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Programme of Work:
A review and analysis of the economic costs of level crossing accidents based on data provided by countries

Programme of Work

A review and analysis of the economic costs of level crossing accidents based on data provided by countries[1,2]

Submitted by Poland, European Union and European Railway Agency

I. Understanding the costs of unsafe level crossings

1. Among all types of road and rail accidents, the accidents at level crossings belong to those with the most serious consequences. These can be translated into monetary costs to the parties involved and to the society. Internalization and understanding of all costs involved is then a precondition for informed decision making in relation to the use of public funds for improving safety conditions at level crossings. It should be also emphasized, that more common use of EMU trains with the speed exceeding 160 kms per hours poses the additional risk of higher number of fatalities in case of a collision at the level crossing.

[1] This document was submitted late due to delayed inputs from other sources.
[2] The present document was not edited before being sent to the United Nations translation services.

2. Comprehensive quantifiable costs of collisions involving a train and one or more motor vehicles at a grade crossing may include substantial property damage incurred by freight shippers as well as the parties to the crash, delivery delay and lost time for traffic that is diverted by the crash, cost of public-service agencies responding to the crash and its aftermath, and more. Little information has been developed about such costs in UNECE countries. Lacking such information, highway and rail system decision-makers cannot effectively judge the economic benefits of public investments to improve or eliminate grade crossings.

3. The absence of quantifiable costs translates into difficulty to put the subject on high level policy agenda and implies a reduced ability to apply risk-based decision making to safety improvements at level crossings.

4. The quantification and systematic internalization of the costs of level crossing accidents should therefore be applied in all UNECE countries, with the effort being proportioned to the achievement of the end goal.

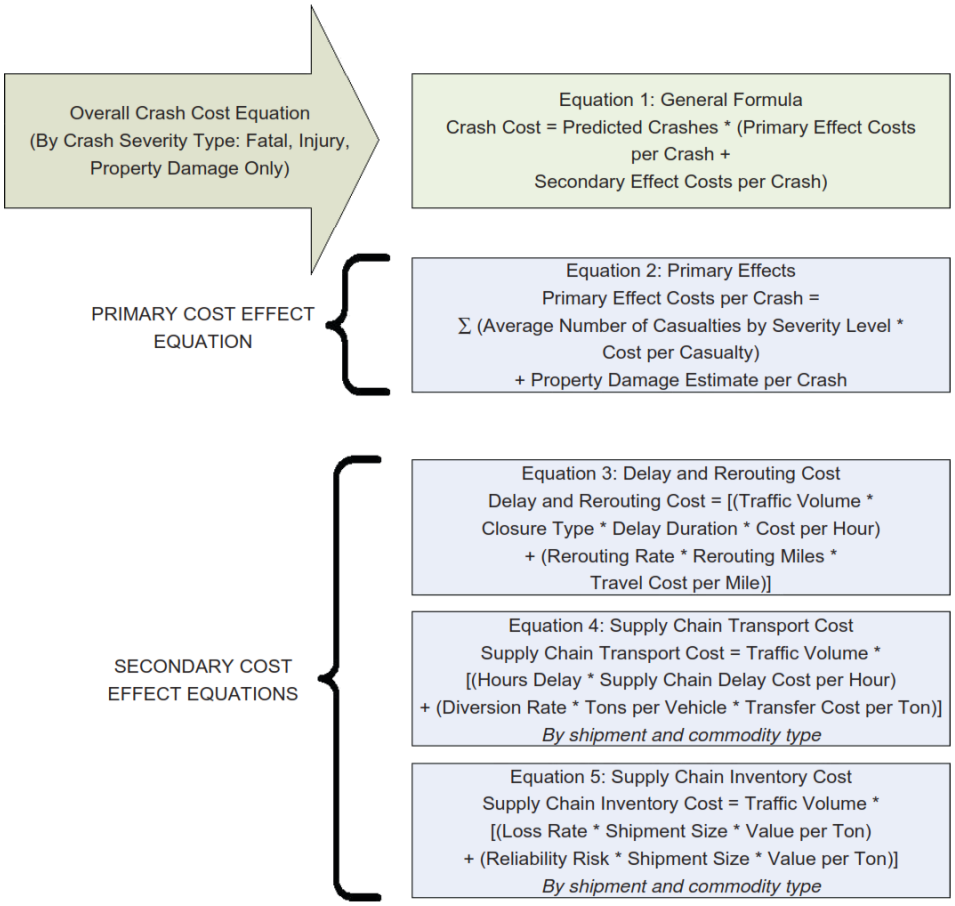
5. The survey run among 22 UNECE countries in 2014-2015 showed that the costs of level crossing accidents are not systematically estimated and that in countries where they are, they do not usually cover all types of attributable costs. Moreover, the survey unveiled that methodologies for estimating costs vary substantially between countries and even within countries.

