USERS, SAFETY, SECURITY AND ENERGY
IN TRANSPORT INFRASTRUCTURE

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Report on common research challenges regarding safety and security

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Disclaimer

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Abbreviations

ADAS	Advanced Driver Assistance Systems
CARONTE	Creating an Agenda for Research ON Transportation sEcurity
CCTV	Closed Circuit TV
CSA	Coordination and Support Action
ECCAIRS	European Co-ordination Centre for Accident and Incident Reporting Systems
ERTMS/ETCS	European Railway Transport Management System/ European Trail Control System
ETSC	European Transport Safety Council
FEHRL	Forum of European Highway Research Laboratories
FORx4	Forever Open Road, Rail, River and Runway
FOX	Forever Open Infrastructure (X) all transport modes (Road, Rail, Water, Air)
GSM-R	GSM- Rail
ICAO	International Civil Aviation Organisation
ITS	Intelligent Transport Systems
NGTC	New Generation Train Control
PNR	Passenger Name Record
SecMan	Security Risk Management Processes for Road Infrastructures
SMS	Safe Management Systems
USE-iT	Users, Safety, Security and Energy in Transport Infrastructure
V2I	Vehicle to Infrastructure communication
V2V	Vehicle to Vehicle communication

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Executive Summary

This report is a deliverable of USE-iT (Users, Safety, Security and Energy in Transport Infrastructure); a Horizon 2020 Coordination and Support Action (CSA) project managed by the Forum of European Highway Research Laboratories (FEHRL). The aim of USE-iT is to better understand the common challenges facing transport modes and in conjunction with stakeholders to produce a multi-modal research roadmap to develop technologies and approaches to addressing these challenges. In addition to a work package on management (WP1) and a work package on dissemination activities (WP5), USE-iT is divided into three technical Work Packages addressing important challenges facing all modes; providing better customer information (WP2); improving safety and security (WP3) and reducing carbon emissions and energy consumption (WP4). This report summarises the results of WP3.

Transport and mobility represent one of the most important elements of any economy and society. Moreover, global transport, across all modes, has a direct impact on the quality of life of people and their traveling. For this reason, not only ensuring but enhancing safe and secure transport across all modes is paramount. In the first WP3 report, a significant number of technologies, methodologies and approaches with capabilities to improve transport safety and security across all modes and domains were identified and categorized in a number of areas and concepts. In this second report, the results of multiple rounds of stakeholders' consultations on these technologies and approaches are summarized, resulting in a list of topics with the highest cross-modal potential to address the challenges in transport safety and security challenges. The topics are predominantly from the infrastructure and technology domains, with significant influences from the governance and user perspective.

Stakeholder consultations were performed in three different stages. Firstly, an online survey with 4-6 key questions relating to each WP was developed and sent to more than 300 stakeholders to collect data on how safety and security are achieved across different transport modes and domains, as well as to gather first views on potential cross-modal cooperation. A total of 83 stakeholders from different countries and transport modes completed the questionnaire.
Then a workshop was held in Brussels, Belgium in January 2016 to present the first identified technologies, methodologies and approaches and gather feedback on potential barriers and opportunities related to their transferability across different transport modes. Approximately 20 external stakeholders were present at the workshop, covering all transport modes as well as various roles within the industry, R&D community, etc. Posters were used to present the information in a simple and efficient format. Stakeholders also provided further input in the form of unidentified technologies/methodologies/approaches with cross-modal potential. The feedback was used to perform a first selection of the most promising topics that was further consolidated with a scoring system commonly developed in the project.
The second stage consisted of a round of stakeholder interviews with safety and security experts from different countries, transport modes and domains and types of organisations. Interviews were held either by phone, email or face-to-face and comprised a range of questions, including a prioritization of the safety and security topics, as well as implementation issues, research gaps and cross-modal opportunities. For the safety aspects of the work package, 39 expert interviews were conducted, while for the security aspects 19 experts were interviewed. Following the interviews, the list of safety and security topics was revised and streamlined one more time.
The third stage of consultations consisted of a second workshop held again in Brussels, Belgium in September 2016, in which the current results and findings were presented in the form of posters and

handouts. The workshop focused only on the streamlined list of safety and security topics and more specifically on identifying the steps to implementation and the research gaps in addressing the identified cross-modal challenges. The stakeholders' feedback was once again incorporated into the current work, yielding the final list of cross-modal challenges related to safety and security.
The safety related cross-modal challenges are:

1. Availability and sharing of high-quality data across transport modes
2. Human factors and safety education
3. Driver state monitoring
4. Automation in the context of multimodal transport
5. Interaction between transport modes in a safe and efficient manner
6. Improving safety performance at national levels

And the identified topics for addressing these challenges:

- Data sharing
- Education and human factors
- Safety management strategies
- Driver state monitoring
- Cross-modal V2V communication
- Automation

The security related cross-modal challenges are:

1. Cybersecurity
2. Ensuring security in transit environments while maintaining privacy demands of passengers
3. Crime prevention through environmental design
4. Remote detection of explosives and other materials

And the identified topics for addressing these challenges are:

- Cyber security
- Security by design
- Security in transit environments
- Remote detection of explosives and other materials

The topics are described in detail in this report, with focus on identifying the benefits and challenges of their cross-modal implementation. Moreover, the steps necessary to implementation as well as an implementation time scale are provided.
The research topics covering at least two modes, combined with outputs from the other work packages will serve as input to the roadmap for the implementation of the FORx4 initiative. This will represent an investment strategy for key infrastructure funders including European, national and regional public bodies and private infrastructure investors, to be used in specific developments.

1 Introduction

Users, Safety, Security and Energy in Transport Infrastructure (USE-iT) is a Horizon 2020 Coordination and Support Action (CSA) project with a duration of two years, coordinated by the Forum of European Highway Research Laboratories (FEHRL). The project addresses MG. 8.2-2014 next generation transport infrastructure: resource efficiency, smarter and safer from the Horizon 2020 Work Programme 2014-2015 in the field of smart, green and integrated transport. In parallel with USE-iT, the Forever Open Infrastructure Across all Transport Modes (FOX) project supports many of the same objectives and there are significant synergies, not least in generating significant stakeholder involvement from infrastructure owners and operators across the EU and beyond.

Both projects are expected to contribute to FEHRL's FORx4 (Forever Open Road, Rail, River and Runway) initiative which aims to develop a common European transport infrastructure promoting mode neutral transport [1].

USE-iT builds on the FORx4 methodology in which the four transport modes (road, rail, water and air) were merged with the four shared domains (infrastructure, technology, governance and customer) to form a holistic transport system for the future. The methodology is shown graphically in Figure 1 and the domains are explained in detail in Table 1.

Figure 1 FORx4 programme [1]

Table 1 Descriptions of the domains

Domains	Description
Infrastructure	The transport network formed from Europe's routes and interchanges, which includes the changes required in construction and maintenance, and the specifications used.
Technology	The information, communications, sensor and power systems that will support the future transport network.
Governance	The management, operations, investment and appraisal of the network.
Customer	The understanding of a customer's motivation for travelling and choice of mode in order to implement policy interventions to support political objectives.

USE-iT examines common challenges across these domains and modes, identifying potential areas for transferring good practice and potential future areas for collaborative research. Moreover, the objective of USE-iT is to better understand the common challenges experienced across transport modes, bring representatives of transport modes together to share experience and skills and to develop a set of common research objectives.
The project will draw upon the experience gained from the Joint European Transport platform with the focus on infrastructure operations, and will also focus on research objectives presented in the Forever Open Road programme and the work of the FORx4 - Forever Open Road, Railway, Runway and River – A Cross-modal transport initiative for research initiated by FEHRL (Forum of European Highways Research Laboratories).

1.1 Objectives

USE-iT examines common challenges across the FORx4 domains and modes, identifying potential areas for transferring good practice and potential future areas for collaborative research. The specific objectives are to:

- Understand the state of the art in three technical areas: user information; safety and security; energy and carbon; across all four modes.
- Determine opportunities for the transfer of knowledge and working practices across modes
- Develop common future research objectives covering at least two modes
- Bring together infrastructure owners, operators and other stakeholders from across the transport modes to facilitate knowledge transfer and develop a network for future co-operation
- Develop a Roadmap describing the research challenges and implementation steps to achieve greater cooperation and co-modal operations in the areas covered by the project

1.2 Report structure

This report is the second deliverable of WP3 and identifies the top cross-modal research challenges and opportunities related to transport safety and security. The structure of the report is as follows: chapter 2 presents the work-related methodology and consists of the description of the three stages of stakeholders' consultations in the form of questionnaires, workshops and interviews. Chapter 3 describes the list of safety topics with the highest cross-modal potential, as yielded by the stakeholders' consultations, while Chapter 4 describes the security topics also returned by the stakeholders' consultations. Chapter 5 concludes the report with a summary, some final considerations and next steps to be taken in this work package. Apendices A to D contain the detailed results of all stakeholders' consultations in the form of interviews', workshops' and survey's summaries and analyses, along with the materials utilised for performing the respective consultations.

2 Methodology

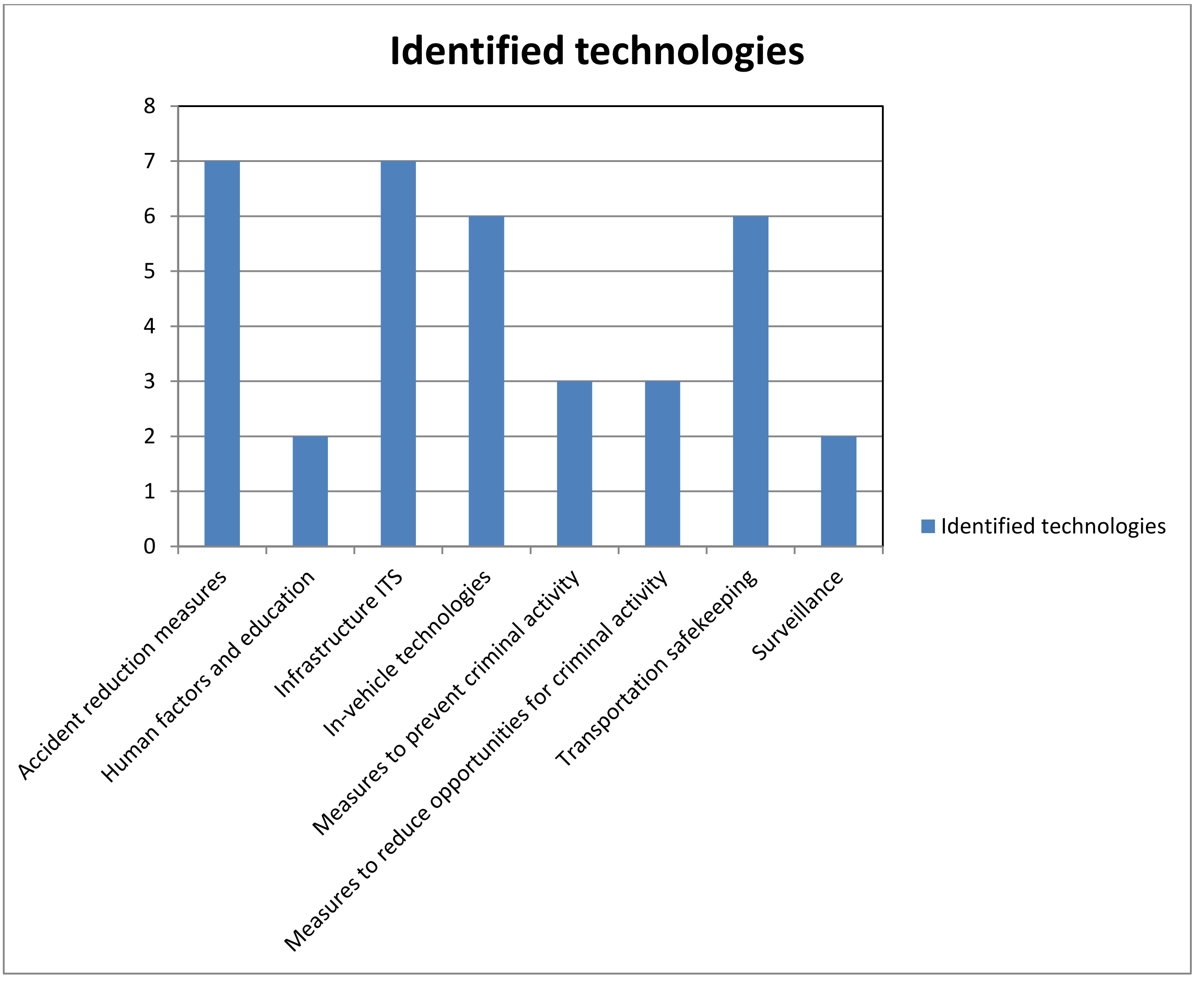
2.1 List of technologies

In Task 3.1 a preliminary investigation was performed to identify best practice approaches, technologies and methodologies that have the potential to cross over from one transport mode to another. A total of 39 technologies and approaches with capabilities to improve transport safety and security were identified through a literature review and categorized in four broad areas:

- Safety of people and safety of goods
- Security of people and security of goods

These were further split into different concepts as shown in Table 2.

Table 2 USE-iT WP3 Technologies by concept



The first WP3 report provides a summary of the technologies identified, together with an analysis of their barriers, opportunities, maturity and transferability to other modes. For more details, please see Deliverable 3.1 [2].

2.2 1st Stakeholder perspective

Task 3.2 built on the information gathered in this preliminary investigation, by assembling information and viewpoints from a wide range of industry stakeholders, consultants and researchers. Stakeholder input was sought jointly for the USE-iT and FOX projects through:

- a joint USE-iT/FOX questionnaire and
- a joint stakeholder workshop

2.2.1 Questionnaire

A questionnaire was sent out to the USE-iT/FOX database of contacts (i.e. SRG – Stakeholder Reference Group) on 28th November 2015 to obtain information and data regarding the transferability of technologies and best practices across all transport modes. More than 300 stakeholders were contacted. The online questionnaire consisted of several introductory questions as well as 4-6 key questions relating to each WP.

A total of 83 stakeholders from different countries and transport modes completed the questionnaire. Appendix A contains the full list of questions as well as a detailed analysis of the results. The key findings of the questionnaire were the following:

- Overall, technology was assessed as having the highest potential to increase safety and security across all transport modes, with 26.5% of respondents stating that they employ technologies, methodologies or approaches that ensure safety and that those could be applied to multiple transport modes. Examples included safety management systems, air safety rules, risk management approaches, automatic control, video cameras and speed radars.
- Nevertheless, approximately 25% of the respondents stated that the safety related technologies, methodologies or approaches that they employ could not be applied to other modes, while 23% stated that they did not know.
- Similarly, 26.5% of the respondents stated that they employ technologies or methodologies that ensure security and that could be applied to multiple transport modes. Examples included security screening technology and procedures, risk models and mitigation measures, Passenger Name Record (PNR), etc.
- While 10.8% stated that they did not believe that the security technologies or approaches that they employ could be applied to other transport modes, almost 34% stated that they did not know.
- Finally, when asked whether their organization employs any cross-modal activities to ensure safety and security, 42% stated that they did not know.

2.2.2 1st Stakeholder Workshop

On 21st January 2016, in Brussels Belgium, the first USE-iT/FOX Stakeholder Workshop was held to present the preliminary findings related to the 39 identified technologies, methodologies and approaches. Posters were used to present the information, in a single, simple and efficient format. The posters are available at http://www.useitandfoxprojects.eu/, as well as in Appendix B.

The questions discussed at the 1st Stakeholder Workshop were:

- Do you agree with the concepts and technologies we have put forward?
- What are the barriers and opportunities for implementing a certain technology/approach from one mode to another?
- What other technologies/methods could we include in our assessment?

