SAFER-LC

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

WP5 – Cost- benefit analysis and final recommendations for SAFER-LC

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IRU PROJECTS

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WP5 – Overview

- **Duration**: M6 → M36
- **Leader**: IFSTTAR
- **Contributors**: All

UIC	NTNU	**IFSTTAR**	CERTH-HIT	Trainose	GLS	COMM	IRU	SNCF
7	4	11	3	5	1	2	10	1

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

WP5 – Work description

Task 5.1: Harmonised Cost Benefit Analysis approach (M6 – M27)

- Leader: IFSTTAR
- Participants: UIC, CERTH-HIT, TRAINOSE, IRU
    - Investigate Cost Benefit Analysis techniques related to safety in railway sector
    - Suggest a harmonised approach based on the results of WP4

Task 5.2: Business Models for the deployment of the suggested solutions (M8 – M32)

- Leader: IRU
- Participants: CERTH-HIT, IFSTTAR, UIC, TRAINOSE, COMM
    - Evaluate the elaborated solutions by means of business models + consider some case studies to perform the assessment

Task 5.3: Recommendations and guidelines (M24 – M36)

- Leader: UIC
- Participants: NTNU, IFSTTAR, TRAINOSE, CERTH-HIT, COMM, SNCF, GLS, IRU
    - Provide a synthesis of the SAFER-LC recommendations on technical specifications, human processes, and on the organizational and legal framework regarding the deployment of the developed solutions => Meet the latest cooperative standards on technical specifications and human processes, but also on the organizational and legal framework

WP5 – Deliverables

- D5.1. Adopted cost-benefit analysis approach **– IFSTTAR**
- D5.2. Proposal of standards for data interoperability and communication **– NTNU**
- D5.3. Business models for safer LC innovative solutions **– IRU**
- D5.4. Recommendations for national policy and regulations regarding the LC from the infrastructure point of view **- UIC**

Developing a harmonized Cost-Benefit Analysis method

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?

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

  - **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
  - Proposing the CBA harmonized method

CBA – Aspects which usually are not monetarized

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

CBA – Specific relevant aspects (1)

- **Life cost 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 value vs. EU averaged value?

CBA – Specific relevant aspects (2)

Values of time for estimating cost of delays

- EC Directive 2009/149/EC estimates delay costs for an accident based on the information of its real duration as follows:
- VT = monetary value of travel time savings
- Value of time for a passenger of a train (an hour):
- VTP = [VT of work passengers]*[Average percentage of work passengers per year] + [VT of non-work passengers]*[Average percentage of non-work passengers per year]
- VT measured in € per passenger per hour
- Value of time for a freight train (an hour)
- VTF = [VT of freight trains]*[(Tonne-Km)/(Freight Train-Km)]
- VT is measured in € per freight tonne per hour
- Average number of tonnes of goods carried per train in one year = (Tonne-Km)/(Freight Train-Km)
- CM = Cost of 1 minute of delay of a train

CBA – Specific relevant aspects (3)

Values of time for estimating cost of delays

- Passenger train: CMP = K1*(VTP/60)*[(Passenger-Km)/(Passenger Train-Km)]
- Average number of passengers per train in one year = (Passenger-Km)/(Passenger Train-Km)
- Freight train: CMF = K2* (VTF/60)
- Factors K1 and K2 are between the value of time and the value of delay, as estimated by
- stated preference studies, to take into account the fact that the time lost as a result of delays is
- perceived significantly more negative than normal travel time.
- Cost of delays upon the occurrence of an accident = CMP*(Minutes of delay of passenger trains) +
- CMF* (Minutes of delay of freight trains)

CBA – Specific relevant aspects (4)

Values of time for estimating cost of delays

Work passenger trips – VT *(2002 in € per passenger per hour)*

Country	Work
Austria	28.40
Belgium	27.44
Cyprus	21.08
Czech Republic	14.27
Denmark	31.54
Estonia	12.82
Finland	28.15
France	27.70
Germany	27.86
Greece	19.42

Examples of data

Table 4: Freight trips VT (2002 in € per freight tonne per hour)

Country	Per tonne of freight carried	
	Road	Rail
Austria	3.37	1.38
Belgium	3.29	1.35
Cyprus	2.73	1.12
Czech Republic	2.06	0.84
Denmark	3.63	1.49
Estonia	1.90	0.78
Finland	3.34	1.37
France	3.32	1.36
Germany	3.34	1.37
Greece	2.55	1.05

CBA – Specific relevant aspects (5)

Cost of damages to environment

Main cases:

- Pollution of an area by liquid, solid or gas release of goods.
- Material damages to an area (e.g. trees pulled down by rolling stock in motion)
- Fires in an area inside or outside the railway premises (e.g. fires of trees caused by rolling stock in motion).