6. In general, varying legal systems and cultural differences in UNECE countries means that there are currently great differences in the availability and categorization of costs, what alongside different methodologies used to estimate indirect and intangible costs. This undermines the objectivity and consistency of the approach. Therefore, it is desirable to develop and implement a common method for the estimation of costs of level crossing accidents. This will assure credibility and validity of costs estimates between countries and in time.

7. The internalization of the costs and the way their redistribution is a powerful tool for engaging all relevant stakeholders as it provides an economic incentive for them. Contractual arrangements and insurance policies play a major role here.

II. Recommended methodology to estimate costs of accidents at level crossings

8. After reviewing the existing theoretical frameworks and cost models used in different UNECE countries, the EG recommends using the cost model published in NCHRP report Nr.755 as a high level framework for the categorization of different types of costs. In that model, cost categories are itemized by effect and impact. Primary effects occur at the crash site and include casualties (with related costs) and property damage (to highway vehicles, railroad equipment, and infrastructure). Secondary effects are associated with supply chain and business disruptions. Also considered are the effects associated with rare catastrophic crashes. Impact describes how each cost component affects society (i.e., directly, indirectly, or intangibly); the process through which the impact is perceived (e.g., through business supply chain disruption); or—in the case of rare catastrophic events—the approach taken to evaluate the cost. Both indirect and intangible costs are captured in the WTP measures for loss of life and injury.



9. The survey among EG members on the available cost components unveiled that primary cost effects are generally available (although not always systematically collected), but there are differences in underlying methods and assumptions to notably derive the costs of casualties and costs to road infrastructure.

10. The value of preventing a casualty should be established by either Willingness-To-Pay or Human Capital/Lost Output approaches. It is essential to consider not only fatal injuries, but also serious (or even minor injuries) in this statistical life valuation exercise.

11. Where the national estimate for the VSL (value of statistical life) is not available, a default VSL/GDP ratio values estimated in IRAP research[3] project could be used instead as follows:

- Value of fatality 70 (60-80) x GDP per Capita
- Value of serious injury 17 (12-24) x GDP per Capita

12. Regarding the costs of delays and rerouting costs, the method described in the EU legislation (Appendix to Commission Directive 2014/88/EU) could be used. It produces unit estimates of costs due to one minute of delay on the lines directly and indirectly affected by the traffic suspension following an accident. As regards rerouting costs, they may be assumed minor and disregarded if they cannot be obtained from involved parties.

3 Valuing life and cost of a serious injury, IRAP 2012.

13. As the other types of secondary costs are borne by business, they do not necessarily have to be included in the overall calculation.

A. Use of accident costs estimates

14. The estimates of the costs of accidents should be used by decision makers when giving a price-tag to the lack of safety at level crossings in the given jurisdiction. A first step is the awareness raising among relevant public figures. Here, the credibility of the estimates is crucial. A second step is the use of estimates in cost-benefit analysis and risk-based decision making process.

15. Indeed, a detailed knowledge of different costs components provide for an informal objective debate among involved actors. It also provides a benchmark which is sometimes more important that the absolute cost figures.

B. Overview of the typical (reported) costs in level crossings accidents

16. Since the costs estimates are not always readily available for all costs component, a survey among rail infrastructure managers was organized in 2015 in order to collect some typical cost estimates that could potentially be used by other UNECE countries in the absence of own estimates. These are showed in the table overview below:

Effect	*Impact*	*Cost Component*	*Costs*
Primarily		Rail infrastructure	240 EUR (PL)
		Rail rolling stock	2,600 (EUR) PL
		Road vehicles	7,000 (EUR) EU
	Property Damage	Road infrastructure	
	Direct	Other direct costs	524 EUR (IM staff intervention) (BE)
		Work-related productivity loss	
	Indirect	Tax loss	
		Quality of life	
	Intangible	Pain and suffering	
Secondary		Rerouting and increased emissions	6,874 EUR (BE)
			2,667 EUR (BE) (Pax train)
		Freight and passenger delays and reliability	1,997 EUR (BE) (Freight train)
			116 EUR (BE) High Speed train
		Increased inventory and its spoilage	
	Supply chain disruption	Prevention	
		Lost sales	

Typical delay of the train involved in a typical accident was between 100 and 150 minutes. The delay value for freight train was slightly lower compared to passenger train.