Approximately 20 external stakeholders covering all transport modes, were present at the workshop from industry, R&D community, government, etc. The format of the workshop was developed on the principle of "world café". After initial presentations regarding the two projects and the workshop's objectives, stakeholders were divided into five groups of 4-6 persons each and rotated around each "café table" relating to the different work packages. Each group spent approximately 30 minutes at each table, before moving on to the next one, visiting five tables out of a total of six. Each "café" had a facilitator and a rapporteur to direct and record the most relevant points of the discussions.
Each work package facilitated the discussion by producing posters which displayed the most relevant methodologies/approaches/technologies. USE-iT WP3 produced 4 posters – two for safety and two for security. Each poster covered two concepts and described, in the form of small boxes, the identified technologies/methods/approaches, as well as their main barriers and opportunities for them being applied cross-modally. Each box was colour coded and indicated the domain to which it pertained, while the attached icons indicated the transport mode from which the specific technology/approach came from and to what modes it could be applied.
The posters were presented and described in detail by the facilitator and after an independent perusal by the stakeholders, a discussion was initiated. The posters and the summary of the workshop results are provided in Appendix B.

2.3 2nd Stakeholder perspective

Following the workshop, a selected list of technologies/methodologies and approaches were chosen as having cross-modal potential to increase safety and security in all transport modes. This list of overall topics was then subjected to further rounds of feedback, through discussions, face to face meetings and telephone interviews, to yield a short list of multi-modal research opportunities.

2.3.1 Initial prioritisation and scoring

Based on the results of the workshop and the feedback from the stakeholders, the list of 39 topics was downsized to a list of selected topics that were considered to have the most cross-modal potential. This process resulted in 9 topics for Safety and 10 topics for Security.

The selected topics for Safety were:

<u>Accident reduction measures</u>

a) Data sharing – A Safety data pool, focusing on cross-modal sharing of data between agencies, authorities, etc.
b) Vision Zero and Safe System Approach
c) Setting safety targets – safety management strategies at regional/national level to improve safety performance

Safety education and training

a) Updating license acquiring processes including regular training in simulators (e.g. taking best practices from pilot training and applying them to car drivers, once automation is here)
b) Education for safety – specific trainings for critical and dynamic situations

Infrastructure ITS (Intelligent Transport Systems)

a) V2V and V2I communication – Cross-modal communication (i.e. V2V - Train2Car communication at level crossings)

In-vehicle technologies

a) Driver state monitoring: Alcohol interlock
b) Driver state monitoring: Fatigue warning
c) Automation in transport (e.g. truck/freight platooning, for maintenance work, etc.)

The selected topics for Security were:

Measures to prevent and reduce criminal activity

a) Cyber security
b) Aviation security technologies and practices
c) Security in transit environments
d) Security in design

Transportation safekeeping

a) Security of railways against electromagnetic attacks
b) Remote detection of explosives
c) Operational system for monitoring the transportation of dangerous goods
d) Technology and measures for blast resistant and fire safe metro vehicles

Surveillance

a) Security of railway transport
b) Total airport security system

In order to further consolidate the topics with the most potential in a consistent and transparent manner, a system for scoring the technologies under different criteria was developed in the project and was commonly used across the work packages. The criteria used were:

A. Potential to increase safety and security

Criterion A is a high level assessment of the potential of a technology/approach increase safety or security. This addresses the main objective of the work package and therefore has been giving a ×2 weighting. This is a qualitative assessment by the assessor based on their view of the ability of a technology or approach to enhance safety or security, assuming it has been implemented successfully.

B. Transferability and potential for widespread use

Criterion B is an assessment of the potential for transferability of a technology/approach across modes and for its widespread use across different transport systems. In addition to transferability across modes, it includes consideration of factors such as geographic or other limits e.g. technologies to increase safety or security can only be installed in specific vehicles or some methodologies can only be employed on certain types of transport users.

C. Efficiency

Criterion C is a high level, qualitative assessment of the potential efficiency of a technology/approach in terms of the resources invested compared to the amount of e.g. saved lives or reduced accidents/critical events. This should involve whole-life cycle approach; for example, the initial effort to implement a technology/methodology/approach may be high, but the potential long term benefits may outweigh this.

D. Ease of implementation

Criterion D is an assessment of the ease of implementation for a technology/methodology/approach in terms of barriers and enablers. Examples of potential barriers include conflicting legislation and user acceptance. Enablers could be supportive legislation or targets, and existing funds or organisations to support implementation. If there are both barriers and enablers - the overall balance should be used.

E. Co-benefits or dis-benefits

Criterion E is an assessment of the additional benefits or dis-benefits over the long-term associated with a technology/approach/methodology. This includes the impact on environmental factors such as noise, air quality or biodiversity, and social factors such safety, security and impact on local communities. If there are both benefits and dis-benefits - the overall balance should be used.

Guidelines for scoring each criterion are given in Table 3.

Table 3 Scoring guidelines

Scoring Criteria	1	2	3	4	5
A. Potential to increase safety and security	Negligible impact foreseen	Low potential	Medium potential	High potential	Very high potential
B. Transferability and potential for widespread use	Not transferable or very niche	Low transferability	Medium transferability	High transferability	Very high transferability and potential for widespread use
C. Efficiency	High effort/investment for little benefit	Low efficiency	Medium efficiency	High efficiency	Very high cost efficiency – very large benefit for little effort/investment

Scoring Criteria	-2	-1	0	1	2
D. Ease of implementation	Significant barriers to implementation	Barriers identified that could impact implementation	Neutral – No barriers or enablers/ Balance between barriers and enablers	Enablers identified that could improve ease of implementation	Significant enablers to implementation
E. Co-benefits or dis-benefits	Significant dis-benefits identified	Some dis-benefits identified	Neutral – No co-benefits or dis-benefits/ positive and negative impacts balance	Some co-benefits identified	Significant co-benefits identified

The topics were assessed by three safety experts and three security experts respectively. Table 4 shows the top 9 topics of safety, with their average score, as well as with the average score for each of the criteria. Similarly, Table 5 shows the top 10 topics of security. As it can be observed, the top 3 topics for safety were “Data sharing”, “Alcohol interlock” and “Fatigue warning”, while the most popular topic for security was “Cybersecurity” with the next seven topics being ranked equally. Please note once again that the first criterion, i.e. Potential to increase safety/security, was given a x2 weighting in the final calculation.

It must be mentioned that this was a qualitative assessment. Nevertheless, the outcomes of the scoring task were helpful to further generate detailed discussions with individual stakeholders.

Table 4 Scoring of Safety topics

Technology/measure/approach	Domains	Transport mode in which it exists	Transport mode in which it could be applied	Potential to increase safety/security average	Transferability and potential for widespread use average	Efficiency average	Ease of implementation average	Co-benefits or dis-benefits average	AVERAGE SCORE
Accident reduction measures									
Vision Zero	Governance	Road	Air, Rail, Water	5	4	1	-1	0	14
Data sharing	Governance	Air	Water, Road, Rail	4	4	2	1	2	17
Implementation of safety management strategies	Governance	Road	Water	3	3	2	1	1	13
Safety education and training									
Education for transport safety	Governance, User	Water	Air, Road, Rail	4	4	2	0	1	15
Updating license acquiring process	Governance	Air	Road	4	4	1	1	1	15
Infrastructure ITS									
Using V2V and V2I communication	Technology, Infrastructure	Road	Rail	4	3	2	-1	1	13
In-vehicle technologies									
Alcohol interlock	Technology	Road	Water	5	3	3	0	2	18
Fatigue warning	Technology	Rail	Road	4	3	3	1	1	16
Automation in transport	Technology	Road	Water	3	4	3	0	1	14

Table 5 Scoring of Security topics

Technology/measure/approach	Domains	Transport mode in which it exists	Transport mode in which it could be	Potential to increase safety/security average	Transferability and potential for widespread use average	Efficiency average	Ease of implementation average	Co-benefits or dis-benefits average	AVERAGE SCORE
Measures to prevent and reduce criminal activitiy									
Cyber security	Infrastructure, Technology	Air, Rail, Water	Road	5	4	4	1	2	21
Aviation security technologies and practices	Governance	Air	Rail, Road, Water	5	4	5	-1	2	20
Security in transit environments	Technology & Infrastructure	Rail, Road, Water	Air	5	4	3	1	2	20
Security in design	Infrastructure	Road	Air, Rail	5	4	3	1	2	20
Transportation safekeeping									
Security of railways against electromagnetic attacks	Technology	Rail	Air, Road, Water	5	4	3	1	2	20
Remote detection of explosives	Technology	Road	Water	5	4	4	1	1	20
Operational system for monitoring the transportation of dangerous goods	Technology	Rail	Air, Road, Water	4	4	3	-1	1	15
Technology & measures for blast resistant and fire safe metro vehicles	Technology & Governance	Rail	Air, Road, Water	3	4	3	0	1	14
Surveillance									
Security of railway transport	Technology	Rail	Air, Road, Water	5	4	5	-1	2	20
Total Airport Security System	Technology	Air	Rail, Road, Water	5	4	5	-1	2	20

2.3.2 Interviews to understand stakeholder priorities

The next step in WP3 was to perform further consultations with stakeholders in order to streamline and define the topics with the most cross-modal potential to increase both safety and security. Each partner working in this work package identified a list of stakeholders, from different countries, transport modes and types of organisations with expertise in safety and security. Interviews were held either by phone, email or face-to-face and included a range of questions, including a prioritization of the safety and security topics, as well as implementation issues, research gaps and cross-modal opportunities.

For the safety aspects of the work package, 39 expert interviews were conducted. Table 6 and Table 7 show a more detailed description of these considerations.

Table 6 USE-iT WP3 Interviewed safety-related stakeholders per transport mode

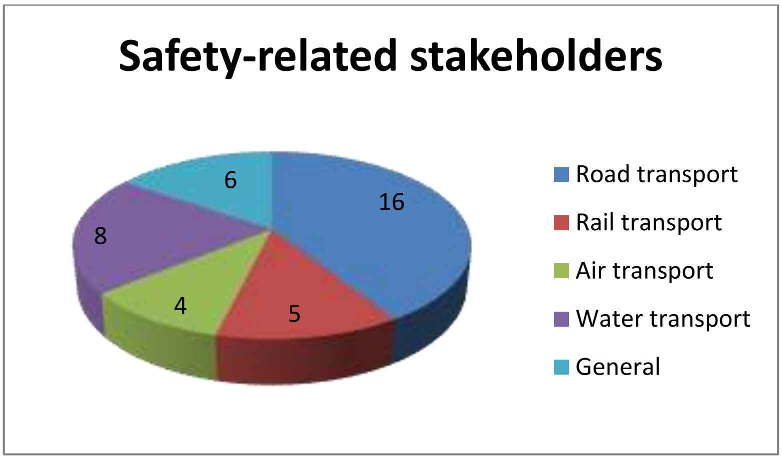
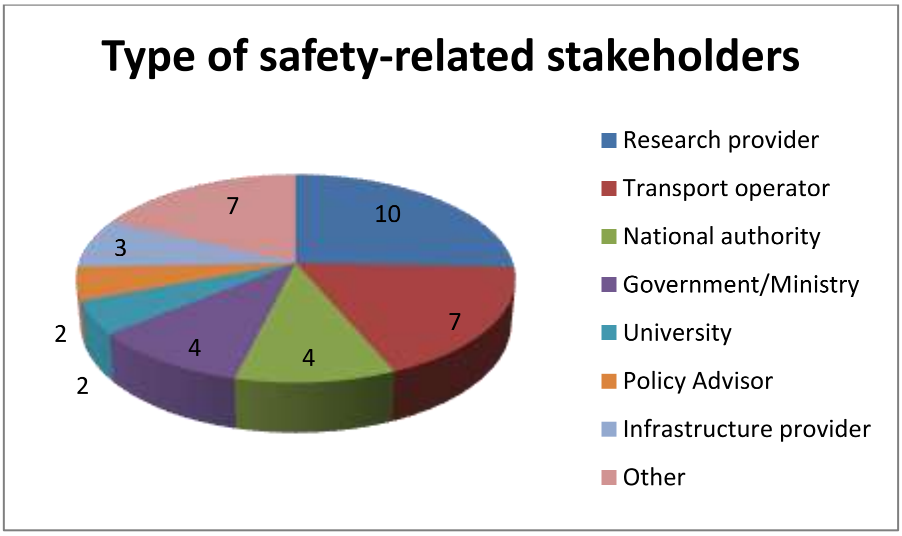


Table 7 USE-iT WP3 Interviewed safety-related stakeholders per expertise/background



For the security aspects of the work package, 12 face-to-face interviews were conducted. Additional input from 7 stakeholders was collected from a technical meeting (i.e. HLEG “Airports of the future”). Table 8 and Table 9 show a more detailed description of these considerations.

Table 8 USE-iT WP3 Interviewed security-related stakeholders per transport mode

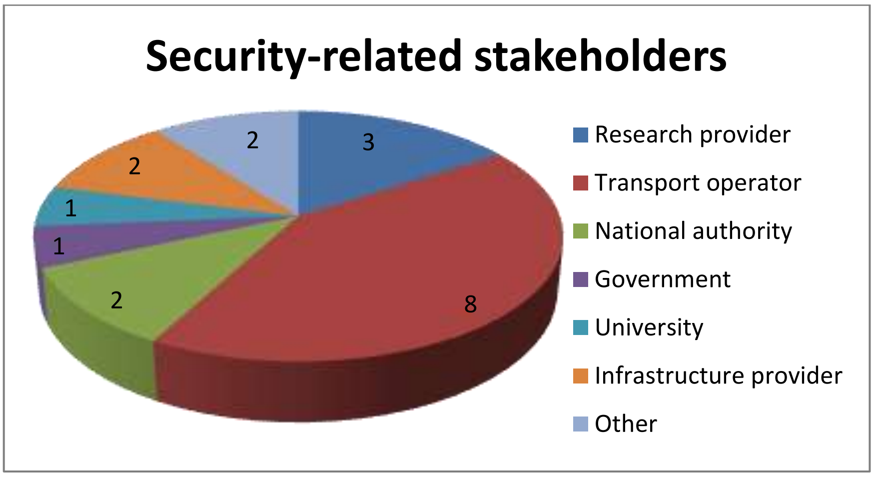


Table 9 USE-iT WP3 Interviewed security-related stakeholders per expertise/background

Appendix C provides a detailed summary of the interviews – for safety and security.

The interviews gave further insight into the safety and security topics identified thus far and helped select the most promising ones, in terms of cross-modal research opportunities.

2.4 3rd Stakeholder perspective

On 15th September 2016, in Brussels, the second USE-iT/FOX Stakeholder Workshop was held to present the current results and findings of the projects. Posters and handouts were used to present the information, in a simple and efficient format. The main questions discussed were:

1. What needs to happen for the identified technologies/approaches to be implemented?

2. What are the gaps in knowledge?
3. How can different transport modes work together?
4. What are the common research topics for more than 2 transport modes?

Internal and external stakeholders were present at the workshop covering all transport modes. The format of the workshop allowed for a more dedicated set of sessions, in which the stakeholders could choose based on their expertise and interest, to which work package and thus, topic of interest, they wish to attend. There were two sets of sessions, each lasting 90 minutes. Each session had a facilitator and a rapporteur to direct and record the most relevant points of the discussions.
The introduction to the specific topic of safety & security and the working procedure within USE-iT was presented in the plenary session. The workshop itself was split into two sessions, the first for safety and the second for security, in order to leave more time for detailed discussions. The sessions were aided by three posters and one handout. The handout, containing an introduction into the topics, was sent to the participants two weeks before the workshop.
After a discussion of main cross-modal challenges in safety and security and an exercise of funding allocations (i.e. investing virtual money on the specific safety and security topics), the implementations issues of the top points, including gaps and research opportunities, were openly discussed. The posters, handout and a summary of the workshop results are presented in Appendix D.