Table 5. Cost in EUR per m3 of soil/water polluted (2008)

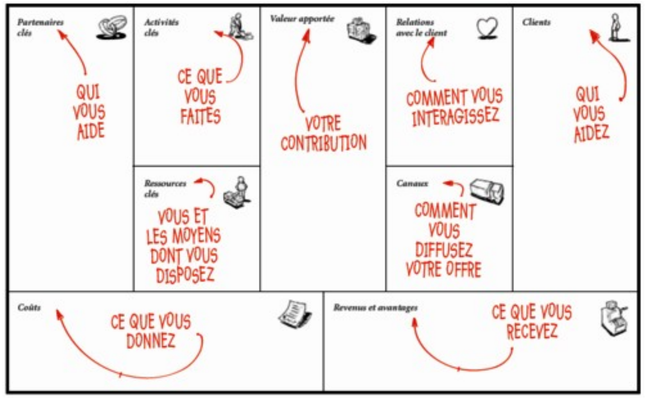
Country	Value (in 2008)
Austria	45.71
Belgium	43.55
Bulgaria	6.20
Channel Tunnel	40.04
Czech Republic	19.96
Germany	40.58
Denmark	57.71
Estonia	16.45

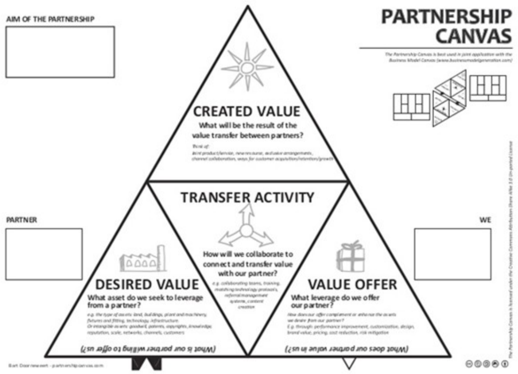
Developing Business models for the SAFER-LC solutions

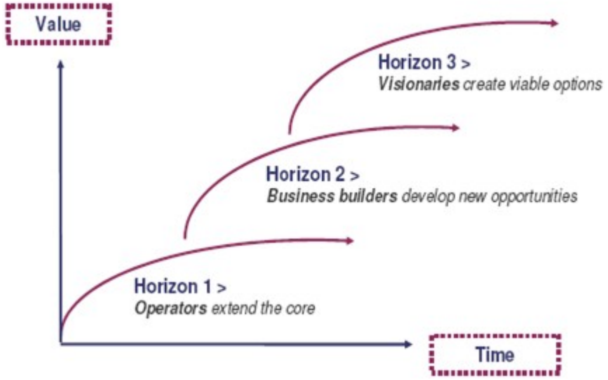
Business Model Techniques

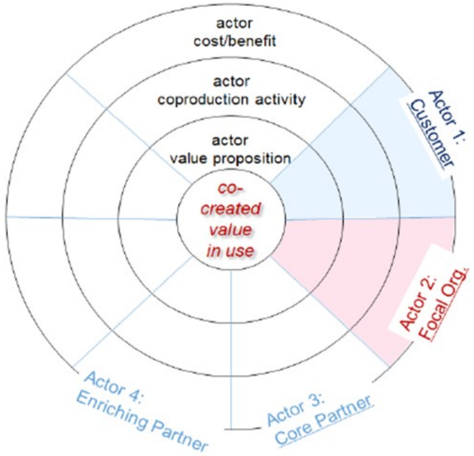
37 different Business Model techniques have been identified

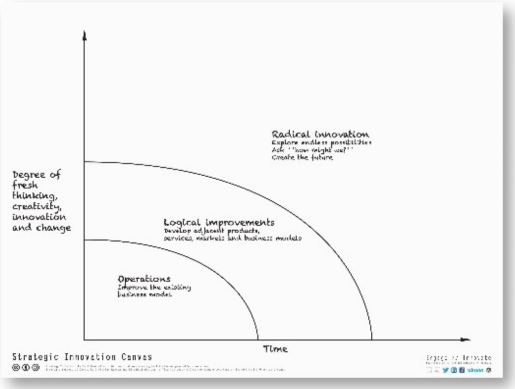
Which ones can present SAFER-LC's BM??



