



SAFETY KPI AT SYSTEM LEVEL FOR RAILWAY

→ **Samuel BONNIER**

Director of Supervision - EPSF

samuel.bonnier@securite-ferroviaire.fr

Project objective

Our objective is to build a railway safety index to detect most critical types of safety events in order to define areas of collaborative work with rail companies

Project team

We have selected two partners for this project :



French national institute for industrial environment and risks (INERIS) maîtriser le risque pour un développement durable

A consultant specialising in rail transport



Data available

- In France, each safety event has to be notified to EPSF according to an event taxonomy

ANNEXE I

NOMENCLATURE DE CLASSIFICATION DES ÉVÉNEMENTS DE SÉCURITÉ FERROVIAIRE

NOMENCLATURE DES ÉVÉNEMENTS DE SÉCURITÉ	
1 - Accident	Événement indésirable non intentionnel ou un enchaînement particulier de cette nature, ayant des conséquences préjudiciables
1.1	Collision
1.1.1	Collision d'un train avec un véhicule
1.1.1.1	Nez à nez
1.1.1.2	Prise en écharpe
1.1.1.3	Rattrapage
1.1.1.4	Heurt d'un train croiseur
1.1.2	Collision d'un train avec un obstacle à l'intérieur du gabarit
1.1.2.1	Collision contre un élément de l'infrastructure engageant le gabarit
1.1.2.2	Enfoncement de heurtoir
1.1.2.3	Collision d'un train contre un animal sur la voie (hors Passage à Niveau)
1.1.2.4	Collision d'un train contre un obstacle sur la voie (hors Passage à Niveau)
1.1.2.5	Collision d'un train avec un matériel en stationnement
1.2	Déraillement
1.2.1	Déraillement de train engageant une voie principale
1.2.2	Déraillement de train sans engagement de la voie principale
1.3	Accident au passage à niveau
1.3.1	Collision (véhicule; piétons; obstacle; ...)
1.4	Accident de personnes hors passage à niveau impliquant du matériel roulant en mouvement à l'exception des suicides et des tentatives de suicide
1.4.1	Accident de personnes hors passage à niveau impliquant du matériel roulant en mouvement à l'exception des suicides et des tentatives de suicide
1.5	Incendie dans le matériel roulant

Seriousness scale

1 « Minor » safety related event	2 Event that could have materiel consequences / light injuries	3 Event that could have human individual consequences	4 Event that could have human collective consequences	5 Accident with significant consequences	6 Accident with serious consequences
---	---	--	--	--	--

→ Each safety event gets a seriousness level:

- ▶ Levels 1 to 4 are used for incidents with potential consequences
- ▶ Levels 5 and 6 are used for accidents with real consequences

Safety index development

- For a given type of safety event, we have defined 2 safety indexes:
 - ▶ Incident Component $CI = f(N_1, N_2, N_3, N_4)$
 - ▶ Accident Component $CA = f(N_5, N_6)$
 - ▶ Where N_i is the number of safety events with seriousness = i


- We choose to use a simple polynomial formula
 - ▶ $CI = W_1N_1 + W_2N_2 + W_3N_3 + W_4N_4$
 - ▶ $CA = W_5N_5 + W_6N_6$

Safety index development


- Weights W_i had to be computed for CI and CA
 - ▶ $CI = W_1N_1 + W_2N_2 + W_3N_3 + W_4N_4$
 - ▶ $CA = W_5N_5 + W_6N_6$
- First, the EPSF project team assessed importance degrees that should be given to each seriousness level.
- Then, these importance degrees have been transformed into weights using AHP (Analytic Hierarchical Process), a widely used technic, developed by Thomas Saaty in the 1970s.

Journal of Safety Research 46 (2015) 99–105

Contents lists available at SciVerse ScienceDirect

 **Journal of Safety Research** 

Journal homepage: www.elsevier.com/locate/jsr www.nsc.org

Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects 

Saman Aminbakhsh, Murat Gunduz ^{*}, Rifat Sonmez

Department of Civil Engineering, Marmara Erciyes Technical University, 38080 Ankara, Turkey

ARTICLE INFO

Abstract: The inherent and unique risks on construction projects quite often present key challenges to contractors. Health and safety risks are among the most significant risks in construction projects since the construction industry is characterized by a relatively high injury and death rate compared to other industries. In construction project management, safety risk assessment is an important step toward identifying potential hazards and evaluating the risks associated with the hazards. Adequate prioritization of safety risks during risk assessment is crucial for planning, budgeting, and management of safety related risks. Method: In this paper, a safety risk assessment framework is presented based on the theory of cost of safety (COS) model and the analytic hierarchy process (AHP). The main contribution of the proposed framework is that it presents a robust method for prioritization of safety risks in construction projects to create a rational budget and to set realistic goals without compromising safety. The impact to the industry: The framework provides a decision tool for the decision makers to determine the adequate accident injury prevention investments while considering the funding limits. The proposed safety risk framework is illustrated using a real life construction project and the advantages and limitations of the framework are discussed.