3 Common safety research challenges and opportunities

The three stages of stakeholder consultations yielded a final list of cross-modal challenges and the research topics with the highest potential to address them. The topics are predominantly from the technology and infrastructure domains; nevertheless user and governance considerations can be found within each topic.
The topics are described in terms of:

- **Benefits** for cross-modal implementation – a description of the benefits that would arise as a result of the implementation of the specific technology / method / approach across transport modes
- **Challenges** for cross-modal implementation – a description of the challenges that would need to be overcome in order for the specific technology / method / approach to be implemented across transport modes
- **Steps to** implementation – the necessary actions that need to taken to reach implementation into a specific transport mode
- Implementation **time-scale** – an estimated time period that would pass until full implementation would be reached, namely: urgent (1 year), short-term (2-5 years), mid-term (5-10 years), long-term (10-20 years)

3.1 Challenge 1 – Availability and sharing of high-quality data across transport modes

Currently, there is a lack of in-depth cooperation between agencies and authorities of different transport modes. As mobility becomes more and more cross-modal, a database with highly detailed information across all transport modes (e.g. incident data, fatalities data) could have potential to increase safety.
This is especially relevant for locations and subsystems where more than one transport mode converge, such as railway level crossings for example. In these cases, safety improvements may be reached if a system's approach – encompassing both modes – is applied. Common data formats and protocols should be developed and agreed upon.

Figure 2 Data sharing [3]

<u>Benefits for cross-modal implementation</u>

- Possibility of cross-modal assessments of potential risks and criticalities
- Development of models/simulation models based on these types of data
- Support in crisis management
- Stronger cooperation between authorities across transport modes
- Fostering a safe system approach for intermodal crossing spots and subsystems
- Faster and stronger reaction time to a cross-modal incident through better cooperation and notification of authorities
- Cross-modal analyses and views on critical infrastructures
- Improvement of traffic management across modes
- Support for more efficient, interlinked/routing – development of multi-modal applications

Challenges for cross-modal implementation

- Difficulty to combine different types of data from multiple modes of transport – a common data format would need to be developed
- More focus should be on data quality rather than on the quantity of the data; input data from sensors need to be 'fit for purpose' to be able to be used in an optimum manner;
- Difficulty to ensure data privacy, data sharing and data security
- Requirement for regular updates of databases, translating into significant amounts of administrative work for maintenance purposes
- Requirements for strict regulation on data ownership, main body of responsibility, main contact for access
- Need for establishing liability rules and data ownership
- High risk for data manipulation, cyber attacks, malfunctions

Steps to implementation

- ✓ Development of a common agreement between different interacting transport modes on the methodology, format, type, usability of data
- ✓ Definition of the data needs, use cases, etc.
- ✓ Agreement on a standardised data format, the frequency of data exchange, data exports/imports and regular updates
- ✓ Development of a common interface and procedure for the data collection and data management procedure
- ✓ Agreement on the main responsible body for data collection, database maintenance, etc.

Implementation timescale

- ❖ Short-term (2-5 years).

3.2 Challenge 2 – Improving safety performance at national levels

Setting safety targets at regional/national level is a method that has been proven to increase road safety performance.
A similar methodology could be applied to, for example, waterborne transport, where according to ETSC (European Transport Safety Council), there are no general safety related strategies. A safety management system could also enable data collection, which would help establish a "transport safety observatory".

Figure 3 Safety management strategies [4]

Benefits for cross-modal implementation

- Support in setting a timeframe for specific measures and solutions to decrease fatalities and severity rates
- Possibility of combining safety targets with economic and environmental milestones to achieve secondary benefits
- Inclusion of new paradigms such as the Safe System Approach in order to incorporate all causing circumstances

- Contribution to societal needs and challenges towards a more safety-oriented culture
- Implementation of motivation actions, in the form of specific incentives that would support new safety strategies

<u>Challenges for cross-modal implementation</u>

- Financial limitations and barriers to resources
- Strategy should be harmonized and should help in daily work (strategy shouldn't be an obstacle). The main challenge is institutional cooperation between the transport modes; there is only theoretical cooperation between the transport modes. Everyone works decentralized with their own interests and don't want to cooperate
- Need for clear policy for implementation, monitorisation, management, enforcement, penalisation, keeping track of the advancement of a measure
- Need for regular updating and reshaping to keep up with latest developments
- Need for keeping in the same line with European and global strategies for safety management

<u>Steps to implementation</u>

- ✓ Development and evaluation of the new strategy concepts
- ✓ Checking if the concepts are in line with European and global strategies
- ✓ Development of specific milestones and aims – which are measurable and can be evaluated or validated
- ✓ Publication in different styles (e.g. factsheet, smartphone application, website) and promotion across different media channels (e.g. TV, email, social media groups)
- ✓ Development of a plan for updating, evaluating and monitoring the strategy and its milestones
- ✓ Development of a tool kit for proper implementation and application (e.g. enforcements, fundings, incentives)

<u>Implementation timescale:</u>

- ❖ short-term (2-5 years).

3.3 Challenge 3 – Safety education and human factors

Human error represents the primary cause for accidents. Increasing safety through education has a very high potential. "Drivers" in air, water and rail transport modes are professionally trained, while the training of road drivers cannot be considered so.

Figure 4 Education and human factors [5]

However, with the coming and implementation of various in-vehicle systems and moreover vehicle automation, the process of acquiring a driver's license should be updated (e.g. the handover process from the vehicle to the driver, especially in a critical situation should be included in the training). Regular trainings in vehicle (i.e. train, air, vessel, car) simulators could help improve driver skills to the required level.

Benefits for cross-modal implementation

- Ensuring optimum and safe change in all transport modes due to new developments, while increasing acceptance and usability
- Decrease in malfunctions, errors and risks caused by human errors
- Upgrade in on-going education procedures (e.g. new driving licence acquiring process, early age education, elders' education)
- Contribution to a more safety-oriented culture
- Optimisation of modal split due to behavioural changes

Challenges for cross-modal implementation:

- Limited time and financial resources
- Trainings in simulators should be mandatory and regulated; however, the infrastructure to deliver simulator training is expensive and resource intensive
- Establishing the chain of resources and benefits, as well as the involved entities and their roles (e.g. who pays and who benefits)
- Difficulty in reaching specific users of various age groups
- Keeping up with new media and new ways to educate (e.g. online certificates vs. real simulations, etc.)
- Establishing frequency and update schedule of education plans and activities
- Inclusion of psychological aspects in the human factors and education procedures (e.g. inclusion of symptoms such as burn-out syndrome, stress-related risks; high risk takers)
- Taking into account new vehicle technologies and developments (e.g. HMI)

Steps to implementation

- ✓ Development and evaluation of the proposed education and training methods or procedures
- ✓ Checking if the concepts are in line with European and global wide curricula for training and education courses
- ✓ Development of specific milestones and aims – which are measurable and can be evaluated or validated
- ✓ Development of common standards and agreements
- ✓ Agreement on common certificates of accomplishment, recognised bodies that can issue them, availability period, geographic extent (national or European)
- ✓ Development and publication of relevant materials in different styles (e.g. factsheet, smartphone application, website) and promotion across different media (e.g. TV, email, social media groups)
- ✓ Development of a tool kit for proper implementation and application (e.g. enforcements, fundings, incentives)
- ✓ Development of a plan for updating, evaluating and monitoring training procedures

Implementation timescale

- ❖ short-term (2-5 years).

3.4 Challenge 4 – Driver state monitoring

Human error represents the primary cause for accidents in transport. Therefore the evaluation of drivers' fitness, combined with appropriate mitigation measures could increase safety, e.g. monitoring the driver's state through systems such as alcohol interlock and fatigue warning. It was found that alcohol and drug use is an increasing cause of maritime accidents.

Currently, Alcohol interlock can be used to prevent unfit road drivers from starting their cars. A similar system could be implemented in maritime transport.

Figure 5 Driver state monitoring [6]

Fatigue warning systems can control the vigilance of a driver and demand feedback at certain intervals. This system, researched for rail transport, could be applied to other modes such as road and water.

<u>Benefits for cross-modal implementation</u>

- Increasing safety and decreasing the risk of human error, leading to a reduction in the number of fatalities and severity rates
- Increasing awareness and decreasing reaction time, while tackling the effects of fatigue
- Improving overall vehicle safety performance
- Improvement of traffic management across modes
- Contribution to a more safety-oriented culture

<u>Challenges for cross-modal implementation</u>

- Limited financial resources for implementation
- Not all driver monitoring systems are proven to decrease number of incidents; so more research on this subject is needed
- Need of research and new knowledge on road user behavior, user adaptation to new technologies/measures
- Low user acceptance in all transport modes
  - In rail transport, safety levels are already quite high, therefore investment interest is quite low
  - In air transport, the level of complexity in aircrafts is already high; implementing such a system would be a challenge
  - Vehicle manufacturers are customer-focused and therefore a system which is not popular with drivers is not seen as an economic-beneficial investment
- Need for technical and procedural clarifications towards implementation
- Need for investigation of legal prerequisites related to implementation
- Need for business models

<u>Steps to implementation</u>

- ✓ Definition of system technical requirements and specific needs for each transport mode

- ✓ Definition of system implementation regulations (e.g. optional vs. mandatory, enforcement vs. recommendation)
- ✓ System development with transport mode-specific technical adaptations
- ✓ Definition of an integration procedure into existing in-vehicle operating systems
- ✓ Testing phase of system
- ✓ Rollout of the system
- ✓ Training of system users

<u>Implementation timescale</u>

- ❖ mid-term (5-10 years).

3.5 Challenge 5 – Cross-modal interaction in a safe and efficient manner: Cross-modal V2V communication

Cooperative traffic systems share information using Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) communications. In so doing, the systems can give advice or take actions with the objective of improving safety, while also contributing to transport sustainability and efficiency.

One potential application would be a cross-modal communication between vehicles – cars and trains, especially at level crossings. The vehicle could not only receive warnings about a train passing, but could also automatically brake before a level crossing, with the help of in-vehicle systems present at various levels of vehicle automation.

Figure 6 Cross-modal V2V communication [7]

<u>Benefits for cross-modal implementation</u>

- Increasing safety and decreasing the number of incidents occurring at road-rail level crossings
- Decreasing the risk of human error, leading to an overall reduction in the number of fatalities and severity rates
- Improvement of vehicle safety performance, facilitating the application of the safe systems approach to crossing nodes
- Improvement of traffic management across two transport modes
- Contribution to a more safety-oriented culture
- Contribution to economic and environmental milestones to achieve secondary benefits

<u>Challenges for cross-modal implementation</u>

- Limited financial resources for research, testing and implementation
- Need for more research to link communication channels across 2 transport modes, not only in terms of infrastructure but also in terms of vehicles communication
- Need for technical and procedural clarifications towards implementation

- Need for investigation of legal prerequisites and definition of standards related to implementation of a cross-modal system
- Need of research and new knowledge on road user behavior, user adaptation to new technologies/measures

Steps to implementation

- ✓ Definition of system technical requirements and specific needs for each transport mode as well as for establishing compatibility between the two transport modes
- ✓ Definition of system implementation specifications (e.g. data format, communication channels and compatibility between modes, etc.)
- ✓ Development of regulatory aspects regarding data protocols, data privacy and liability
- ✓ System development with mode-specific technical adaptations
- ✓ Definition of an integration procedure into existing in-vehicle operating systems
- ✓ Testing phase of system
- ✓ Rollout of the system
- ✓ Training of system users

Implementation timescale

- ❖ Long term (10-20 years).

3.6 Challenge 6 – Automation in the context of multimodal transport

Automation in transport has a high potential to primarily increase safety, but also influence efficiency, travel time, etc.

Automation in road transport is still under development at various levels (e.g. fully autonomous vehicles are still in the future); nevertheless, best practices can be applied and taken from other modes.

For example, work areas are still a cause for many accidents and automation could bring benefits not only in roadworks but also in rail maintenance work.

Figure 7 Automation [8]

Benefits for cross-modal implementation

- Increasing safety, by minimising or eliminating the human error factor involvement, leading to a reduction in the number of fatalities and severity rates
- Reduction of driver stress and workload and driver costs
- Provision of self-car mobility for non-drivers
- Improvement of overall transport safety performance by becoming more technologically secured
- Improvement of traffic management across modes, increased capacity and efficiency and reduced costs
- Contribution to a more safety-oriented culture

- High potential to learn and exchange ideas between less and more automated transport modes (e.g. road and air)

Challenges for cross-modal implementation

- Need for clear business models
- Need for clarification and approval of real-life testing
- There is still a lot of apprehension regarding autonomous driving: even in an autonomous vehicle environment, humans should be ready to take over in critical situations
- Low user acceptance
- Need of research and new knowledge on road user behavior, user adaptation to new technologies/measures
- Need for development of take-over scenarios (i.e. driver – vehicle) in critical situations
- Need for investigation of transport infrastructure requirements
- Regulatory aspects, definition of ownership of data and standards
- Security and data privacy concerns
- Need for a clear definition of responsibility and liability

Steps to implementation

- ✓ Technological research
- ✓ Clarification of testing specifications and regulations
- ✓ Testing and validation of specific key applications within each mode
- ✓ Development of regulatory aspects regarding data privacy and liability
- ✓ System development with mode-specific technical adaptations
- ✓ Definition of integration procedure into existing in-vehicle operating systems
- ✓ Testing phase of particular application
- ✓ Rollout of application
- ✓ Training of application users

Implementation timescale

- ❖ Long term (10-20 years).

4 Common security research challenges and opportunities

The three stages of stakeholder consultations yielded a final list of common challenges and research opportunities as having the highest cross-modal potential for enhancing security. Similarly to the safety topics, they are predominantly from the technology and infrastructure domains, however the governance and user issues are even more relevant for the transport security challenges.
The topics are also described in terms of benefits, challenges and steps to implementation, with an estimative time-scale being provided.

4.1 Challenge 1 – Crime prevention through environmental design

Security by design refers to the structure or its form and to the planning of transport infrastructures and include proven and effective security measures to prevent, mitigate or deter threats.
These measures include the implementation of appropriate physical secure stations/terminals against bomb blast, chemical, biological, radiological and nuclear (CBRN) attacks involving particle dispersion and fire events; security procedures (screening, materials detection, intrusion detection systems, and tracking applications) should be considered at all stages of transport infrastructures development.

Figure 8 Security by design [9]

The containment of building services and power supplies, locating public car parks as far away as possible from station buildings, creating a distinct separation with other "crowded places" are examples of possible secure by design measures.

Benefits for cross-modal implementation

- High relevance for cross-modality since it applies to all transport modes
- Should be applied at an early stage of infrastructure design and development and not be considered as an extra concern that could be later addressed
- Should be applied to obviate high costs on facilities adaptation/renovation
- Design is the initial step of a complex process of providing security, which starts with a concept and finishes with the production of an infrastructure
- Transport system enhancement must be understood globally, from access ports, traffic corridors to existing public furniture and to the visibility to law enforcement authorities

Challenges for cross-modal implementation

- Difficulties to forecast the evolution of security technologies (e.g. new technologies in carry-on luggage inspection lead to longer lines which might not be accommodated in older facilities)
- Existing transport infrastructures are not prepared for the installation of new technologies and need to be adapted (e.g. new x-ray machines that due to its weight cannot be incorporated in most airports)
- Safe areas in passenger traffic are not designed to consider security
- Difficult joint management between the various transport modes; the dialogue between law enforcement authorities, emergency management services and transport operators is critical

Steps to implementation
- ✓ Development of guidelines/strategies
- ✓ Building information modelling and design simulation tools
- ✓ Risk assessment to identify the most important physical and non-physical vulnerabilities
- ✓ Research production regarding best practices and needs for security by design methods for building infrastructure
- ✓ Security by design should be extended to include ICT security by design, e.g. the design of ICT systems where security is embedded [10]; [11]

Implementation timescale
- ❖ Short-term (2-5 years) and mid-term (5-10 years).