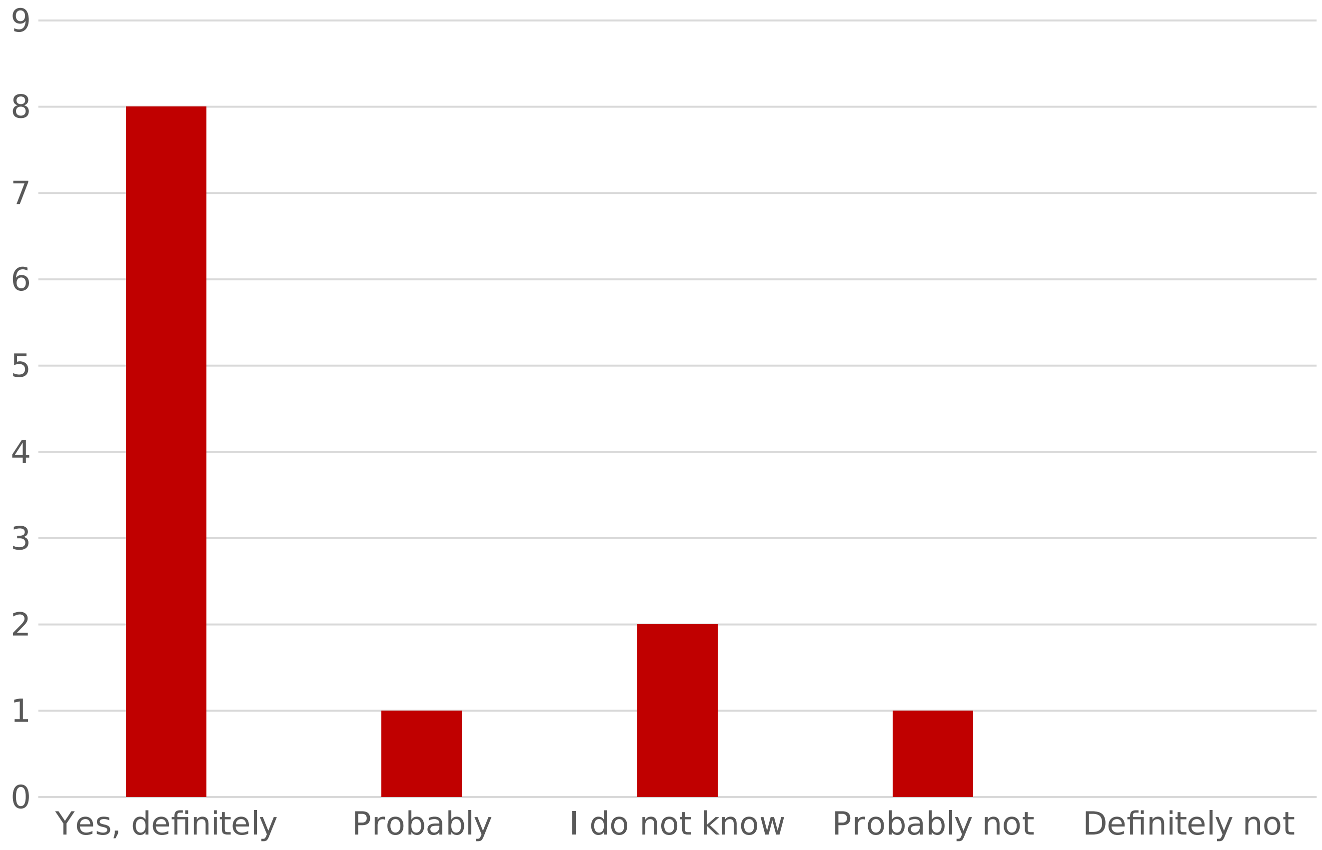






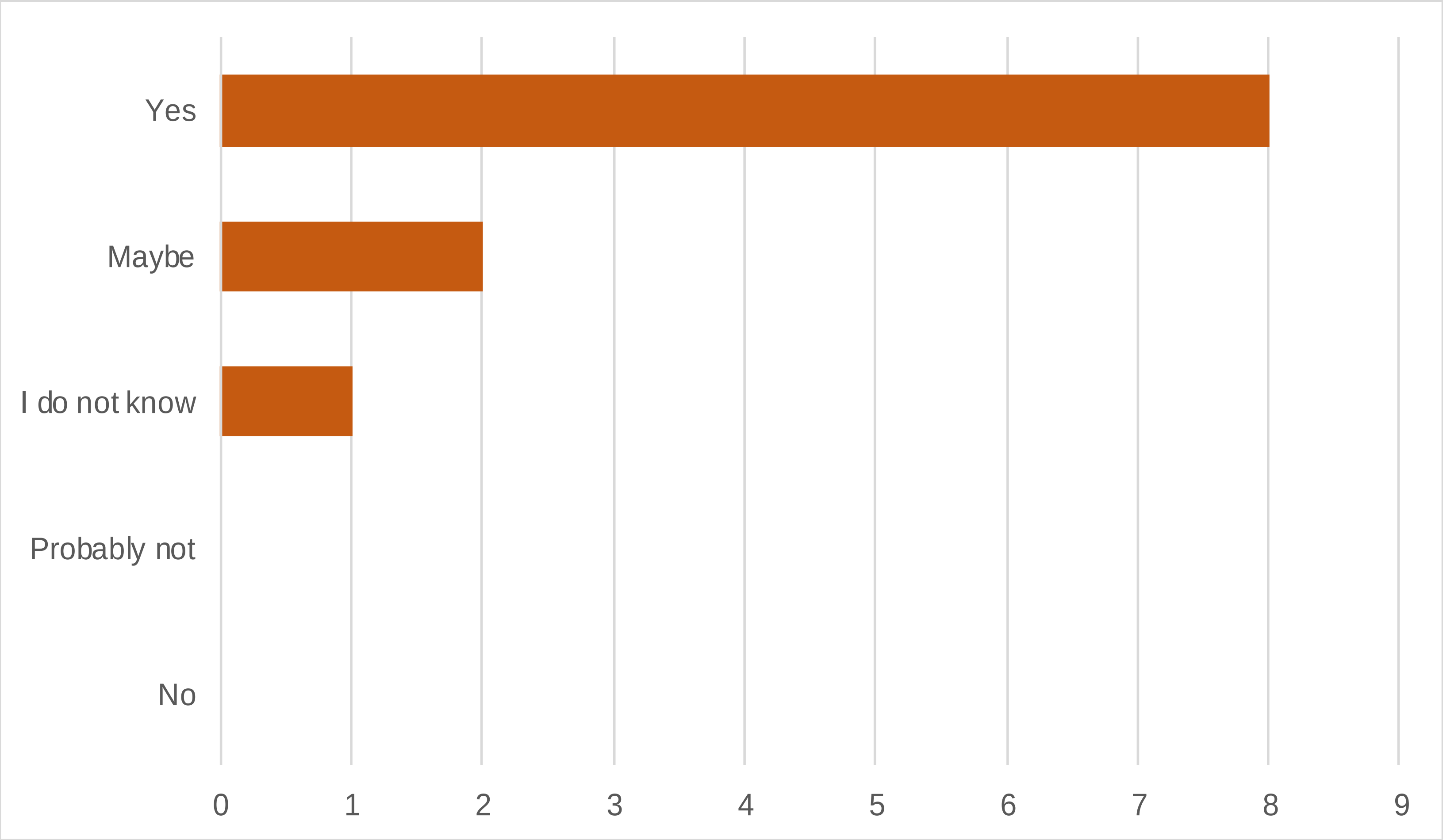


Market readiness - Online survey
Final results



Collaboration continuation after project-life?

Market readiness - Online survey
Final results



Benefited from the solution as end-users?