C. Overview of the typical costs of level crossing protection systems

17. Alongside the estimates of typical costs of level crossing accidents, a series of typical costs of level crossing protective equipment was provided by several UNECE countries. They are provided in the table below:

Type	*Average*	*Range*
Bridge/Underpass	3 mio EUR	2-4 mio EUR
Automatic warning only	120,000 EUR	50,000-150,000 EUR
Automatic barriers	350,000 EUR	100,000 – 900,000 EUR
Automatic traffic law enforcement cameras	250,000 EUR	200,000 – 300,000 EUR

18. There is significant variation in the technical scope and complexity of crossings between different countries, which is a key factor in determining the cost. The recorded costs of level crossings are also highly dependent on the scope of work recorded within the project costs – there is no such thing as a 'standard' level crossing upgrade or renewal. The cost of 'non-materials' expenditure (design, installation, overheads, testing and commissioning and project management) dominates the cost of level crossings rather than materials costs which only contribute between 20% and 30% of total cost.

III. Approaches to efficient funding

19. Many different funding models exist across the participating countries. These range from the work entirely funded by the railway, to other models in which costs are shared between the railway, the local community, road authorities and central government.

20. In 2012, a survey was carried out by the UIC among its members on the financing of new level crossings and their maintenance. This survey showed that large discrepancies among countries in terms of bearing (part of) costs related to construction and maintenance of level crossings.

21. In terms of construction costs, they were either borne in full by the transport agency, but very often, the road and rail administrations shared the costs by different proportions. In many cases, the local municipalities were involved in co-financing as well. In terms of maintenance costs, they were typically borne by the rail infrastructure manager either in full or in a significant portion of them. In some countries, the involvement of the road infrastructure manager is prescribed very strictly.

22. It appears that the arrangements in which different public agencies shared the costs contributed most to achieving a commonly understood goals. However, the mobilization of public resources through a leading agency is crucial. Mobilizing substantial resources to improve safety of railway lines should be seen as a long-term investment that reduces level of subsidies that the state provides to provide for public services (passenger train transport).

IV. Contractual arrangements and insurance policies

23. Policies and contractual arrangements among the rail operating company and the infrastructure manager that provide incentives for securing level crossings are a solid and proven tool used in several UNECE countries. Once the infrastructure managers have to

borne the costs incurred by the railway undertakings (typically lost profits due to delays and reduced attractiveness of the railway system), their motivation for improving the safety at level crossings would increase.

24. Private insurance policies are often used to recover some of the costs incurred in level crossing accidents. However, they would normally only cover (part of) the direct costs and not the indirect costs. Raising awareness with the insurance sector and its engagement to raise profile of level crossing safety is a less developed avenue that should be explored by the regulators.

V. Informal paper input

25. In its first session, the Group of Experts on Safety at Level Crossings decided to extend the remits of its work program, as described in the Terms of Reference, to the economic evaluation of safety at level crossings.

26. The Group of Expert shall notably review and analyze the economic costs of level crossings accidents based on data provided by country. It shall analyze the underlying methodologies with the view to prepare a recommendation on how to evaluate costs of lack of safety at level crossings at national level, as an input to strategic national safety improvement programs.

27. The ultimate goals of the work should be to:

- Develop a comprehensive taxonomy of level crossing accident costs, their contributing factors and their order of magnitude.
- Develop an analytical framework that enables the estimation and forecasting of level crossing accident costs and effectively support resource allocation decisions.
- Prepare a catalogue of main measures for improving safety at level crossings including their typical costs.

VI. Summary of issues

28. While LC accidents represent a fraction of all road (and partly also rail) accidents, their impact is often disproportionally large. The comprehensive quantifiable costs of accidents at level crossing often include substantial property damage, delays, costs of public-service agencies responding to the crash and its aftermath and many more. Little information has been developed about such costs and the lack of this information represents a limitation for decision makers to effectively judge the economic benefits of public investments to improve or eliminate level crossings. As it was emphasized before , the increased speed of trains, exceeding 160 kms per hours, can pose the additional risk of higher number of fatalities in case of a collision at the level crossing.