4.2 Challenge 2 – Cybersecurity

Figure 9 Cybersecurity [12]

Cybersecurity is the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and user's assets.
Cybersecurity affects surface transportation electronic devices and signalling, transit systems, transport infrastructure, passengers and cargo vehicles. The potential vulnerabilities in transport infrastructure and vehicles need to be mitigated by security protocols and plans ahead of time. It is necessary to understand critical systems, interdependencies and the importance of cyber physical control systems, traffic control and operations management systems, safety management systems, traveller and operator services (112, e-commerce, e-payment).
The creation of a cybersecurity system that incorporates security into the design process, the development of policies and procedures for cybersecurity and the improvement of systems and operations' resilience, would bring benefits and motivate users with training, exercises & "hot triggers".

Benefits for cross-modal implementation
- Cybersecurity is a highly cross-modal topic in its nature
- Improve prevention, detection and fast reaction in the event of cyber-attacks or cyber disruption promoting cyber resilience [10]; [11]
- Implies knowledge transfer frameworks
- Implies regulation of standards
- Adoption of minimum standards of cyber technologies

Challenges for cross-modal implementation
- Difficulties on cyber threat detection (i.e. regarding nature, severity, type of attack)
- Capability of ICT systems being resilient to cyber-attacks

- Ability to operate transportation systems in the case of IT-failure [10]; [11]
- Evolving from an "equipment" oriented approach to a "system" oriented approach including networking of various pieces of equipment which opens new vulnerabilities to cyber-attacks
- Increase social awareness regarding cyber threats as a societal challenge and not an IT one
- Develop appropriate safety measures and seamless cybersecurity applications to transport sensitive data on a local and international scale: BIM data, TMC control of traffic signals, operation of multimodal transport platforms, etc.

<u>Steps to implementation</u>

- ✓ Development of security plans, operation centers and anticipatory cyber security governance models
- ✓ Development of national and international cyber defense
- ✓ Build-up of competences for doing cybersecurity
- ✓ Allocation of responsibilities (legal aspects)
- ✓ Reinforcement of collaboration between stakeholders to establish best tackling procedures (e.g. procedures for exchanging threat information) and regulatory aspects
- ✓ Early detection and rapid response for targeted cyber-attacks
- ✓ More research on cybersecurity (i.e. identify potential threats; protection solutions; assess systems resilience; publish and share mature research results)
- ✓ Provide control and supervision mechanisms for a continuous cyber risk assessment
- ✓ Promote cyber intelligence communities towards a solid level of cyber resilience [13]
- ✓ Harmonize ICT systems between transport modes

<u>Implementation timescale</u>

- ❖ Urgent (1-2 years)

4.3 Challenge 3 – Ensuring security in transit environments while maintaining privacy demands of passengers

Security in transit environments refers to the security of bus stops, stations and interchanges, to the immediate vicinity of transport stops and stations and to the 'en route' travel (on board of different modes). Criminal acts in transit contexts are a result of the environment of the transport node itself (e.g. design of platforms, CCTV, dark corners, bad lighting, hiding places) and the social interaction within those environments (e.g. poor guardianship, crowdedness).

Figure 10 Security in transit environments [14]

A multi- and interdisciplinary approach is required to tackle transit security and demands a more integrated, holistic and cross-disciplinary approach. Also, the identification and assessment of transport infrastructure vulnerabilities regarding man-made threats can contribute to the strengthening of the resilience of the European Transport

Network against various man-made hazards, by providing infrastructure owners and operators with an easy to manage, practice-oriented tool for the assessment of the infrastructure.

Benefits for cross-modal implementation

- Approach is focused on the layout of the transit environment (infrastructure) and on the users of the entire transport system
- Responsibilities for minimizing transit risk can be also examined within this framework, by assigning responsibility to those who police, manage, regulate, design and maintain the transit settings
- Extended security forces intervention and operation
- Common level of security for all modes of transport
- Security in transit settings tries to identify and mitigate security threats

Challenges for cross-modal implementation

- Complexity of the system complicates transit environment analysis (e.g. passenger density, offender proximity and familiarity with a setting/area; guardianship; design and management; user proximity, familiarity and feelings of security; relative position within the network; type of security concern; time of day, day of week and season)
- Transit settings can potentially limit the potential positive influence of capable guardianship, due to issues such as unfamiliarity or poor design
- The dynamic and transient nature of the transportation system and the rapidly changing nature of its use makes it complex to understand
- Interventions directed only at transit nodes have less chance of succeeding in reducing security concerns at transit stations than those which consider the nodes nearby other environments
- Wide range of organizations with responsibilities for the security of the system (e.g. at large multimodal interchanges) adds a multi-ownership and management issues (i.e. who does what in various critical situations)
- Risk assessment through behavior pattern recognition/profiling
- Ensuring security in transit environments while maintaining privacy demands of passengers and avoiding disturbances
- Make sure that all modes have the same information basis

Steps to implementation

- ✓ Analysis of the movement of passengers at the stations to identify the best possible routes of guardians [15]
- ✓ Determine ridership patterns and exposure to potential targets; this changes as a function of the system growth [15]
- ✓ Demand for the cooperation of actors with responsibilities in the transportation system itself and those who deal with security issues in and around transportation nodes
- ✓ Improve the quality of joint collaborative work between actors involved in providing security
- ✓ Develop a consistent and integrated threat detection approach for all modes of transport
- ✓ Improve data sharing between modes and across nations
- ✓ Implement security management systems

Implementation timescale

- ❖ Urgent (1 year), short-term (2-5 years)

4.4 Challenge 4 – Remote detection of explosives and other materials

Recent developments on explosive remote detection are based on advanced optic technology. A laser system can precisely identify the atomic and molecular structure of the explosives and the device can rapidly and remotely scan the steering wheel or the door of a vehicle (also applicable to luggage, opaque container) and pick up trace residue. This technology was identified with potential to be applied to maritime transportation.

Moreover, remote detection of other threats (e.g. radio-active materials) should be taken into account.

Remote detection of radio-active materials is an emergent critical issue since personnel working in airport cargo are exposed to this risky material (no real-time detection).

Figure 11 Remote detection of explosives and other materials [16]

<u>Benefits for cross-modal implementation</u>

- Remote detection of threats is of high relevance for cross-modality
- Highly inclusive across modes of transport since it is a transversal topic
- Capability to detect explosives sensitively, accurately, and rapidly could have great benefit to national and international security
- Rapid detection of materials in a noninvasive way can serve as an indicator for identifying attempts at concealed assembly or transport of explosive materials and devices [17]

<u>Challenges for cross-modal implementation</u>

- Need of urgent reliable and affordable detection technologies that meet the special requirements of land transportation
- Gap between the need to identify threats and the technologies commercially available
- Technologies and measures need to be implemented without passengers disturbances
- Need for high resolution technologies on imaging and profiling
- Applicability for civil aviation requires and depends on reliable detection of small amounts of explosive in a very short time
- Urgent need for real-time detection of radio-active materials (since air mode staff is exposed to these materials)
- The need to be done without disturbing the passengers
- Passenger experience and acceptance are very important (e.g., the concept of Smart Security Solutions)
- New technologies and advances in technology are too expensive and not cost- efficient since input of information to users implies specialized staff
- Lack of control of the objects carried by passengers; lost and found objects are a problem (given the frequency and the amount) and there are no rapid methods of analysis

<u>Steps to implementation</u>

✓ Investment in social aspects since profiling is mainly based on psychical (e.g. race) and demographic characteristics (e.g. education)

- ✓ More reliable knowledge/research production
- ✓ Research should cover multi-risk situations by aiming the combination of detection data (different substances and individual behaviour) and long distance detection
- ✓ False alarms must be reduced to a minimum
- ✓ Increase the use of profiling and digital identification technologies as a mean of threat detection

<u>Implementation timescale</u>

- ❖ Short-term (2-5 years).

5 Conclusions and next steps

5.1 Summary

Transport and mobility represent one of the most important elements of any economy and society. Moreover, global transport, across all modes, has a direct impact on the quality of life of people and their traveling. For this reason, not only ensuring but enhancing safe and secure transport across all modes is paramount.

In the first WP3 report, a significant number of technologies, methodologies and approaches from all considered domains, with capabilities to improve transport safety and security were identified and categorized in areas and concepts. In this second report, the results of multiple rounds of stakeholders' consultations on these technologies and approaches are summarized, resulting in a list of topics to address the cross-modal challenges related to safety and security.

Each identified challenge is addressed with a specific topic. The topics are predominantly from the infrastructure and technology domains; nevertheless, governance as well as user domains are intricately intertwined in all the topics, as regulation and user acceptance are two of the most important factors influencing the implementation of any technology or solution. The topics are described in detail in this report, with emphasis on describing the benefits and challenges of cross-modal implementation. Moreover, steps towards implementation as well as an implementation time scale are provided.

<u>Common challenges</u>

The safety related cross-modal challenges are:

1. *Availability and sharing of high-quality data across transport modes* – The lack of cooperation between relevant transport agencies from all transport modes result often in un-coordinated actions, disparate safety measures that while effective, could be improved . Big data, a database with highly detailed information from all transport modes could have potential to increase safety.

2. *Human factors and safety education* – There is a gap between professional drivers/pilots/captains and private vehicle users, in terms of safety performance, needs and expectations. Unlike drivers in air, water and rail transport, road drivers are not professionaly trained. New technologies such as automation, connectivity and Internet of Things will require an update in education and licensing processes, as to maintain and increase safety in transport.

3. *Improving safety performance at national levels* – Setting safety targets at regional or national level is a proven method to increase road safety performance. A transfer of knowledge to water transport could lead to similar benefits in this transport mode.

4. *Driver state monitoring* – The evaluation of a driver's fitness is a topic which is becoming more and more important in the context of effective mitigation measures for increasing safety. As human error is still the main cause for accidents in transport, in-vehicle monitoring systems are seen as a viable option for decreasing this risk and increasing safety.

5. *Interaction between transport modes in a safe and efficient manner* – Points where different transport modes cross paths and interact are still considered hot spots. One in particular is level crossings, where road and rail mode interact. Cooperative traffic systems can give the option of communication between two vehicles – the train and the car, leading to an increase in safety, by reducing the number of incidents occurring at road-rail level crossings.

6. *Automation in the context of multimodal transport* – A reduction in fatalities and severity rates due to minimising or eliminating the human error factor involvement in the driving process would be a high benefit of automation. In air transport, more procedures are automated and other transport modes could learn and adopt best practices, especially road transport.

The security related cross-modal challenges are:

1. *Cybersecurity* – Cybersecurity affects surface transportation electronic devices and signalling, transit systems, transport infrastructure, passengers and cargo vehicles. The potential vulnerabilities in transport infrastructure and vehicles need to be mitigated by security protocols and plans ahead of time. It is necessary to understand critical systems, interdependencies and the importance of cyber physical control systems, as there is an inadequate increase of security systems against cyber attacks.

2. *Crime prevention through environmental design* – This topic refers to the structure and the planning of transport infrastructures. Existing infrastructure is often not prepared to deal with the installation of new technologies and needs to be adapted to accommodate new security measures that need to be put in place. Moreover, safe areas in passenger traffic are not designed to consider security.

3. *Ensuring security in transit environments while maintaining privacy demands of passengers* – This topic refers to the security of bus stops, stations and interchanges, to the immediate vicinity of transport stops and stations and to the 'en route' travel (on board of different modes). There are a wide range of organisations with responsabilities for the security of large multimodal interchanges; this adds a layer of complexity due to multi-ownership and management issues.

4. *Remote detection of explosives and other materials* – This topic addresses the need for detection of explosives, radio-active materials and other dangerous substances. For example, remote detection of radio-active materials is an emergent critical issue since personnel working in airport cargo areas are exposed to high-risk material. There is a need of reliable and affordable detection technology that meet the specific requirements of transport modes.

Identified opportunities

After an initial list of 40 technologies, methodologies, techniques and approaches with potential to increase safety and security that was identified through literature review and a stakeholder workshop, face-to face interviews with stakeholders, internal rankings and a second workshop facilitated the identification of a total of 10 topics with the highest potential for cross-modal transfer:

Safety

1. *Data sharing* – This concept would give stakeholders and transport agencies the opportunity to increase their cooperation and openness in terms of data, leading to a potential direct communication between all transport modes authorities, especially in crisis management. The benefits would include a faster reaction time to cross-modal incidents, optimised cross-modal traffic management, as well as facilitation of development of multi-modal routing applications. Stakeholders indicated that more focus should be on data quality rather than on quantity. Data protection and privacy are highly relevant issues. Moreover, user-friendly applications facilitate implementation.

2. *Education and human factors* – Upgrading on-going education processes, such as new license acquiring processes would lead to better informed and prepared drivers to new technologies such as automation. Stakeholders indicated that focus should shift to driver trainings, especially for critical and dynamic stations; trainings in simulators should be mandatory and regulated, as to increase the competence of human actors. Nevertheless, the infrastructure to deliver simulator trainings is expensive and resource intensive.

3. *Safety management strategies* – Setting a strategy and a delivery plan with timeframes for specific safety targets increases the chances of successful implementation. Stakeholders indicated that combining safety targets with economic and environmental milestones can help achieve secondary benefits. The main challenge is institutional cooperation; strategy should be harmonised and should help in daily work. Only theoretical cooperation without concrete actions will not lead to improving safety performance.

4. *Driver state monitoring* – Through systems such as alcohol interlock (transferred from road to water transport) or fatigue warning (transferred from rail to road transport), this topic has a high potential for increasing safety. The benefits would include reducing the number of fatalities and severity rates, while also improving the overall vehicle safety performance. Fatigue warning systems could also fit very well with the current regulations on fatigue in air transport. However, stakeholders did indicate low user acceptance as an obstacle for implementation. In rail transport, safety levels are already high, therefore interest in investment is low. In air transport, the level of complexity in aircrafts is also very high; implementing such a system would be a challenge. Moreover, air transport is very cautious in implementing new safety-related systems.

5. *Cross-modal V2V communication* – Vehicle to Vehicle communication (road and rail) could be very useful for level crossings. A warning system that could signal a train approaching could be installed in the car; through automation, the car would automatically brake at level crossings when a train is approaching. Stakeholders indicated that while road and rail transport have different data standards, this type of cross-modal communication could have high benefits for increasing safety.

6. *Automation* – Would have a high potential to increase safety, especially in road transport, which would benefit most from best practices taken from the other modes. Reducing driver stress and workload, providing mobility for young, elderly, impaired people and even taking the driver out of the equation are all benefits of automation. Stakeholders draw attention to regulatory aspects, the need for clear business models, development of take-over scenarios in critical situations and the need for high security and data privacy. There is still a lot of apprehension regarding autonomous driving. User acceptance is paramount.

<u>Security</u>

1. *Cybersecurity* – The creation of a cybersecurity system that incorporates security into the design process, the development of policies and procedures for cybersecurity and the improvement of systems and operations' resilience, would bring benefits. Security issues should be treated in a complementary and subsidiary way, attending the emerging threats. It was noted by stakeholders that cybersecurity culture implementation is not yet achieved at various decision-making levels.

2. *Security by design* - The containment of building services and power supplies, locating public car parks as far away as possible from station buildings, creating a distinct separation with other "crowded places" are examples of possible secure by design measures. These measures should be applied at an early stage of infrastructure design and development. Stakeholders pointed out that transport system enhancement must be understood globally, from access ports, traffic corridors to existing public furniture and the visibility to law enforcement authorities. All these considerations must have security in mind. Moreover, joint management between various transport modes is very important – dialogue between law enforcement authorities, emergency management services and transport operators is critical.