Market readiness - Online survey
Final results

Targeted Market

Global (7 responses)

Continental. In the global number of level crossings (LC). In France we have 15 000 LC

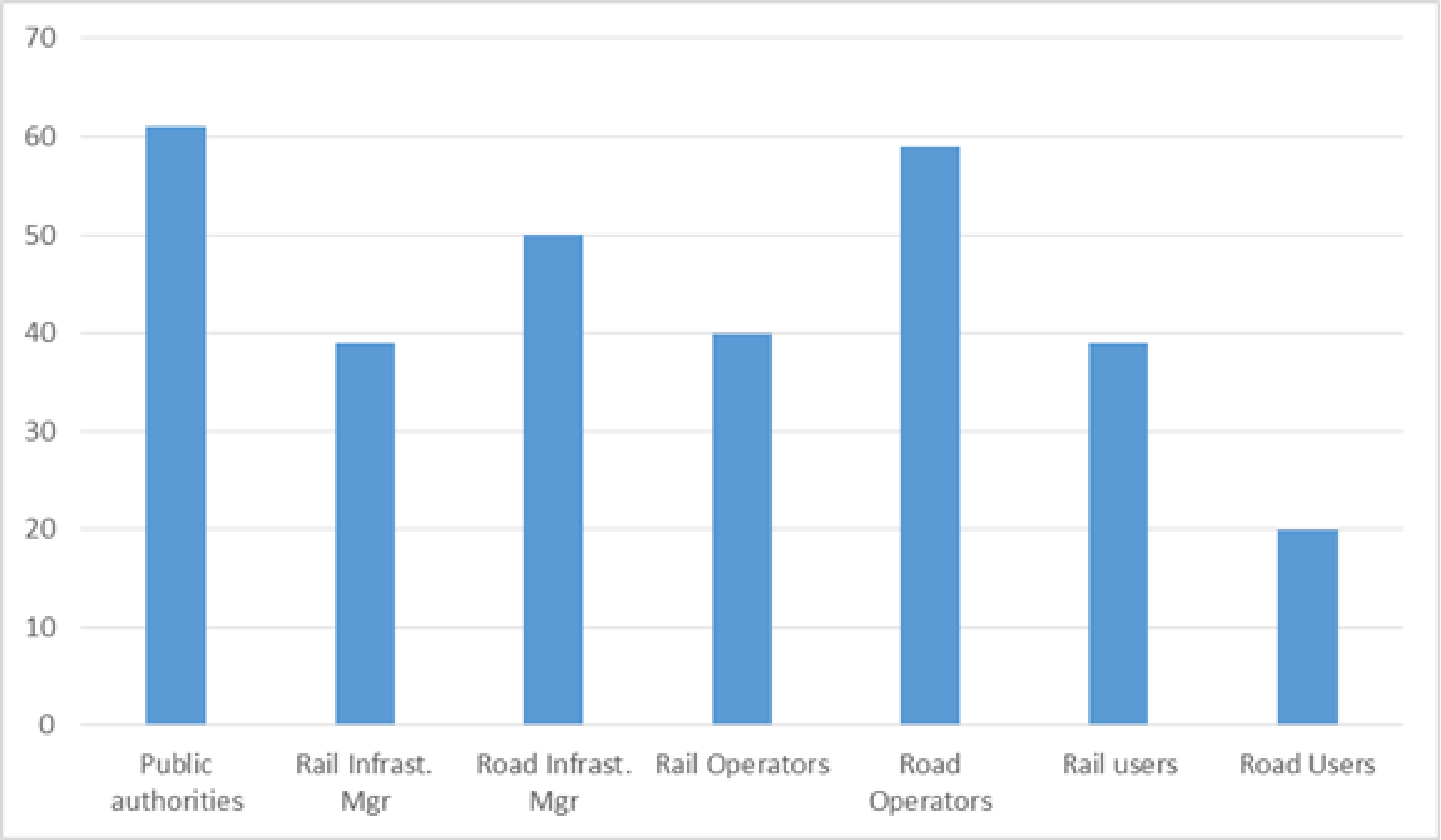
Regional, national or European

At each country a potential market is amount of locomotives and rail equipment which drive rail sections where level crossings are.