29. Estimating costs of road accidents proved to be a useful concept to attract attention of decision makers and to promote evidence-based and effective policies at national and international level. Since accidents at level crossings are often excluded from road safety statistics[4], the estimates of costs of these accidents are rarely available. In their absence, it may be difficult to establish a cause for LC safety improvements.

[4] The CARE database of road accidents contains statistics on LC accidents for only X countries out of 29.

30. The railway sector seems to have limited concern of direct and indirect costs associated with accidents at level crossings. This may be due to the fact that the direct costs are relatively low and often covered by insurance policies and indirect costs are often not established and analyzed. Yet, the increasing pressure on competitiveness of railways brings the indirect costs under spotlight.

31. There are a number of frameworks available for estimating costs of road and rail accidents; however the development of specific frameworks for estimating costs of level crossings accidents was rather limited in UNECE countries.

32. A comprehensive taxonomy (categorization) of costs components is the prerequisite for establishing a sound analytical framework. As a starting point, a categorization used in TRB 755 report, is proposed as a basis for further discussion:

Effect	*Impact*	*Cost Component*
Primarily	Direct	Property Damage
		Other direct costs
	Indirect	Work-related productivity loss
		Tax loss
	Intangible	Quality of life
		Pain and suffering
Secondary	Supply chain disruption	Rerouting and increased emissions
		Freight and passenger delays and reliability
		Increased inventory and its spoilage
		Prevention
		Lost sales

VII. Findings from survey

33. The following overview summarizes the replies to the questionnaires as received by 15 September 2014. Altogether 24 replies are available coming from 22 UNECE countries.

A. Estimation of costs of level crossing accidents in UNECE countries

34. In 7 out of 22 countries are the costs of level crossing accidents estimated at the national level.

35. These estimations are carried out by various actors: By a railway infrastructure manager (3 countries), national railway companies (1 country), National rail safety authority (1 country), National statistical office (1 country) and Research institute (1 country).

36. In all seven countries except one are the statistics compiled on annual basis (even if costs are established for each individual accident separately).

37. The motivation for establishing level crossing accidents costs and collecting relevant statistics vary between countries: They serve as input to national safety plan (2 countries);

they are reported to ERA under CSI data (2 countries); they are established as they represent criteria for (EU) mandatory accident investigation (1 country); they are used in cost-benefit studies (1 country).

B. Type of costs considered

38. Property damage costs (Infrastructure Manager, Railway Undertaking, Highway vehicles) are the most commonly registered costs of level crossing accidents. They are followed by environmental costs and by costs of delays. The table below shows the number of countries (out of 22) in which the particular costs are reported.

Type of costs	*Nr of countries*
Property damage costs	16
Rescue services	3
Insurance	3
Work related productivity costs	6
Costs of casualties	5
Environmental damage costs	7
Investigation costs	1
Costs of delays	7
Costs of rerouting	1
Prevention costs	1
Lost sales	1

C. Estimation of costs of human life in UNECE countries

39. In 6 of 22 countries are the costs of human life established at the national level. One country reported that VPF is used as a method (defined by the Directives 2004/49/EC and 149/2009/EC), one country provided reference to HEATCO study. One country uses expert opinion estimate at the national level.

D. Good practice worth sharing

India

40. The loss of human on Level Crossing is a loss to NATION because most of the death on Level Crossing in India is due to Accident of Train and Road Vehicle. It is worth mentioning that a person owning a vehicle must be a person above Mid-Income Group and he decided to cross track in hurry because he has value of Time.

Ireland

41. Values for economic indicators for various member states are given in the ERA CSI Guidance, Annex, Tab. 1-3.

Russia

42. For yet in Russia there is no single methodology for cost estimates. Assessment of costs in different regions is different.

Belgium

43. ERA Guidance (study HEATCO 2008).

VIII. Conclusions and next steps:

44. The initial survey confirm that the costs of level crossing accidents are not systematically estimated in UNECE countries and that in countries where they are, they do not usually cover all types of attributable costs.

45. The methodologies for estimating costs vary substantially between countries and even within countries. Some countries provided reference to a common methodology for estimating railway accident costs contained in the EU legislation (88/2014/EU).

Further action 1*:* Available methodologies for estimating rail/road accident costs should be reviewed by the subgroup and a method derived for the estimation of costs of level crossing accidents.