3. *Security in transit environments* - A multi- and interdisciplinary approach is required to tackle transit security and demands an integrated, holistic and cross-disciplinary approach. Also, the identification and assessment of transport infrastructure vulnerabilities regarding man-made threats can contribute to the strengthening of the resilience of the European transport network against various man-made hazards. Stakeholders pointed out that a complex transit environment complicates analysis and development of security measures. Moreover, maintaining the privacy demands of passengers is a challenge.

4. *Remote detection of explosives and other materials* – The capability of new technologies to detect explosives sensitively, accurately and rapidly could have great benefits for security, as there is a gap between the need to identify threats and the technologies commercially available. False alarms should be reduced to a minimum. Stakeholders mentioned that passengers disturbances should be minimised or eliminated as much as possible, as passenger experience and acceptance are very important.

<u>Cross modal implementation</u>

An important output of the project is that stakeholders from all transport modes recognised that there are benefits to coming together and having an open collaboration towards increasing safety and security. There are still challenges regarding the lack of communication between different agencies in specific infrastructures. This implies a consequent challenge regarding responsibility procedures, e.g. who does what in various critical situations. Another highlight of the stakeholder consultations is that it is clear that there are common challenges faced by all transport modes and that taking the best out of each mode and transferring to other modes is a valid and useful idea with high potential for safety and security. More often than not, the greatest opportunity is where the largest challenge exists. Large opportunities for collaboration exist at transport nodes for example, where different transport modes connect or cross each other. Nevertheless, one of the most important points is that while technologies may be developed and proven through trials, case studies and field tests, governance and user acceptance are crucial to a successful implementation. Regulations on cross-modal data sharing, data protection and privacy, incentives for achieving safety targets, cybersecurity measures, the implementation of a system (mandatory/voluntary), automated vehicles testing and others will greatly influence implementation. Moreover, user experience, behavior and acceptance is paramount.

All the topics identified in WP3 have potential for application in at least two modes and there is a clear indication that there are great opportunities for transport modes to share existing and new ideas for improving safety and security .

5.2 Next steps

The next steps will consist of combining the work performed across the whole project; links between the different work packages have been emerging, such as the importance of user acceptance (USE-iT WP2) or the secondary environmental benefits arising due to the implementation of various safety solutions (USE-iT WP4). This final step will lead to a set of common research themes across WP topics, transport modes and domains, which will serve as input to the roadmap for the implementation of the FORx4 initiative – incorporated into the final deliverable of the project, D5.4.

The resulting roadmap will represent an investment strategy for key infrastructure funders including European, national and regional public bodies and private infrastructure investors to be used in specific developments. The project recommendations will be presented at the final USE-iT Stakeholder Workshop, in the first half of 2017.

6 References

[1] FEHRL, 2013 “FORx4 Forever Open Road, Runway and river: A co-modal transport initiative for research”, FEHRL, Brussels, Belgium

[2] Mocanu, I. et al, 2015. Preliminary report on safety and security based on investigation across modes and domains. Deliverable 3.1 of USE-iT, H2020.

[3] GS1, n.d. GS1 Healthcare data sharing [Image]. At http://www.gs1.org/healthcare/share-data, last accessed 28th October 2016

[4] MTR, n.d. Safety Management Model [Image]. at http://www.mtr.com.hk/en/corporate/sustainability/2014rpt/safe-intro.php, last accessed 28th October 2016

[5] University of South Dakota, n.d. Human Factors Program [Image]. At http://www.usd.edu/arts-and-sciences/human-factors, last accessed 28th October 2016

[6] Rosekind, M., 2014. Sleep apnea: Why everyone who travels is at risk, NTSB Safety Compass [Image]. At https://safetycompass.files.wordpress.com/2014/07/drowsydriving.jpg, last accessed 28th October 2016

[7] findingDulcineea, 2009. Video of near misses is latest attempt to eliminate rail crossing incidents [Image]. At http://www.findingdulcinea.com/news/Americas/2009/feb/Video-of-Near-Misses-Tries-to-Contain-the-Number-of-Rail-Incidents-.html, last accessed 28th October 2016

[8] Hoffman, A. J., 2016. How will driverless cars change the world? CityMetric [Image]. at http://www.citymetric.com/transport/how-will-driverless-cars-change-world-1875, last accessed 28th October 2016

[9] APSM, 2016. Security by Design at 200 George St. [Image] at http://www.asiapacificsecuritymagazine.com/security-by-design-at-200-george-st/, last accessed 31st October 2016

[10] Burbiel, J., Grigoleit, S. & Kochsiek, J. (2016) Assessment of existing and possible approaches and solutions. Creating an Agenda for Research On Transportation sEcurity (CARONTE). Deliverable D6.1.

[11] Burbiel, J., Grigoleit, S., & Ghazel, M. (2016). Creating an Agenda for Research On Transportation sEcurity. Research Agenda for Security Issues in Land Transport (CARONTE). Deliverable D6.2.

[12] University of Massachusetts Amherst, n.d. Cybersecurity. [Image], at http://security.cs.umass.edu/, last accessed 31st October, 2016

[13] van Staalduinen, M. & van Zeijst, R. (2015). Ahead of the Threat. European Cyber Security Perspectives, pp. 44-48.

[14] Carter, A., 2015. 2015 ORR Station Data: Movers & Shakers. Calling All Stations. [Image], at https://callingallstations.co.uk/2015/12/, last accessed 31st October, 2016

[15] Ceccato, V. & Newton, A. (2015) (Eds.) “Safety and Security in Transit Environments”, London, Palgrave Macmillan, ISBN 9781137457653.

[16] Tangerine Travel, 2015. Airport Security Highlights: How to Expedite Getting Through Security. [Image] at https://www.tangerinetravel.com/How-to-Expedite-Getting-Through-Security, last accessed 31st October 2016
[17] Wynn, C., Edwards, B., Kunz, R., Zayhowski, J., Palmacci, S. & Rothschild, M. (2008). Novel method for remotely detecting explosives. SPIE Newsroom. DOI: 10.1117/2.1200805.1179

7 Appendix A: Summary of stakeholder questionnaire

7.1 Questions

1. **Where do you see the greatest potential to increase SAFETY in ROAD / RAIL / WATER / AIR (please apply the question to transport mode in which you perform your activity)?**

Please tick all that apply:

- Technology
- Infrastructure
- Governance
- Customer

Additional information box

2. **Where do you see the greatest potential to increase SECURITY in ROAD / RAIL / WATER / AIR (please apply the question to transport mode in which you perform your activity)?**

Please tick all that apply:

- Technology
- Infrastructure
- Governance
- Customer

Additional information box

3. **Are there any Technologies/Methodologies/Guidelines that you already employ within your organization to ensure or increase SAFETY (in the transport mode in which you perform your activity) that could be applied to the other transport modes?**
   - Yes
   - No
   - Don't know
   - If yes, please specify

Additional information box

4. **Are there any Technologies/Methodologies/Guidelines that you already employ within your organization to ensure or increase SECURITY (in the transport mode in which you perform your activity) that could be applied to the other transport modes?**
   - Yes
   - No
   - Don't know
   - If yes, please specify

Additional information box

5. Do you employ any cross-modal activities to ensure or increase SAFETY and/or SECURITY within your organization?

- Yes
- No
- Don't know
- If yes, please specify

Additional information box

7.2 Summary of results

Over two-thirds of these represented multi-modal transport (35%) or only road transport (34%). The representation of all modes is presented in Figure 12.

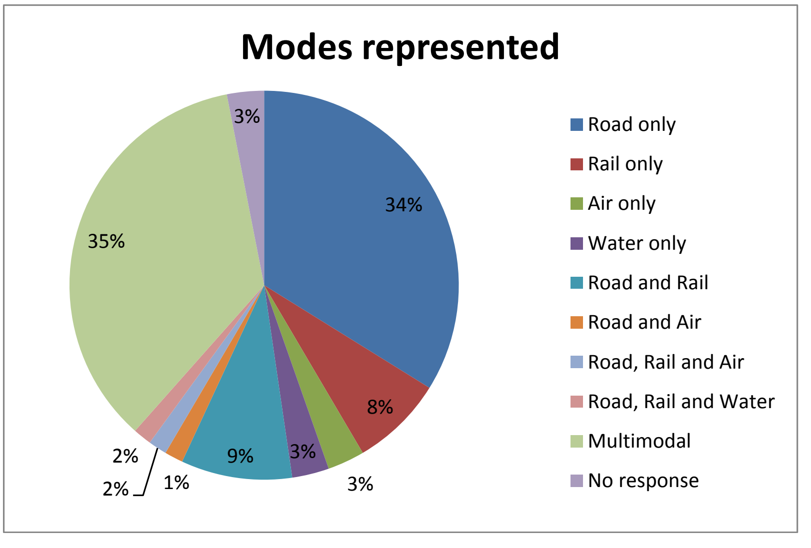


Figure 12 Modes of transport represented by respondents in the survey

The results of the survey questions in relation to WP3 of USE-it are presented below.

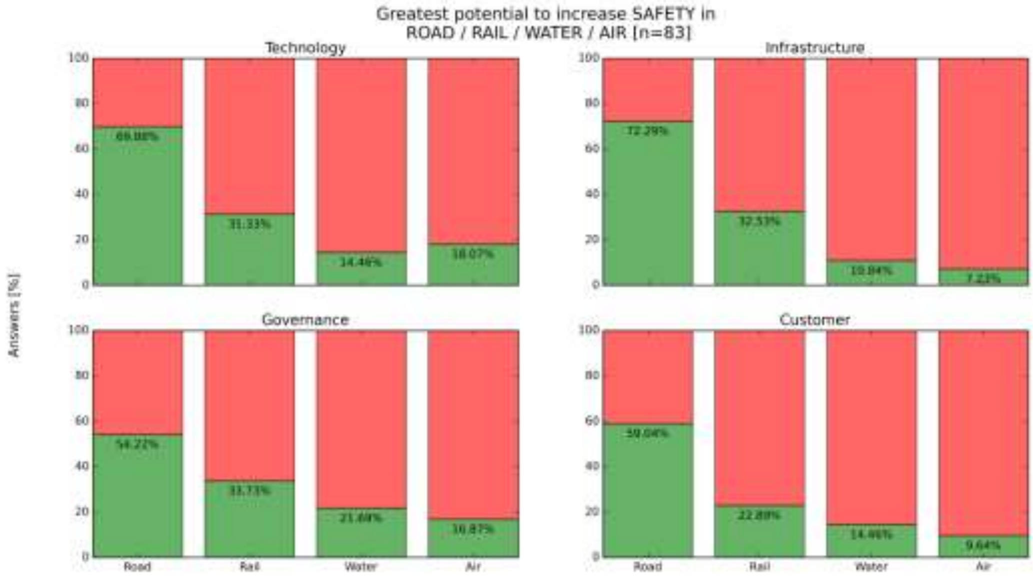


Figure 13 Level of potential to increase safety in each transport mode per domain

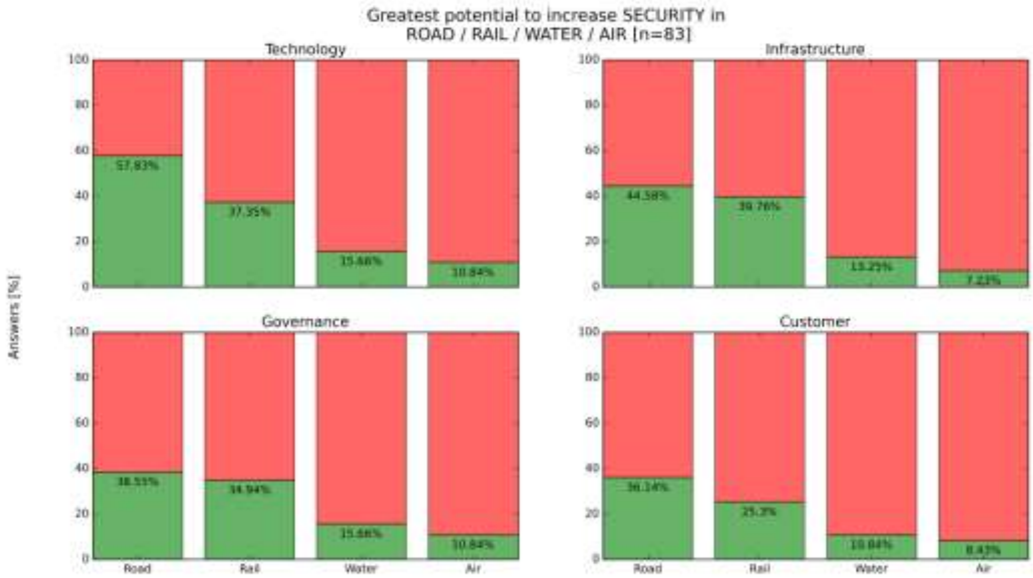


Figure 14 Level of potential to increase security in each transport mode per domain

When asked about where they see the greatest level of potential to increase safety in each transport mode, respondents thought that technology and infrastructure have the most potential out of the four presented domains. If the comparison is done by modes, then road transport has the most potential out of all modes to have safety benefits. However, the results may be influenced by the high number of respondents coming from the road transport area.

For security, the results are similar. Technology and infrastructure are seen as having the greatest potential to increase security out of the four domains.

Overall, technology was assessed as having the highest potential to increase Safety and Security across all transport modes, with 26.5% of respondents stating that they employ technologies, methodologies or approaches that ensure safety and that could be applied to multiple transport modes. Examples include:

- Safety management systems in order to make prioritization based on forecasts and historical infrastructure data
- A common safety management information system for the whole rail industry in a country
- Risk management approaches
- Automatic control systems
- Video cameras
- Speed radars
- Novice training
- Alert information systems
- Human factor/man machine interfaces
- Automatic train control usable for road and water transport
- Road workers safety guidelines
- Safety audits at design, construction and operation of roads
- design norms

Nevertheless, approximately 25% of respondents stated that the technologies, methodologies or approaches that they employ to increase safety could not be applied to other modes, while 23% stated that they did not know.

