologies fulfilling multiple functions (dissuasion, prevention, road user feedback, support for those responsible for maintenance of railway equipment) are unparalleled in terms of cost effectiveness. The same applies to simple solutions to increase visibility and readability of railway and road installations (LEDs on barriers, active road signage and road intersection layout based on local risk analysis).

Finally, a study of accidents over some 12 years, conducted prior to analysis of the various solutions' cost-effectiveness, has shown that a reduction in road users' speed on the approach to level crossings is a positive factor. However, changes in urban planning such as, for example, new public buildings, are extremely unfavourable factors which require systematic, specific prevention measures.

To go further on this method, SNCF NETWORK has assessed and ranked each topic related with the investments program called 'safety to system'. It allows decision makers to get a precise overview on all series of investments covering many areas, such as fences, foot passenger bridges on stations, hot box detectors, video-surveillance on railways, etc. This new tool is helping decision makers to update the investment strategy, considering the destination and the life-cycle of each of the assets involved.