© 2013 National Safety Council and Elsevier Ltd. All rights reserved.



myPMI Certifications Membership Learning Events Bliss Gove

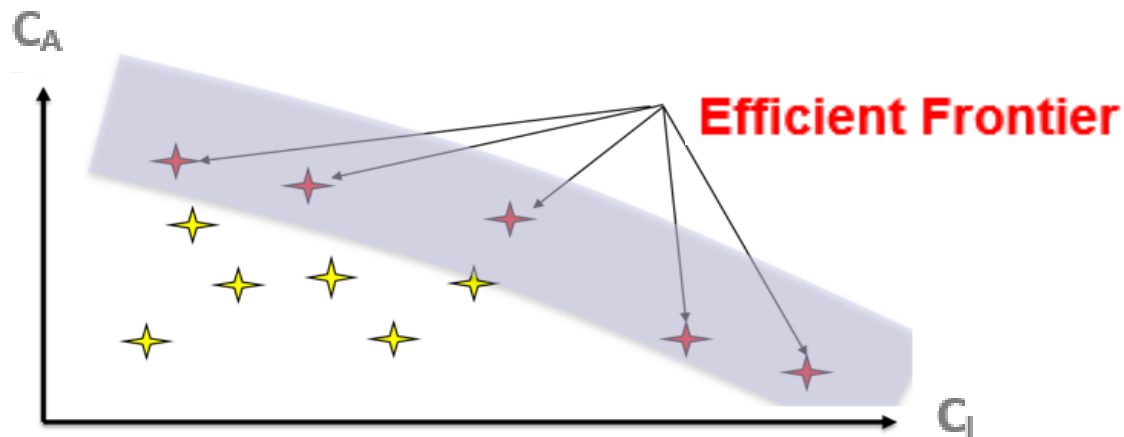
Learning » Library

Prioritizing project risks using AHP

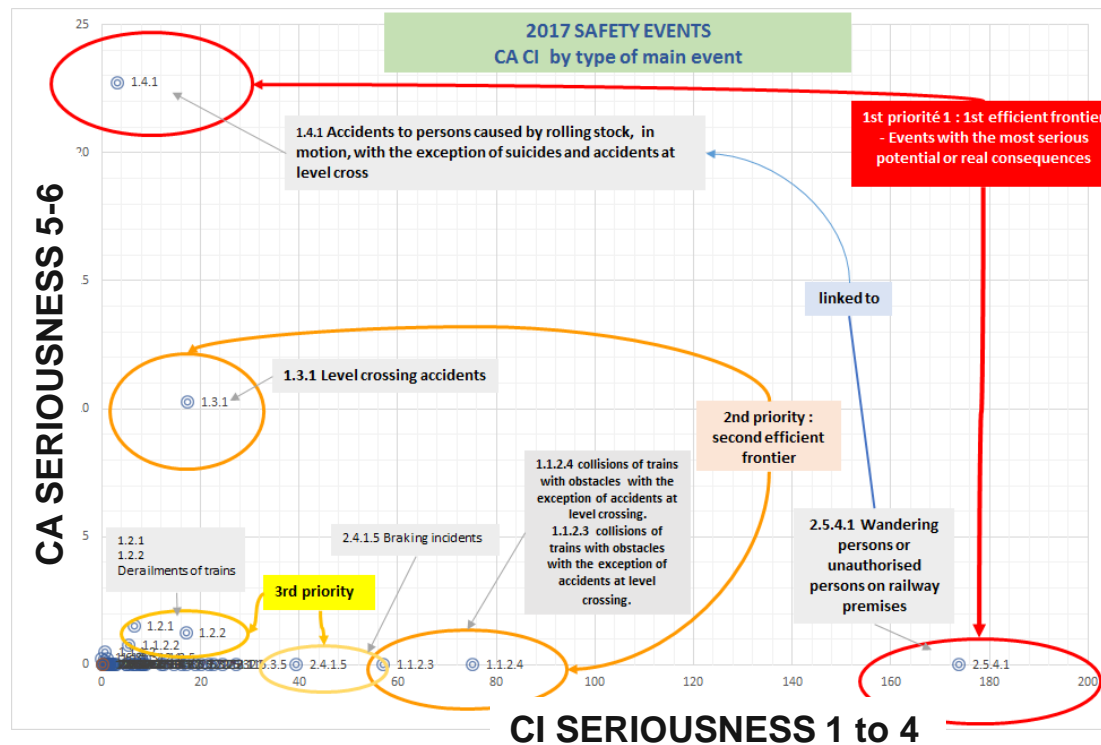
CONFERENCE PAPER | Risk Management , Decision Making | 2007
Thibodeau, Barbara

Safety index development

We can represent events in a graphical plan to detect priorities using efficient frontier.