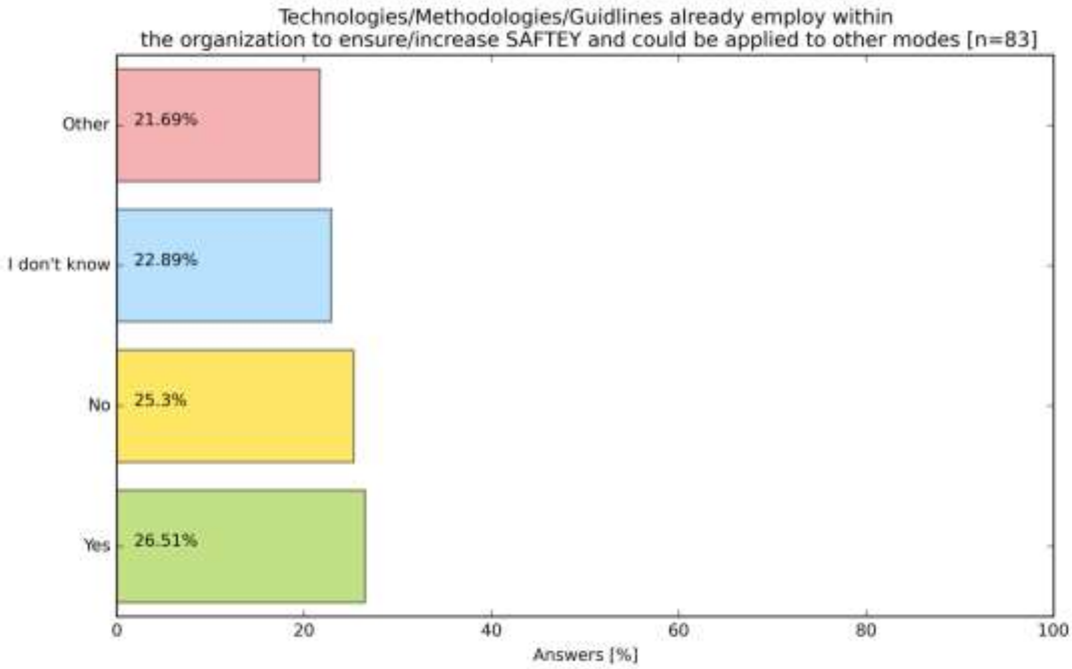


Figure 15 Employment of any technologies/methodologies/guidelines to increase safety that have cross-modal potential

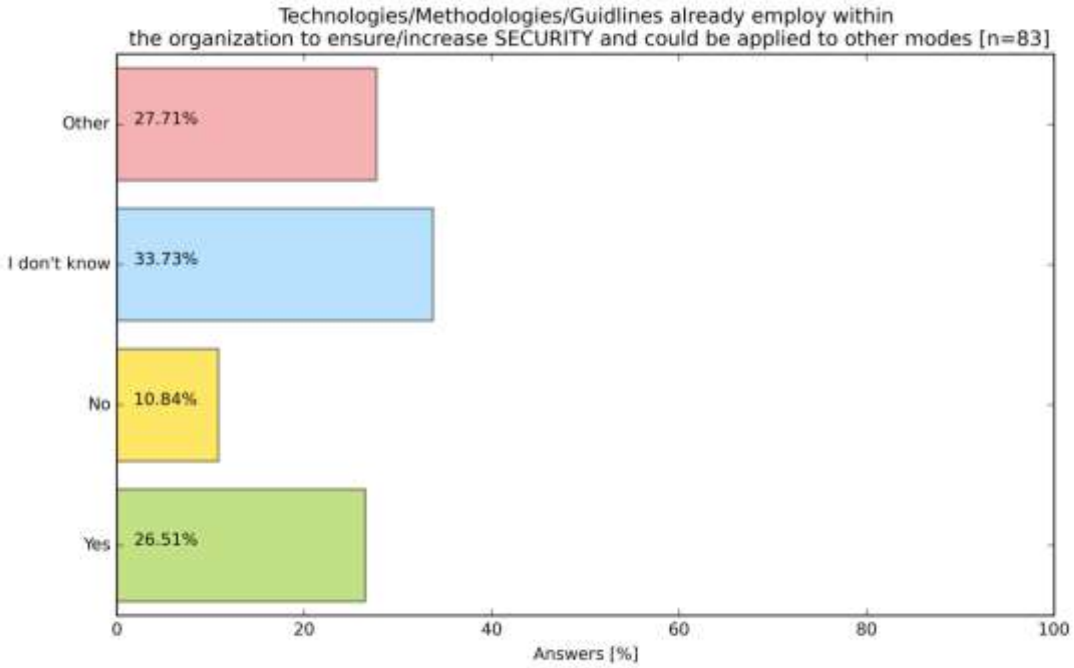


Figure 16 Employment of any technologies/methodologies/guidelines to increase security that have cross-modal potential

26.5% of respondents stated that they employ technologies or methodologies that ensure security and that they could be applied to multiple transport modes.

Examples included:

- Security screening technology and procedures,
- Risk models and mitigation measures to identify security issues integrated with sensors, CCTV, etc.,
- Passenger Name Record (PNR),
- Security screening technology&procedures,
- Guidelines, etc.

While 10.8% stated that they did not believe that the technologies or approaches that they employ could be applied to other transport modes, almost 34% stated that they did not know.

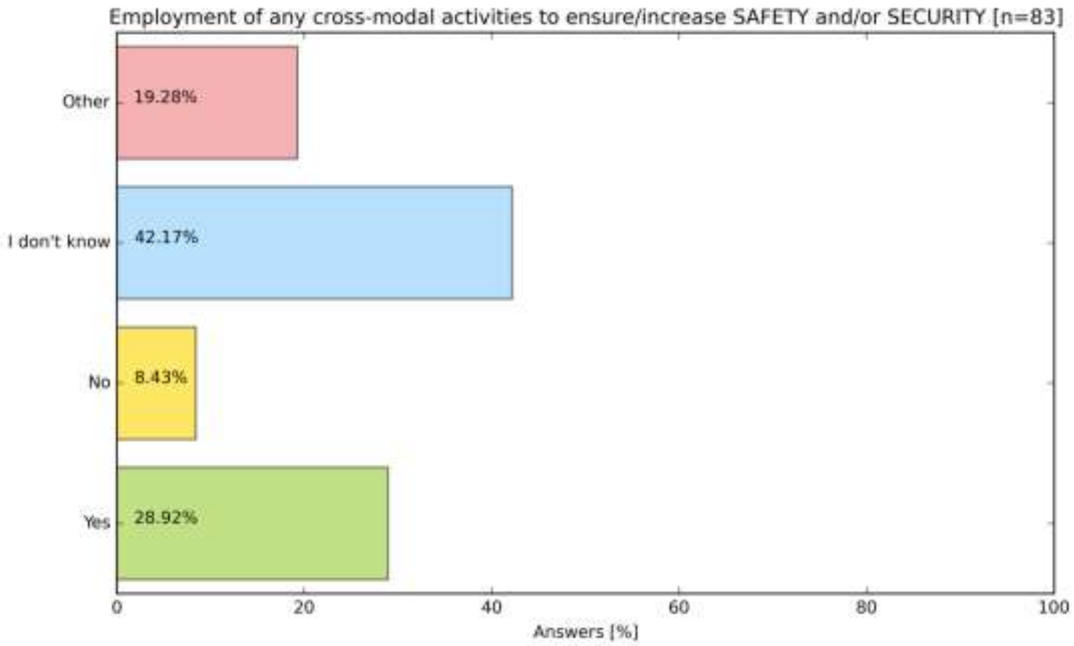


Figure 17 Level of employment of any cross-modal activities towards increasing safety and security

8 Appendix B: Summary of the 1st Stakeholder workshop

8.1 Posters

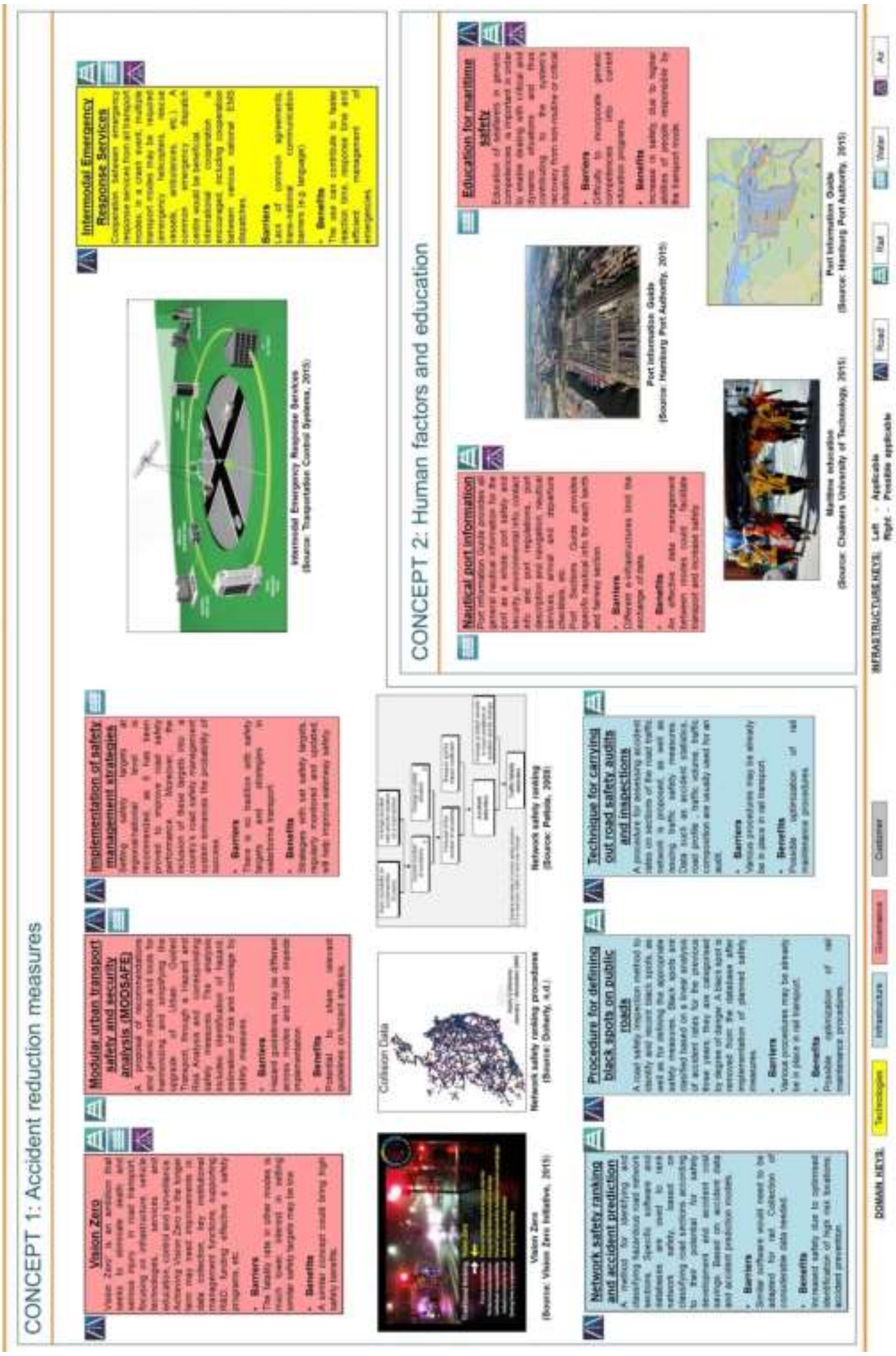


Figure 18 USE-iT WP3 Poster – 1st and 2nd Safety concepts

Figure 19 USE-iT WP3 Poster – 3rd and 4th Safety concepts

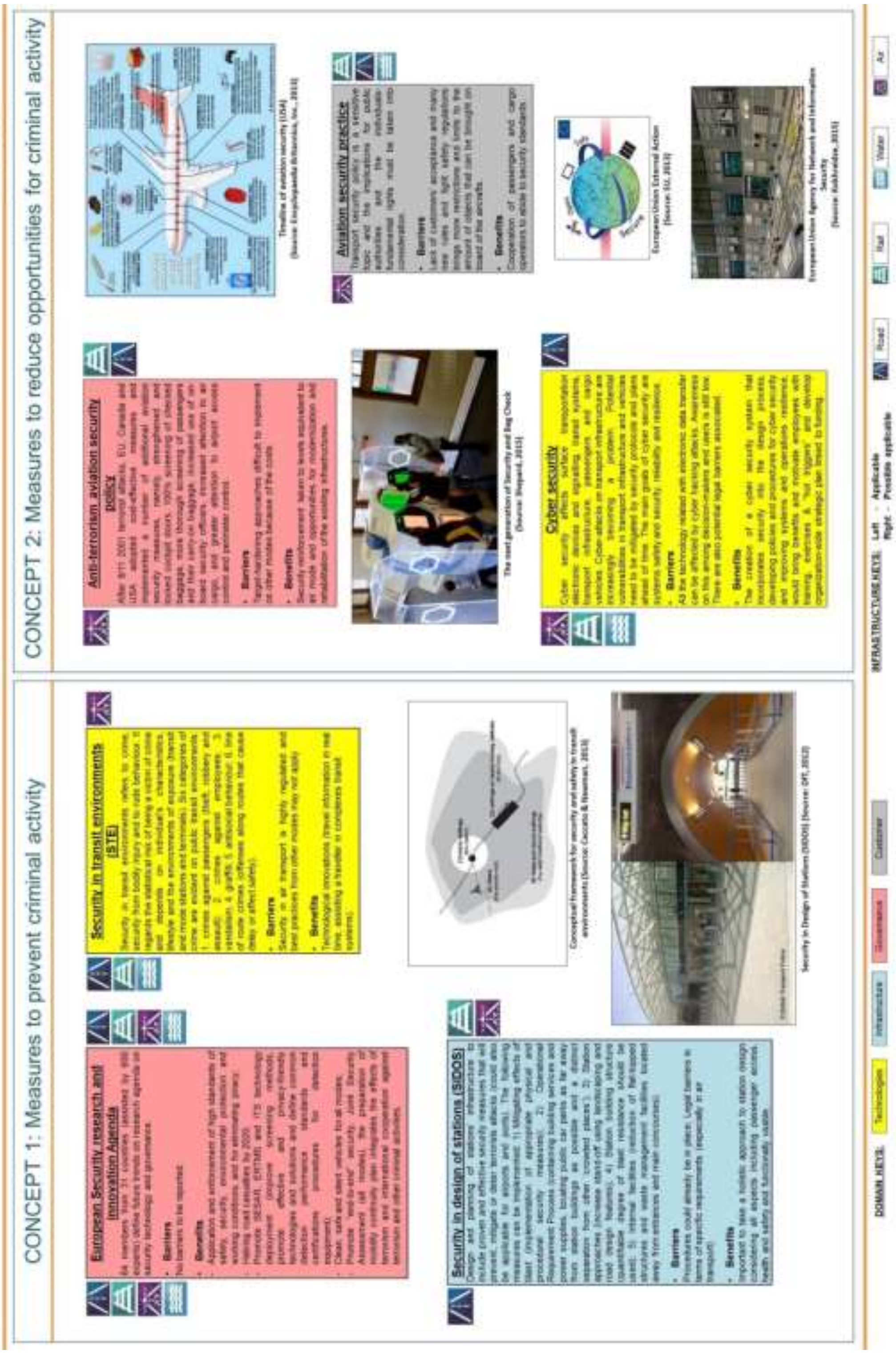


Figure 20 USE-iT WP3 Poster – 1st and 2nd Security concepts

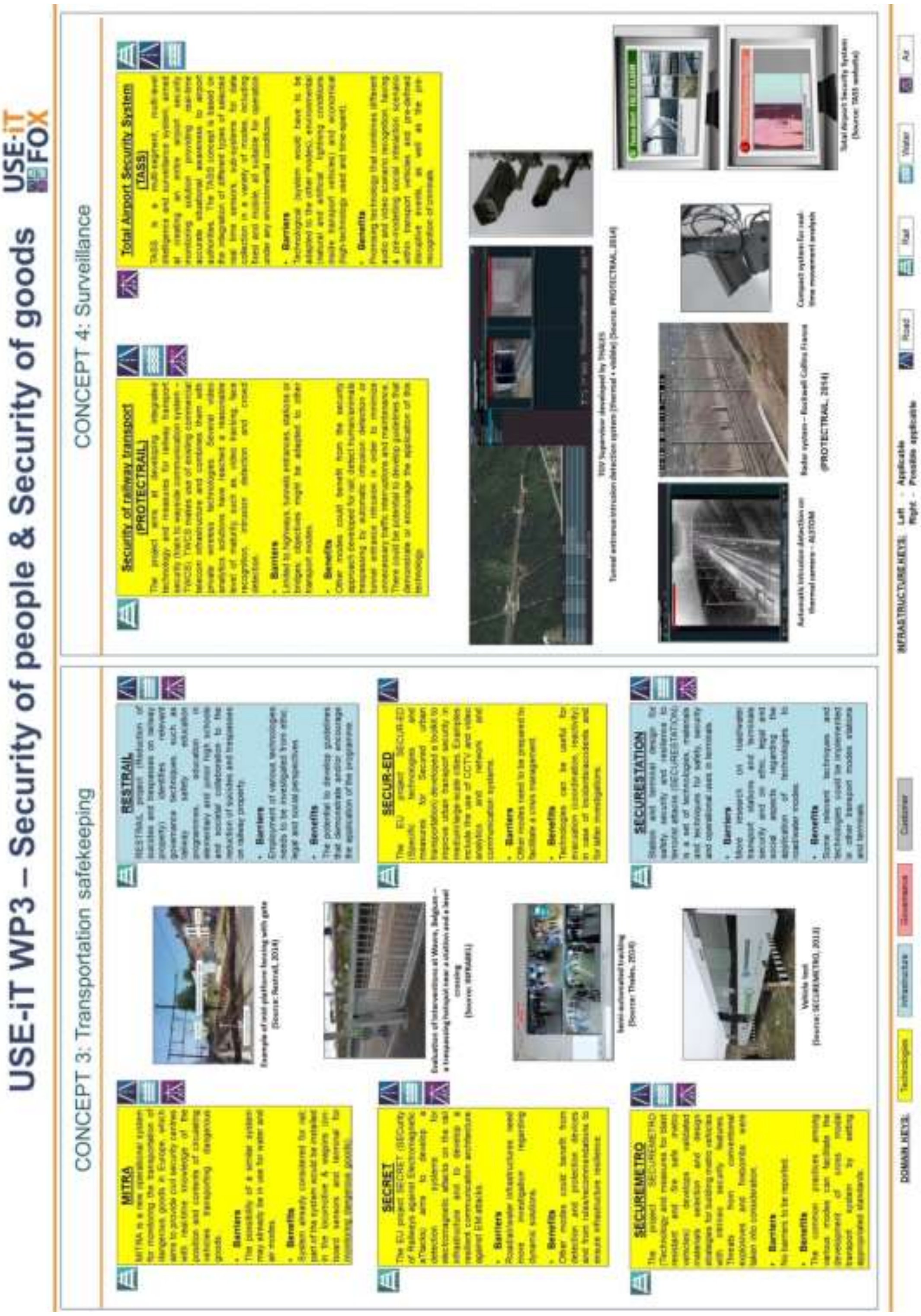


Figure 21 USE-iT WP3 – 3rd and 4th Security concepts

8.2 Summary of the Workshop findings – Safety

Concept 1: Accident reduction measures

- General comments
  - In aviation, maritime and rail transport – safety & security are connected, while in road transport this is not the case.
  - There is a European project EUPAVE, which investigates the so-called White Spots – low accident areas.

