SAFER-LC

SAFER LEVEL CROSSING BY INTEGRATING AND OPTIMIZING ROAD-RAIL INFRASTRUCTURE MANAGEMENT AND DESIGN

Cost- benefit analysis – Findings & Recommendations

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objectives

- Establish a comprehensive C/B analysis method to assess the developed solutions, while taking into account various aspects
  - Economical
  - Social
  - Environmental
- Issue a concise set of recommendations pertaining to
  - Technical specifications
  - Human processes
  - Oraganizational and legal frameworks

➔ Implementation of the solutions + Feed into future international standard in rail and road → Safer LX

Developing a harmonized Cost-Benefit Analysis method (1)

- CBA- Definition

  A systematic process for calculating and comparing the benefits and costs of several projects/criteria/decisions or government policy.

- Purpose
  - To determine if it is a judicious investment/decision (justification/ feasibility)
  - To provide a reference for comparing projects / criteria / decisions

  ==> offering a basis for a rational decision-making

Developing a harmonized Cost-Benefit Analysis method (2)

- In practice

  Comparing the total expected cost of each option against the total expected benefits: do the benefits outweigh the costs, and by how much?

$$CBR = \frac{\Sigma \text{ benefits}}{\Sigma \text{ costs}}$$

- Aim
  - Identifying alternatives
  - Defining alternatives in a way that allows fair comparison.
  - Adjusting for occurrence of costs and benefits at different times.
  - Calculating monetary values for items that are not usually expressed in money.
  - Coping with uncertainty in the data.
  - Summing up a complex pattern of costs and benefits to guide decision-making.

Developing a harmonized Cost-Benefit Analysis method (3)

Approach

- State of the art regarding C/B analysis, particularly in railways
  - Analysis of relevant projects
- Comparison Cost-benefit Analysis (CBA) vs. Cost-Benefit Effectiveness (CBE): adequacy/relevance to our context
- Investigation of the economic aspects of safety at LXs
  - Investigation of all the cost and benefit types w.r.t. LX safety
- Identification of relevant indicators: NPV, IRR, CBR
- A questionnaire based survey regarding CBA

CBA - Main findings (1/4)

- CBA vs. CBE: CBA is largely preferred to CBE since it provides quantified indicators→ More directly and more easily exploitable by the stakeholders (source: survey questionnaire)
- Importance of data
  - Data of good quality and sufficient quantity are crucial inputs for CBA
  - data regarding LX accidents
    - Available at a high level, without enough details
    - Often dispatched on different (non-interoperable) databases (formatting, nomenclature, etc.)
- Need of common baselines for LX accident data recording
  - which information to record
  - data formatting
- Need of common methods to quantify CBA related aspects

CBA - Main findings (2/4)

- **National values vs. EU-averaged values**: EU-averaged values are preferred
  - **Pros**: Common valuation way for all EU countries + comparison of results
  - **Cons**: raises some issues regarding the relevance of these values for local/national decision making

- **Payers vs. Benefeciaries**
  - Variety of beneficiaries/potential payers → different from CBA of common products/services (benefeciaries=payers)
  - In the case of LX: who must pay ? → fairness question?
  - Need for a comprehensive identication of the beneficiaries/benefeces → better support/dispatch the cost

CBA - Main findings (3/4)

▲ Illustration: Non-monetarized aspects

Ease in terms of implementation	Privacy issues regarding the collected data
Ease in terms of use	Effects on the surrounding / other stakeholders
Reputation of railways	Availability of the solution (used components)
Effects on the environment	Certification procedures (necessary delays, etc.)
Customer satisfaction with the railway safety	Impact on the LC operation (closing duration, etc.)
Capacity performance	Acceptability by users
The possibilities of by-passing the system	Maturity degree of the technology

CBA - Main findings (4/4)

- Illustration: Discrepancy of Life cost evaluations as a factor in the CBA
  - Value of Preventing a Casualty (VPC) is composed of [ERA 2015]:
    - 1) Value of safety per se: Willingness to Pay (WTP) values based on stated preference studie carried out in the Member State for which they are applied.
    - 2) Direct and indirect economic costs: cost values appraised in the Member State, composed of:

      - medical and rehabilitation costs,

      - legal court cost, cost for police, private crash investigations, emergency service and administrative costs of insurance,

      - production losses: value to society of goods and services that could have been produced by the person if the accident had not occurred.

Country	Fatality	Severe injury	Slight injury
Austria	2,395,000	327,000	25,800
Belgium	2,178,000	330,400	21,300
Bulgaria	984,000	127,900	9,800

Examples of data

→ Country specific values vs. EU averaged values?

Applying CBA on SAFER-LC solutions/measures

▲ Cost and benefit categories taken into account

Cost categories:

- Further development of the solutions
- Installation
- Operational costs
- Maintenance costs
- Other general costs

Benefit categories:

- Number and severity of accidents that may occur in such type of LCs (historical data or if not existing, conditions similar to cases where historical data exists),
- Environmental damage an accident can create (trucks or trains carrying toxic, inflammable or toxic goods, use of land close to the LC etc.),
- Rescue services costs avoided (helicopters may be needed),
- Traffic of the train and road users and the impact this may have to the users (delays),
- Potential savings on infrastructure if damaged etc.