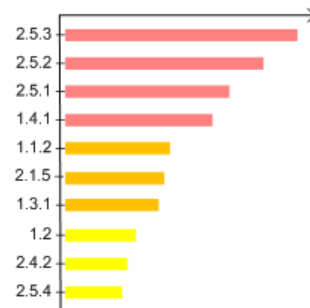


Safety index results

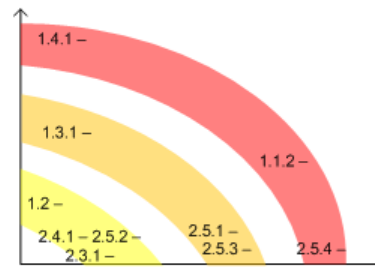


Safety index results

1- Type of events (seriousness 3 to 6) in 2018 by occurrences



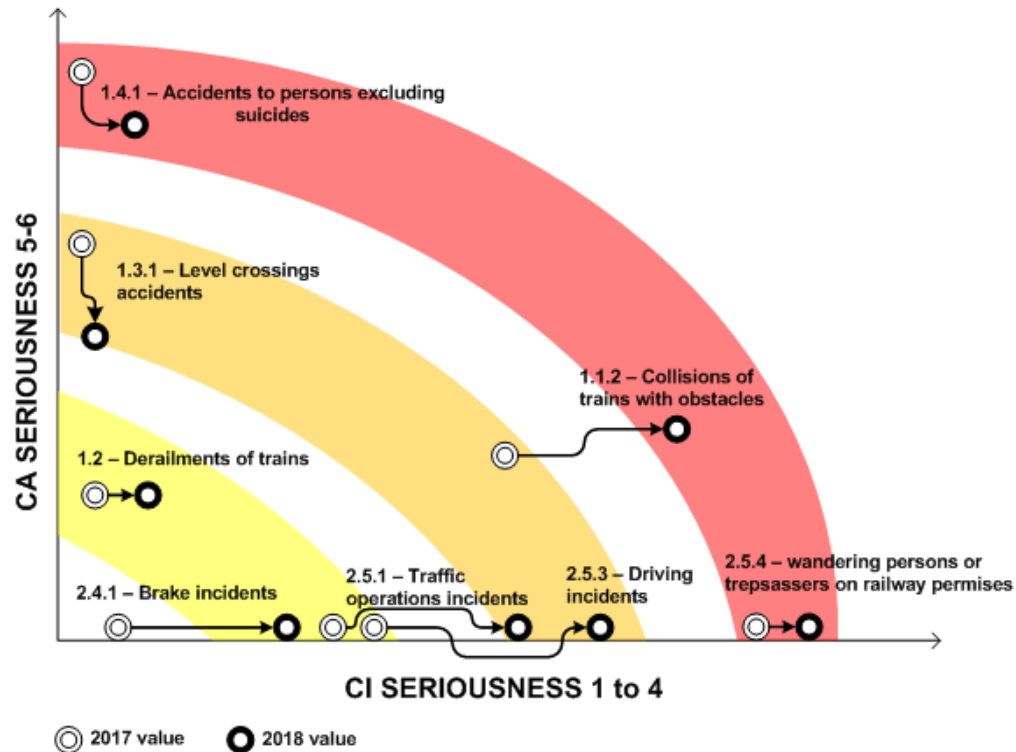
2- Type of events in 2018 using CI /CA projection



3- Priority levels comparison

Type of event	Occurrence priority	CI / CA priority
1.4.1 – Accidents to persons excluding suicides	1	1
2.5.3 – Driving incidents	1	2
2.5.1 – Traffic operations incidents	1	2
1.1.2 – Collisions of train with an obstacle	2	1
1.3.1 – Level crossing accidents	2	2
2.1.5 – Level crossing equipment failures	2	Not identified
2.5.2 – Train composition incidents	1	3
2.5.4 – Others incidents in operations and traffic management sub-system	3	1
1.2 – Derailments of trains	3	3
2.4.2 – Others failures	3	Not identified
2.4.1 – Critic element of rolling stock failures	Not identified	3
2.3.1 – Signalling incidents	Not identified	3

Safety index results



Conclusion

Our objective is to build a railway safety index to detect most critical types of safety events in order to define areas of collaborative work with rail companies

Conclusion

- Those indexes should help to decision-making on safety
- They must be used as a tool for debate on main safety questions.

- In term of perspectives, many evolutions of those type of indexes can be explored.
 - ▶ the possibility of CA/CI projection with causes (instead of type of event)
 - ▶ Use of CA/CI by railway companies on their own activities with their events
 - ▶ the link with risk modelling such as bow-tie models

Caution

- It is not a KPI to assess the safety level or the safety performance of railway companies :
 - ▶ This wouldn't be relevant : reporting an event does not mean being responsible
 - ▶ Not good for Safety Culture



Thank you for your attention