- Opportunities:
  - A possible solution for mitigating collisions – steel sandwich structure (from maritime) could be applied to cars.
  - Black spots analysis could be applied to rail transport.
  - GIS tools could be applied to all transport modes for accident reduction.
  - Vision Zero could be applied to other transport modes; however its application depends on the country.

- Barriers:
  - Black spot Management does not lead to a significant decrease in incidents; it is not often preventative.
  - eCall already exists in other transport modes. It also took too much time to reach implementation phase in road transport.

Concept 2 Human factors and education

- General comments
  - Human factor training is highly important, especially in road transport, as human error is the main contributing factor for accidents.
  - Human factors and training should be maintained.

- Opportunities
  - With the coming of automation, there will be changes in driving education and training. Lessons learned could be taken from aviation. E.g. more realistic training, use of simulators.

Concept 3 Infrastructure ITS

- General comments
  - Road for Pedestrian and Road for Cyclist should be included in the analysis.

- Opportunities
  - ERTMS/ETCS could be combined with automation.
  - ADAS (Advanced Driver Assistance Systems) could be transferred from road to rail, with the inclusion of V2V.
  - V2V communication (road and rail) could be very useful for level crossings; (e.g. a warning system that could signal a train approaching; through automation -> automated braking at level crossing when a train is approaching)
  - V2V could be used for level crossings (road to rail communication)
  - Travel information -> warning on the GPS (Navigation) could also increase safety.
  - Thermal scanners in front of road and rail tunnels could also be investigated.
  - Geo-fencing areas could also be investigated.

- Barriers
    - Infrastructure providers are lacking in following the vehicle industry; better communication and open standards are needed.
    - Road and rail transport have different data standards.
    - ERTMS is being pushed by the industry and the EC, but national systems are already, in some cases, better.
    - GSM-R is already outdated. Its cost is very high.
    - There is no interest to increase safety in rail transport; the investments needed are very high to achieve even a couple of percent points.
    - NGTC (New Generation Train Control) will replace ERTMS and will connect the rail network with the urban network.

<u>Concept 4 In-vehicle technologies</u>

- General comments
    - Some technologies for safety could also be used for other aspects, such as low carbon or user information.
    - There is a need for very fast implementation of technologies, otherwise by the time all other barriers are resolved, the technology is not relevant anymore.
    - Costs are very important.
    - Traffic Management concerning all modes, potentially at a European level could lead to a Safety data pool.
    - The risk of death and injury in rail maintenance work is higher in rail than in road. Automation would be highly beneficial for rail maintenance.

- Opportunities
    - Alcohol interlock would be suitable to all transport modes. Alcohol interlock could be useful to all modes, but must be considered against automation.
    - Drug tests are also worth taking a look at.
    - Fatigue warning already exists in road transport; could be fitted for trucks, or other transport modes. Fatigue warning could be applied in maritime and even in air transport.
    - Road work zone warning systems could be applied to other transport modes.
    - Automation is highly important and can be applicable to all transport modes. Rail transport could specifically benefit. A challenge is user acceptance.
    - Automation could help with wrong-way drivers.
    - Big data (across transport modes – rail, air, water), a database with highly detailed information, could have potential.
    - Automation can be applied to freight trains; at the moment there is a lot of research in road; there is a need for more research in rail transport and even more in other modes.

- Barriers
    - Automation (platooning) may be transferred in maritime transport, although it may be more difficult to implement (as vessels are more difficult to steer). Could this be applied to rivers?
    - Platooning could also be used for reducing carbon consumption.
    - User acceptance in automation is a challenge.

2. New safety topics (proposed by the stakeholders) in consideration to be added to the project for further investigation

d) Data Sharing – A Safety Data pool focusing on cross-modal sharing of data between agencies, authorities, etc.
e) Updating license acquiring processes including regular training in simulators (e.g. taking best practices from pilot training and applying them to car drivers, once automation is here)
f) V2V - Train2Car communication at level crossings

8.3 Summary of the Workshop findings – Security

Concepts 1 & 2 – Measures to prevent and reduce criminal activity

- Security by design was identified as an important measure with potential to be transferable to other modes (e.g. design of airports).
- Anti-terrorism security practices (not policies) derived from aviation can be included in water transportation (e.g. locked cockpit doors); these technologies can increase the feeling of security environments among users.
- Openness to data sharing should be embraced, especially sharing of data between various security agencies/security forces across transport modes.
- Cameras used on roads for traffic management could be useful for security purposes; cameras in rest areas (gas stations) are currently used for security reasons.
- Cyber security pointed to be relevant to the future of automation.
- More automation and new technologies must be developed to improve automatic security checks.

Concept 3 – Transportation Safekeeping

- The project SECRET (SECurity of Railways against Electromagnetic aTtacks) was identified as particularly applicable to road transportation.
- Remote explosive detection was identified with potential to be applied to maritime transportation.
- Potential technology: tracking of bags/valuable goods through GPS; general concerns regarding the social acceptance of this technology/measure.

Concept 4 – Surveillance

- Technologies/measures deriving from PROTECTRAIL (The Railway-Industry Partnership for Integrated Security of Rail Transport) project should be implemented to the entire length of the railway line and not limited to highways, tunnels entrances, stations and bridges.
- Emergency evacuation concept should be included in Concept 4 - Surveillance.

Main barriers to technologies transferability

- Ethical, legal (data privacy, data purposes, data management) and social/societal challenges (disruptive practices, privacy issues, intrusive measures) are identified within the transferability to other modes (mainly on surveillance and aviation security technologies/measures and practices).
- Costs are identified as one of the major barriers to technologies/measures transferability.
- Cost-benefit analysis and social perception are important factors towards the success of implementation of technologies/measures to other modes.
- User acceptance must be taken into consideration for upcoming/transferable technologies.

- A balance should be achieved between increased security and user acceptance.
- More human resources should be allocated to air security procedures in order to decrease social annoyance.

4. New security topics (proposed by the stakeholders) in consideration to be added to the project for further investigation

a) To investigate SecMan (Security Risk Management Processes for Road Infrastructures) project in the concept “Measures to prevent criminal activity”
b) To investigate CARONTE (Creating an Agenda for Research ON Transportation sEcurity) project in the concept “Measures to prevent criminal activity”

9 Appendix C: Summary of stakeholder interviews

9.1 Safety

Q1. What are the innovative techniques/methodologies to increase safety that you have newly introduced in your organization in the last 5 years?

39 stakeholders responded with data from all transport modes, such as:

- Risk assessments and risk management, pro-active rather than reactive; Risk Based Oversight and Performance Based Oversight (road, rail, air, water)
- Safety Management System (SMS) – for the optimization of resources in accordance to the risks (air)
- Advanced Driver Assistance Systems ("Human out of the loop") e.g. Automated Emergency braking system; Departure from carriageway warning systems; Tire pressure control system, End of queue detection, In-vehicle monitoring systems (road, rail)
- Road Safety Audits/Road Safety Inspections, Road safety impact assessment
- Accident prediction modeling, black spot and hazardous road section management (TARVA LT software) (road)
- Safe system approach +Human Factors, replacing Vision Zero (road)
- Traffic management; Traffic information systems; Real time monitoring of traffic flows (road, air)
- Intelligent traffic lights, Average speed control, Fixed speed limits (air, road)
- Smart Motorways and Connected Corridors
- Improved winter maintenance (road, air)
- Alcohol interlocks in school buses
- Acoustic detection of incidents (road)
- Train to infrastructure communication at level crossings (rail)
- Safety at level crossings and detection of obstacles and fallen objects in railway level crossings (rail)
- Prevention of persons entering illegally the rail track area, through: extended fencing, camera surveillance, anti-trespassing grids (rail)
- ETCS – European Train Control Systems, ERTMS (European Rail Traffic Management System) (rail)
- Special training/education of employees and drivers, training and awareness actions for prevention of accidents (water) (e.g. Push-Back drivers)
- Use of simulators to improve the driver training of the vehicles which are required on the runways and within the airport
- Update on driver licenses process, including regular training with simulators (rail)
- Increase competence and responsibility of human actors (e.g. drivers, maintenance people, development engineers, etc.) (rail)
- Development of a just culture – encouragement of the reporting of safety occurrences thanks to a non-punitive environment
- License plate recognition in the airport area
- Temperature sensors on the runway at airports
- Increase use of Flight Data Monitoring
- Dynamic Underkeel Clearance – real time system used by ports to maximize port productivity and safety (water)

- Implementation of a Breathalyzer Control Regulation (water)
- Evaluation of the wake turbulence effects of one aircraft on another (air)
- Tool for modeling water levels on runways based on topography and a stationary flow of fluid model (air)
- New methods for improving passenger flow management – the coordination of different transport modes (air)
- Automation of jetways and other vehicles which participate in the handling of aircrafts (air)
- Lasers to scare birds from the runways and taxiways (air)
- Automated incident detection (through CCTV) in terminals or within the trains linking the airport terminals (air)
- Implementation of a permanent network for the acquisition of environmental data for climatological characterization, monitoring of marine environment, oceanographic and weather forecast (water)
- Data mining and surveillance data treatment for dangerous situations and incident detection (road and rail)

Comments included:
- Rail and air transport have very strict rules; road transport could learn from them
- Rail transport is a very safe transport system; the overall number of deaths and serious injuries in recent years has remained unchanged
- The approach on road safety has changes from "healing" to "preventing"
- Car manufacturers have shifted to in-car automation and argue that this has led to improvements; however not all road safety professionals agree
- Air transport is very cautious in implementing something new, especially if safety is involved; therefore many new technologies impacting safety require years to be full proofed

Q2. Do you think that these techniques/methodologies have the <u>potential to be transferred to other transport modes</u>?

30 stakeholders answered "Yes", while 6 answered "No".
Comments included:
- In air transport, more procedures are automated and the other modes could learn and adopt best practices
- Suicides also occur in road traffic, however their profile is different
- In relation to automation specifically, road transport is considered to be behind the level of automation in other transport modes (i.e. air, rail)
- Rail and air transport are technologically secured to minimize the human factor; the same could be said about water transport

Q3. If there are no innovative techniques to be reported please let us know if <u>any norms or procedures have been changed</u> using the same techniques and technologies since the last five years.

Stakeholder responses included:
- Specifications, norms, laws which allow testing of innovative solutions → e.g. testing of Autonomous Driving (also checking the acceptance; transition period)

- Legislative authority can steer the implementation of the technologies → e.g. rules for automated transport. But the influence of the transport sector itself, if it is private or public makes the difference
- Different procedures on train movement - checkpoints: infrastructure checks (on relevant spots) the clearance, speed, weight, temperature of the brakes (relevant for trucks on roads), balance of the loads, etc.
- New safety targets (including suicide) for 2020
- New fencing standards for rail transport
- Update of important and practical road safety document in Lithuania (i.e. Recommendations of using engineering road safety measures)
- New accident black spot detection methodology developed for city streets and roads passing villages
- A general consideration in the road safety sector is that developments being introduced by car manufacturers are moving faster than legislation. Equipment levels in vehicles also are shifting toward less driver involvement
- The Technical Specifications for Interoperability (TSI) introduces many changes in the rail sector, many of them related with safety
- „Implementation of ITS development action plan until 2020 (and Horizon 2050)"
- Road design norms considering safety of less protected road users and visually impaired people (safety islands, zigzag ground pedestrian crossings, widening of the sidewalk toward the carriageway, tactile pavement)

Q4. Presentation of <u>our list of topics and concepts</u>, along with explanations

- **Ask for approval, additional comments, scoring/rating**
- **What are the Top 3?**

All stakeholders agreed with the USE-iT WP3 Safety topics. The topics were presented and explained the help of a handout.
All stakeholders chose the top three topics they considered had the most potential for cross-modality. After compiling the results, the prioritization of the topics is:

- Data sharing (18 stakeholders)
- Education and human factors (16 stakeholders)
- Safety management strategies (14 stakeholders)
- Driver state monitoring (12 stakeholders)
- Automation and cross-modal V2V (11 stakeholders)
- Safe System/ Vision Zero (8 stakeholders)

Comments included:

- More focus should be on data quality rather than on the quantity of the data; input data from sensors need to be 'fit for purpose' to be able to be used in an optimum manner;
- Sharing data between modes is not beneficial
- The benefits of using alcohol interlock has been long debated in rail transport; due to the high safety systems already in existence, the safety risk of a drunk driver is low
- Vision Zero and Safe System approach should be used in other transport modes as well; Vision Zero is a moral statement and must be coupled with a strategy and delivery plan; Safe System approach is considered more suitable for road transport

- Topics related to enforcement are missing
- There is still a lot of apprehension regarding autonomous driving: even in an autonomous vehicle environment, humans should be ready to take over in critical situations
- More focus should be given to driver trainings, in particular for critical and dynamic situations; trainings in simulators should be mandatory and regulated; however, the infrastructure to deliver simulator training is expensive and resource intensive
- Human errors are a consequence of human overloading due to inadequate road infrastructure or complicated traffic situation
- Training for critical and unexpected situations is highly important in aviation, possibly more than for other transport modes due to the high level of automation during normal operations which would tend to emphasize the gap in work load between normal and abnormal operations
- Fatigue monitoring is an interesting concept and could fit very well with the current regulations on fatigue in air transport; however, the level of complexity within an aircraft is already very high
- Development and deployment should follow three axes: proportionality (level of automation and scope should depend on size and traffic volume as no automation is required for smaller infrastructures), flexibility (adapt to operational contingencies), progressivity (step by step implementation)
- Alcohol interlock should be extended to drugs as well; however, car manufacturers are customer-focused and are unlikely to install something which is unpopular for their target audience
- Data sharing is a good idea; however, the ECCAIRS database is not user-friendly and difficult to use; a database across all transport modes could pose even more difficulties

Q5. Are the topics <u>relevant</u> in their modes?

31 stakeholders responded with "Yes" to this question. However, a present comment was that some topics were more relevant than others.

Q6. Are there any <u>specific needs with regards to research (knowledge gaps)</u>?