*Cost valuations resulted from the questionnaire to the pilot-site leaders

*Fixed assumptions:

- 1 fatality in 100LCs in 10 years (**2.384.033€**)*safety effect
- 2 light injuries: **10,000€**
- Various benefits: **103.000€**

Applied CBA - Results

▲ The example of "Blinking lights on locomotive"

Equipping 20 trains:

- Initial investment – **40.000** euros
- Annual costs – **20.000** euros
- Annual benefits – low scenario: **58.360,49** – high scenario: **94.120,98** euros

NPV (Low interest alternative - savings account)	
Blinking lights on locomotive	
Reduction 15%	
Interest Rate	2.00%
Initial Investement	40,000.00
Net Cash Flows	
Year 1	38,360.49
Year 2	38,980.65
Year 3	38,980.65
Year 4	38,980.65
Year 5	38,980.65
Output:	
NPV	**143,125.72**

NPV (Low interest alternative - savings account)	
Blinking lights on locomotive	
Reduction 30%	
Interest Rate	2.00%
Initial Investement	40,000.00
Net Cash Flows	
Year 1	74,120.98
Year 2	74,120.98
Year 3	74,120.98
Year 4	74,120.98
Year 5	74,120.98
Output:	
NPV	**309,366.24**

BCR = Σ Bt / Σ Ct = **2.08** and **3.36**

Cost categorisation of the selected solutions

- Prices in the table represent the scenarios from the CBA (usually 100 LCs)
- Installation costs per LC - Low: <10,000€, Medium: 10,001 – 100,000€ and High: >100,001€
- Operational - maintenance - Low: < 20,000€, Medium: 20,001 – 50,000€ and High: > 50,001€

Solution	Initial investment (€)	L/M/H	Average annual operation/ maintenance (€)	L/M/H
In-vehicle train and LC proximity warning	198,000	L	2,800	L
Blinking lights on locomotive (20 equipped trains)	40,000	L	20,000	L
Peripheral blinking lights near tracks	400,000	L	10,000	L
Blinking amber light with train symbol	400,000	L	10,000	L
Rumble strips	150,000	L	5,000	L
Road sign “Is a train coming?”	80,000	L	4,000	L
Message "Is a train coming?” written on the pavement	80,000	L	16,000	L
Smart Detection System	370,000	L	75,000	H

The SAFER-LC business model canevas

▲ Business model for low-cost safety solutions

Key Partners
- Public authorities (regional, national or European level)
- Rail infrastructure managers
- Road infrastructure managers
- Hardware developers
- Software developers
- Research institutes
- Rail operators
- Road operators (commercial fleet managers)
- Rail users (passengers, train drivers, …)
- Road users (drivers, riders, cyclists, pedestrians, …)

Key Activities
- Consulting on the most suitable – applicable - efficient LC solutions
- Development of the solutions
- Installation activities
- Operational activities
- Maintenance of the solutions and updates
- General and/or other (updating, research for improvement etc.)

Key Resources
- Hardware devices constructed for some solutions.
- Software developed for the SAFER-LC needs
- Personnel (further research, installation, maintenance etc.)
- The SAFER-LC developed solutions - knowledge

Value Proposition
- Augmented safety in LCs during day and night
- Provision of low-cost solutions
- Providing mixed solutions for specific needs that can support numerous level-crossings with little or no need for employees to monitor – inspect
- Fit with the environmental and circulation needs
- Possibility for integration with digital systems – new technologies
- More efficient network operations
- Less costs on damages

Customer Relationships
SAFER-LC potential customers are limited – estimated approx. 100 (European level), so a special customer relationship should be established with emphasis on the needs of each one.

Channels
- conferences,
- networking,
- specialised magazines and websites,
- associations where rail infrastructure managers (or other potential customers are represented,
- tender calls (in regional, national or European level) for safety solutions
- salespersons etc.

Customer Segments
- Government, regional governments, cities, etc.
- Rail operators or rail infrastructure managers
- Road infrastructure managers
- Application and service providers

Cost Structure
- Product development costs
- Hardware development costs
- Personnel costs
- Installation costs
- Operational costs
- Maintenance costs
- General, administrative and other costs

Revenue Streams
- Consultancy fees to define the best solutions for LCs
- Studies on the suitability of the solutions, the results that could bring etc.
- Hardware sales
- Software – application sale / subscription
- Less realistic - taxes, tolls, charges from government

The SAFER-LC consortium's online survey

- As end-users, the majority of the respondents would be willing to pay indirectly for the provided solutions
- 67% of the respondents are willing to continue the collaboration after project-life (further research or/and implementation)
- There is no need for legislative changes for the solutions to be implemented
- 73% believe the solutions can be integrated with the current/existing LC infrastructure

Conclusions / Recommendations

- A set of concepts and artefacts to derive CBA for LC securing solutions have been established
  - Illustrations made on SAFER-LC developed solutions, considering estimated data
- Data of sufficient volume and good quality are required to obtain trustworthy results
  - obtaining such adequate data could be challenging
- Need of common methods to quantify CBA related aspects
- CBA is an evolutionary process that should take into account:
  - up-to-date safety indicators
  - updated costs (new technologies, etc.)
- CBA should involve various stakeholders
  - the various beneficiaries
  - the potential payers
  - the solution developers/providers
  - safety experts (most importantly)

  ➔ reach optimal decisions supported by most stakeholers

Main reports

- Reports are online at https://safer-lc.eu/

  D5.1 Adopted cost-benefit analysis approach

  D5.3 Business models for safer LC innovative solutions

  D5.4 Recommendations for national policy and regulations regarding the LC from the infrastructure point of view

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Thank you for your attention!