Further action 2*:* Authors of the methodology prepared by the World Bank should be invited to the next session of the Group of Experts to share their ideas on the development of the methodology.

46. Costs of casualties are established in a few UNECE countries only, in some others, they rely on estimates produced by external EU wide studies. ERA Guidance on CSI implementation has been quoted as a useful reference for a methodology and national fall back values of certain types of costs.

Further action 3*:* Available studies that produced estimates of economic costs of casualties should be reviewed by the subgroup and a recommendation made on their use in the absence of nationally established estimates.

47. A group should seek to collect exact amounts of costs for accidents at level crossings from a pool of UNECE countries with the view to establish typical contribution of single cost items to the overall costs of LC accidents.

48. Besides, certain data are available at ERA for EU-28 countries, through the accident investigation reports. These relates to infrastructure and vehicle damage costs in level crossing accidents investigated by National Investigation Bodies.

Further action 4: Prepare and execute a more detailed survey targeting relevant interested countries in order to get overview of typical costs incurred in LC accidents.

49. While the costs of LC safety equipment may be well known to rail infrastructure managers, the decision makers may not have access to a more comprehensive overview of all possible measures and their costs. This may limit their ability to make right decisions. The subgroup may want to discuss how to limit the list of measures to those most relevant to the work of the WP.

Further action 5: Prepare and execute a general survey on the costs of selected level crossing safety improvement measures.

Annex A: Questionnaire responses

The table below summarizes the replies on the question "If you estimate the costs of LC accidents, which costs are included?"

Country	Property damage costs	*Rescue services*	*Insurance*	*Work related productivity costs*	*Costs of casualties*	*Environmental damage costs*	*Investigation costs*	*Cost of delays*	*Costs of rerouting*	*Prevention costs*	*Lost sales*
Belarus	X			X	X	X	X				
Belgium	X						X			X	
Bulgaria											
Estonia	X									X	
France											
Georgia	X		X			X	X			X	
Germany	X			X			X			X	
Greece	X		X				X			X	
Hungary	X									X	
India	X				X		X			X	
Ireland	X	X		X		X				X	
Italy											
Lithuania											
Moldova	X			X		X				X	
Norway	X									X	
Poland	X									X	
Portugal	X									X	
Romania	X	X	X	X	X	X	X	X	X	X	
Russia											
Spain											
Sweden	X				x	X				X	
Switzerland											
UK	X	X								X	
Turkey	X						X			X	

The table below summarizes the replies on the question "Do you estimate the costs of casualties?"

Country	*VPF*	*Method*
Belarus	No	
Belgium	No	
Bulgaria	No	
Estonia	N/A	
France	No	
Georgia	No	
Germany	No	
Greece	No	
Hungary	Yes	
India	No	
Ireland	No	
Italy	No	
Lithuania	Yes	
Moldova	No	
Norway		
Poland	No	
Portugal	Yes	VPF as defined by the Directives 2004/49/EC and 149/2009/EC
Romania	No	
Russia	Yes	cost method (cost)
Spain	No	
Sweden	Yes	The value of preventing causality is established but not annually updated.
Switzerland	Yes	Expert opinion, not evaluated on regular basis
UK	Yes	
Turkey	Yes	The cost of slight injuries & fatalities are adopted and calculated according to HEATCO (Developing Harmonized European Approaches for Transport Costing & Project Assessment). This method is used only by DG Turkish Highways, is planned to generalize to other organizations. Besides, the cost of human life is determined by courts considering factors; age, education, occupation, social status, etc.

Estimated cost values:

Table 1: Primarily and secondary costs of LC accidents

Effect	*Impact*	*Cost Component*	*Typical costs (significant LC accident)*
Primarily		Property Damage	€140,000 (EU-28)
	Direct	Other direct costs	€2,000 (EU-28) – environment
		Work-related productivity loss	
	Indirect	Tax loss	
		Quality of life	
	Intangible	Pain and suffering	
Secondary		Re-routing and increased emissions	
		Freight and passenger delays and reliability	
		Increased inventory and its spoilage	
	Supply chain disruption	Prevention	
		Lost sales	

Table 2: Estimated costs of average EU significant level crossing accident (2012), Source: NIB investigation reports, CSI data

Human costs	*1,330,000 €*
Property damage costs	140,000 €
Costs of delays	22,000 €
Environmental damage costs	2,000 €
Other costs (investigation, insurance, legal)	6,000 €
Total	1,700,000 €