National

Market readiness - Online survey
Final results

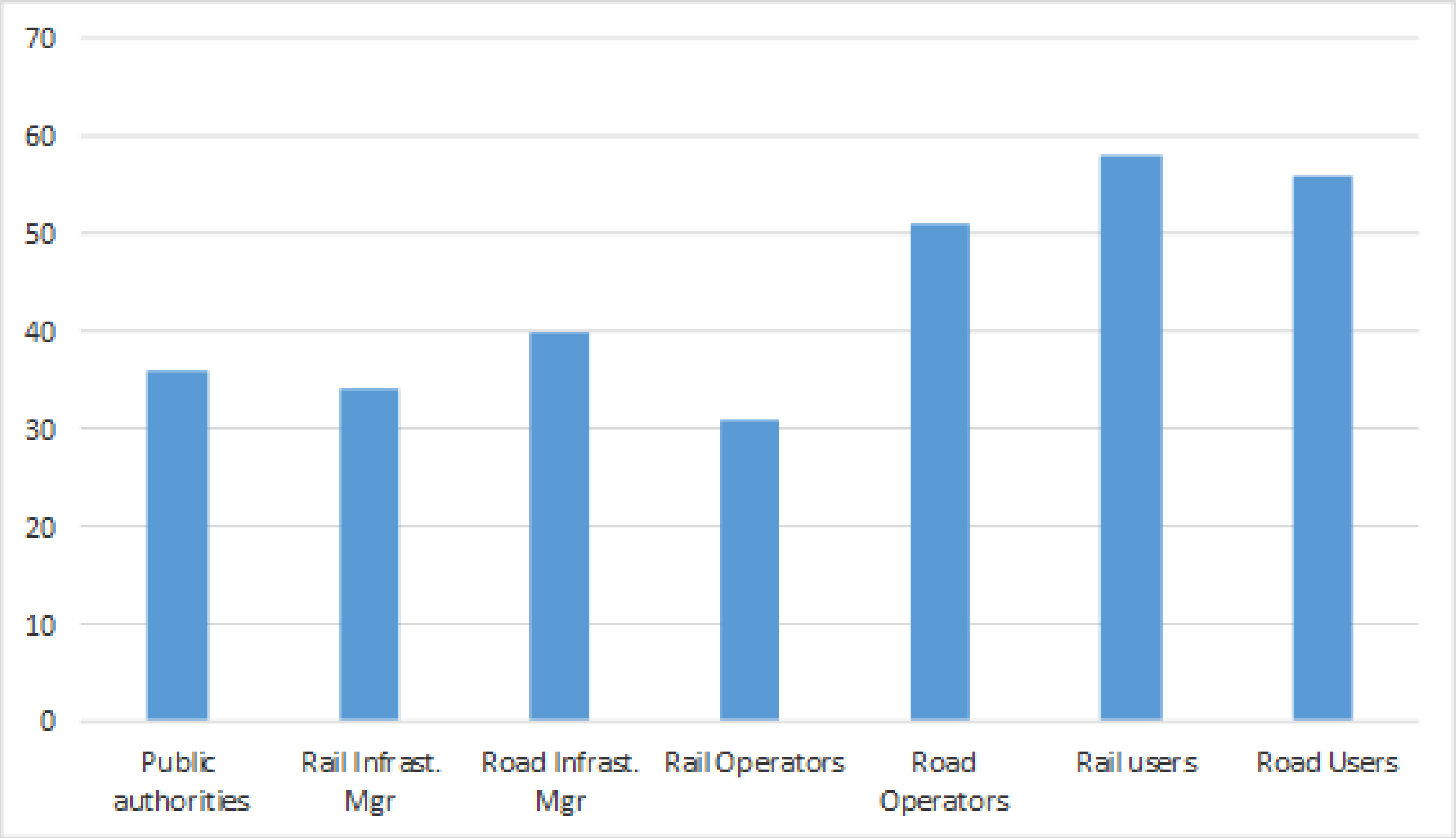
Main beneficiaries



Weighed results of main beneficiaries

Market readiness - Online survey
Final results

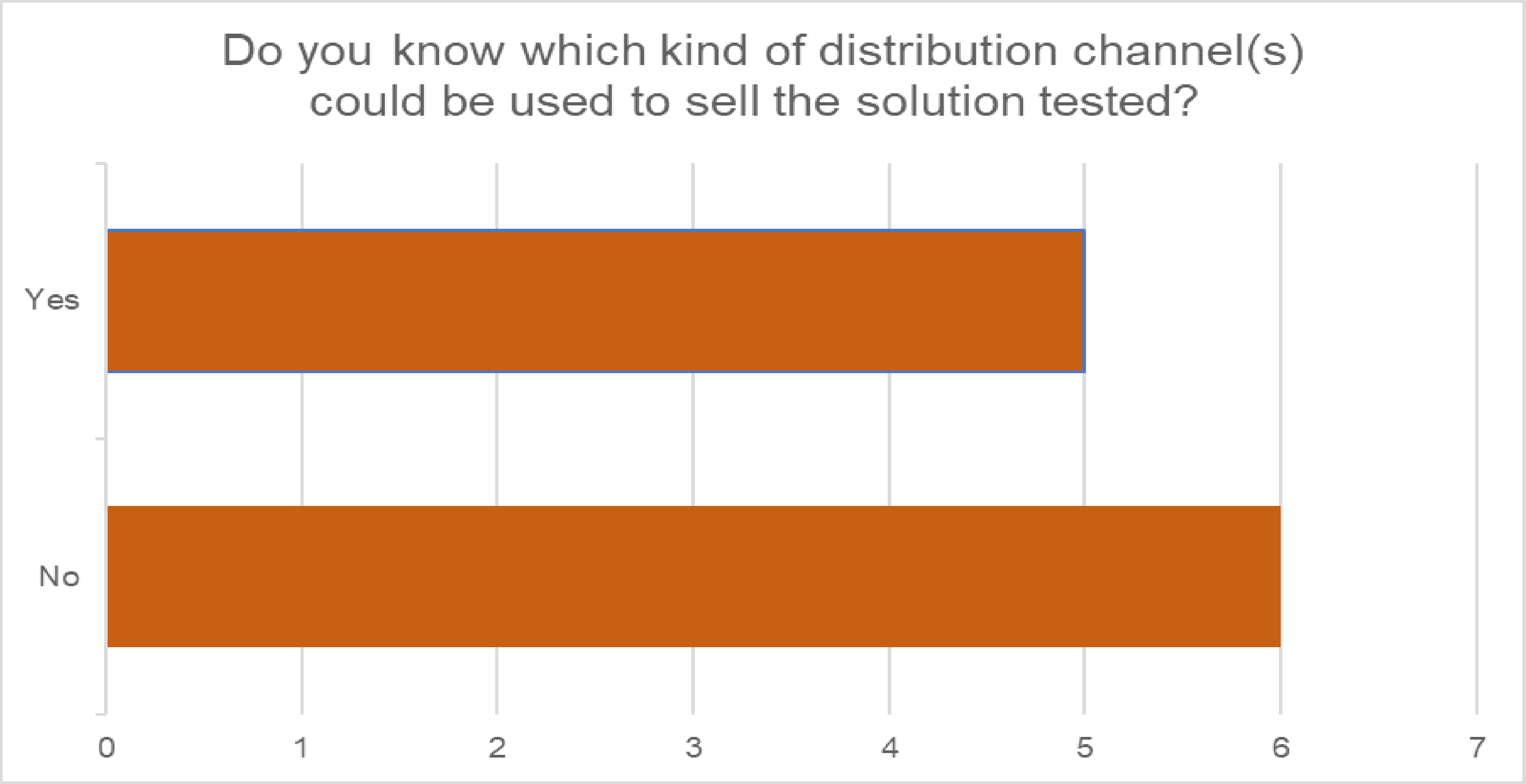
Main stakeholders for implementation



Weighed results of main stakeholders for implementation

Market readiness - Online survey
Final results

Distribution channel(s) used to sell the



The partners need to define the distributions channels that will be used to sell the solutions

Characteristics of SAFER-LC solutions

- SAFER-LC solutions could be provided as public goods
  - Difficult to introduce the solutions as commercial products as the free riders' problem cannot be avoided and the positive externalities created for the society
- SAFER-LC market is characterised by few but big potential customers
- There is no direct competition – same products
- High ROI (return on investment) at the majority of the solutions (CBA)

Proposed Business Model for SAFER-LC

Key Partners

- Public authorities (regional, national or European level)
- Rail infrastructure managers
- Road infrastructure managers
- Hardware developers
- Software developers
- Research institutes

Also:

- 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
- 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
- Safer passing during night time

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

- Hardware development costs
- Product 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

General recommendations

SAFER-LC recommendations (M36)

Goal: Issue general recommendations regarding various aspects

- Technical specifications on the light of the project findings: LC configurations and setups, railway/road operation rules, etc.

- Implementation of the proposed solutions:
  - human processes
  - organizational framework
  - legal framework

- Best practices to secure LCs according to the LC configuration, operational context and potential hazards

- Derive a comparative analysis of the communication standards to issue a set of technical recommendations
  - Adequacy to the communication needs of the developed solutions
  - Ensure interoperability in terms of data exchange
  - Provide necessary input for standardization bodies, such as CEN and ETSI, which are defining communication and application environments for C-ITS.

Thank you!