- **Please specify how those knowledge gaps could be overcome.**

Stakeholders made the following comments and indicated these research gaps:

- Take over scenarios between driver and automated vehicles
- Infrastructure quality vs. level of safety
- Along with data sharing will come data protection and subsequent legal issues
- Each aviation company has its own safety rules, in connection with how vehicles have to move towards the plane – difficult to comply
- Emphasis on the move from political will to systematic practice, assigning resources in accordance with the expected gains
- Need of research and new knowledge on road user behavior, user adaptation to new technologies/measures
- There is a need to ensure fatigue warning systems are "fit for purpose" and therefore an effective way of preventing incidents involving fatigue
- The insurance industry holds a vast array and depth of data that would be invaluable from a

road safety perspective (e.g. location and types of collisions, demographic data on those involved in collisions, severity of incidents etc.). It has been extremely difficult to establish a mechanism whereby this information can be shared. Even a series of 'top 20' of collision 'hot spots', for example, would be extremely helpful to road safety practitioners. This comment is road-safety specific but the same challenges might be applicable in other transport modes

- The need to balance safety requirements and privacy demands of passengers
- Development of new technologies that will enhance drivers' awareness of safety risks
- An awareness that business models are needed

Q7. Do you have any past experience with cross-modal activities in your organization? Please specify.

23 stakeholders indicated that they have previous experience with cross-modal activities, while 14 stakeholders gave a negative response.
The stakeholders specified various activities such as:

- Road/rail level crossings
- Mixed modes of transport at airports (i.e. on runways and taxiways)
- Collaborations between national authorities of road, rail and air, with the wish of having a collaboration with the water national authority as well
- Water and road/rail interaction through the transport of cargo at port level
- Data sharing in terms of transport time tables
- Pavement structure design and maintenance

Q8. What do you think are the common challenges to increase safety across modes?

The respondents indicated the following common challenges to increase safety:

- Education: Acceptance and peoples reaction on Automated Transport; increasing automation while keeping the driver/pilot in the loop
- Training and education needs time and money
- Data protection; Lack of input data, privacy of data
- Missing (financial) resources
- Gap between safety performance, needs and expectations between professional drivers/pilots/captains and private vehicle users
- Sensor quality and data exchange
- Pre-warning of natural hazards, landslides, avalanche, flooding
- Improve rail platform safety signing for passengers
- Increasing the safety for those who are not using the transport mode but still are exposed to safety risks connected to a transport mode
- The frequency of road fatalities and the per-crash investigation levels
- Building systems that are resilient to human error
- Understanding human factors, developing better human/machine integration and producing adequate regulation are common challenges across all modes
- Being able to analyze safety occurrences to prevent future accidents
- Common challenges to increase/improve safety across modes will be the shared issues and the quality of information, relative to transportation of both people and goods

- A common safety strategy across all transport modes. The strategy should be harmonized and should help in daily work (strategy shouldn't be an obstacle). The main challenge is institutional cooperation between the transport modes; there is only theoretical cooperation between the transport modes. Everyone works decentralized with their own interests and don't want to cooperate
- Coordination between operators is one of the main challenges to increase safety; Coordination of data collection and processing should also be an interesting challenge
- One challenge which does not seem to be addressed currently is the consideration of safety as a cross modal issue and not mode by mode. For instance, it is usually never considered when investing a given amount of money on safety enhancing projects for a transport mode that the same amount of money might be better spent on safety enhancements for another mode.

Q9. Have you been involved in any cross-modal activities in this area (safety)? If yes, please elaborate or specify.

11 stakeholders indicated that they have been involved in cross-modal activities in the area of safety, while 16 respondents gave a negative response. Some comments include:

- Development of risk models for rail/road level crossings
- Intelligent lighting for interaction between vehicle, pedestrian and cyclists
- Safety aspects of intermodal transfers
- Development of road and rail level crossings design guidelines
- Development and implementation of mobility monitoring systems for rail and road sectors

Q10. What opportunities do you think there are for cross-modal research in enhancing transport safety?

The respondents indicated the following opportunities for cross-modal research, related to increasing safety:

- Opportunities strongly depend on the potential consequences of failures (i.e. crashes, accidents); for example, aviation need higher redundancy of safety systems – therefore higher costs are accepted
- Potential to learn from rail / aviation: minimum skills for safe pilots, train conductors
- Potential to learn from road: manage drivers with different driving skills
- Investigation in the level of quality in education
- Research in level crossing safety + autonomous driving
- Opportunities of improving sharing issues and also quality of information shared amongst modes, relative to transportation of people and goods
- Automation, surveillance and positioning systems, data processing are fields where research might benefit to all transport modes
- Surveillance and positioning systems, data processing, de-icing methods are fields of common interests
- Direct communication between all transport modes authorities, especially in crisis management

Additional comments included:

- The greatest opportunity is where the largest challenge exists. A lot of opportunities exist at the transport nodes where different modes connect or cross each other
- Road traffic collisions are more frequent than collisions in other transport modes. Individual road collisions are not investigated to the same extent as in other modes. Fatal accidents in other transport modes tend to attract a lot of attention because they happen infrequently but result in a high number of deaths in one occurrence. Because deaths in road collisions occur over a longer period of time, these incidents are not subject to the same scrutiny / public interest
- Focusing on the specific challenges in each mode will naturally lead to increase of transport safety cross modality
- Air transport has a lot of specificities and the level of safety is already very high. But new ideas coming from other modes are always welcome and there are definitely some common topics where research would be beneficial to several modes (e.g. friction measurements, snow/ice removal/protection)
- The level of safety and usage of technologies or programs to improve safety varies greatly among the different transport modes. Taking the best out of each mode and transferring it to other modes is a good idea. However, there are a lot of specificities in each transport mode and only few concepts/technologies can really be shared across modes
- The main opportunity is the possibility to share new ideas for improving safety. Putting together the efforts of several industries could also enable reducing costs in the development of similar technologies

Q11. Would your organization be interested in practical involvement for transferring best practices across modes? If yes, please elaborate.

24 stakeholders indicated that they would be interested participating in transferring best practices across modes, with the conditions that the specific activity would have be related to specific topics linked to their area of interest and that resources would have to be available or made available.
Examples include participation in expert groups, exchange of information through cooperation between various stakeholders, participation in cross-modal projects, etc.
9 stakeholders responded negatively, with the lack of resources being mentioned as one of the reasons.

9.2 Security

Q1. What are the <u>new/innovative techniques/methodologies</u> to increase security that have been newly introduced in your organization in the last 5 years?

Two stakeholders did not mention the introduction of new/innovative techniques/methodologies in their organizations. 10 stakeholders from all transport modes stated the introduction of new/innovative techniques/methodologies, such as:

- Electronic security has been the most sensitive area deriving from the use of a critical infrastructure (bridge)
- The company uses electronic surveillance systems and human surveillance
- The main core of the company activity in security terms is to combat the fraud and vehicles vandalism by using system alarms associated to CCTV systems
- The company introduced operating rules including the work of the security forces before trains circulation
- A spring system has been implemented (technology developed specifically for taking into account the existing space in the terminal) into a given terminal. The installation of this system was made to ensure the damping in the event of a collision to ensure the safety of employees and passengers inside the vehicle
- Close contacts with civil protection agents for action optimization, emergency planning into operation and some safety procedures were updated
- Creation of the department of security road-rail
- Procedural changes in the administrative conduct of the criminal situation/criminal reporting
- Identity double-check (security and customs forces and on boarding) and the ones deriving from annex 17 (ICAO)
- Differentiated update and training according to the access levels to the airport infrastructure
- Special firewalls and software solutions against cyber attacks
- Video monitoring systems at railway stations and terminals
- Regular trainings with security forces
- Risk assessment based on 3D modelling of area to be protected, using drone and photogrammetry
- Near real-time standoff detection of explosives: Wide area of surveillance capability at distances of about 30 m; remote, stand-alone system; non-contact
- Short-wave infrared hyperspectral imaging by liquid crystal tunable filter
- LAG-screening technology included new SW and new processes
- ETD-screening technology for different cross-checks for Pax and Handbag
- Use of new generation of body scanners for Pax screening
- New equipments (evaluation of security scanners, multiplexed x-rays, ACBS)
- “Security culture" implementation
- Innovation programme to develop airports partnerships ("Vision Sûsete")
- Crisis management based on quantitative indicators assessing systems resilience (the ability to cope with disruptions/ failures/ faults, etc.) and the identification of systems’ weakness and vulnerabilities
- Research on cybersecurity in order to improve systems and operations resilience

Other comments included:

- In the last 5 years, technological innovations in the security area have not been implemented but the existing systems were maintained and/or strengthened as determined by operational needs
- Criminal activity prevention by infrastructures design is an example of what is now made in terms of security (on the past USA norm suggested long corridors which are neither friendly nor secure). Today, metro stations are built up with central atrium stations and former models/design of an atrium at the end was abandoned

Q2. Do you think that these techniques/methodologies have the potential to be transferred to other transport modes?

8 stakeholders answered "Yes", while 4 answered "No".
Comments included:

- Transferability of CCTV and thermal cameras (infrared) to water mode
- Electronic (cyber) to water and road modes
- The spring system can be interesting in other modes, since it is designed to absorb the energy of the vehicle's crash at the end of the line in a short journey. The existing models needed a larger space so as to absorb the necessary energy
- Aviation security technologies are very difficult to implement in other modes (high costs, research needs, service time constraints) but have potential for maritime (long distance cruises) and high-speed railway transport
- Methodologíes can be used for developing a 3D model of airport, harbor, central bus depot, and railway station
- Out of the aviation-industry are demands in the transportation & logistic industry
- More communication and consultation services between all transport modes for cross-modal implementation as aviation security technologies and practices are very particular

Q3. If there are no innovative techniques to be reported please let us know if any norms or procedures have been changed using the same techniques and technologies since the last five years.

Stakeholder responses included:

- Technology has evolved substantially in the last five years and became more effective and useful, but not necessary friendlier or cheaper. The systems and security procedures were maintained to operate; much like the existing form and "attention/vigilance" regarding security was strengthened
- The situation could be described as follows: the rules did not dictate practices, and these were not justified because the degree of threat was null or negligible
- Existing changes were in the procedures – regarding the speed set on the line and the optimization of contacts/joint work with civil protection agents
- Alarm systems with defined tasks for our staff
- Training lessons with specialised content
- Communication rules with security authorities and ambulance services
- All new equipment for process and procedures in security are certified by different

international regulations (ECAC, ICAO, FAA) and national regulations

Q4. Presentation of <u>our list of topics and concepts</u>, along with explanations

- **Ask for approval, additional comments, scoring/rating**
- **What are the Top 3?**

All stakeholders agreed with the USE-iT WP3 Security topics. The topics were presented and explained with the help of a handout. All stakeholders chose the top three topics they considered to have the best potential for cross-modality. After compiling the results, the prioritization of the topics is as follows:

- Cybersecurity (10 stakeholders)
- Security by design (7 stakeholders)
- Security of railway transportation (6 stakeholders)
- Security in transit environments (3 stakeholders)
- Total airport security system (3 stakeholders)
- Remote detection of explosives (3 stakeholders)
- Aviation security technologies and practices (2 stakeholders)
- Operational system for monitoring the transportation of dangerous goods (1 stakeholder)

Comments included:

- Security issues should be treated in a complementary and subsidiary way, attending the emerging threats
- Resilience should be achieved with the use and implementation of various systems and crossing of different technologies and approaches
- Threats are no longer linear, since it requires to reflect about what are the threats and risks and what the value of the property to protect, and then think what is accurate
- The more systems are functioning the better and the question is how to analyse large amounts of information; so the most important is to have an interface that aggregates all these technologies and systems and displays the information the way we want, that is to give the "alerts"
- The securization of a transport system (whatever the mode considered) must be understood globally, from access ports, traffic corridors, to existing public furniture, and includes visibility from LEAs (law enforcement authorities). The dialogue between LEAs and transport operators is critical. Very important is also the security training, which should be valued
- The information/knowledge sharing management on the evolution of the security demands versus the evolution of security solutions regarding the various transport modes is relevant
- The difficulty that organizations/companies have in addressing security results from the vulnerability/difficulty of managing the "unknown" or the "insufficiently known". The current global context will bring short-term challenges in this field and organizations/companies will have greater a difficulty to overcome if this issue is not mitigated
- The main challenge on remote detection of explosives is the need to be done without disturbing the passengers
- Radioactive material detection will be an emergent issue and the airports will have to install it. Currently, radio-active material is being transported a lot and the airport cargo staff is exposed to this materials since there is no real-time detection
- Passenger experience and acceptance are very important (e.g., the concept of Smart

Security Solutions)
- There is a need for the calculation of the probability of an event. The concept of Integrated Security based on the Onion Skin Principle is an important issue since one cannot provide 100% security at each ring. There is a need to be mindful regarding the objectives and purposes and what is crucial to protect. The main challenge is the calculation of the probability of an event; this could be more cost-effective for civil aviation
- There is a challenge regarding the lack of communication between different agencies in a given and specific infrastructure. This implies a consequent challenge regarding responsibility procedures, e.g. who does what in various critical situations

Q5. Are the topics relevant in their modes?

The majority of the stakeholders responded affirmative to this question, although some topics were considered more relevant than others (CCTV- surveillance systems, cybersecurity and security by design). Stakeholders made the following noteworthy comments regarding this question:
- Lack of control of the objects carried by passengers; lost and found objects are a problem (given the frequency and the amount) and there are no rapid methods of analysis
- Existing systems are too open and difficult to implement security measures
- Safe areas in passenger traffic is another major concern since these areas are not designed to take into account threats and there is no joint management between the various transport modes
- Introduction of common procedures to more effective prevention and control of security occurrences

Q6. Are there any specific needs with regards to research (knowledge gaps)?
- **Please specify how those knowledge gaps could be overcome.**

Stakeholders made the following comments and indicated the following research gaps:
- Systems that can be scaled / customized to produce early warnings
- Cyber security culture implementation is not achieved at the various decision-making levels
- Nanotechnologies applied to security are underused
- User willingness to pay (considering the transferability of air security technologies and procedures to rail mode)
- Data protection issues
- New forms of crime (terrorism) and the information management process / knowledge on this topic
- There are some shortcomings such as the lack of communication between the various agents, a greater sharing of experience and know-how, allowing a more efficient joint action
- Legislation should also follow the existing needs in the area of security, which often does not permit an effective action
- Necessary to contradict the idea that rail mode is safe to the practice of criminal acts; the presence of security forces (even though the constraints affect the service, i.e. delay on trains) can increase objective security and the security perceptions among users
- Inefficiency in communicating crime occurrences in transport modes
- Lack of systematic procedures and rules for registry and data treatment since many security procedures are still “handmade”
- Body and baggage scanning technologies

- Quality control improvement which may involve changes in staff training
- Enlargement of the procedures allowing security forces staff to fly carying weapons
- Willingness by the transport organizations to actually deploy the security technologies developed over the past 10 years in a multi-layered manner as integrated security systems
- New Pax- and Handbag Screening methods to increase security & performance
- New Pax- and Handbag-Screening concentrating on new materials (e.g. plastics)
- More research on cybersecurity (i.e. identify potential threats, protection solutions; assess systems resilience; publish and share mature research results)
- Top priority issues for land transportation security research are : 1) staying operational in the event of a cyber-incident; 2) timely and efficient threat detection, and 3) special security problems of railways as open systems

Stakeholders made the following comments to overcome the research gaps:

- Creating interfaces/systems "layers" to produce early warning alerts
- Increase people's awareness in general of security issues (flyers, younger generations, etc.) among the different players
- Support/enhance knowledge produced by research by promoting a wider dissemination of research
- Definition of strategies to improve the approach to the problem
- Enhance interactions and partnerships for implementing mitigation solutions
- Collaborative work between different players (security forces, infrastructure owners and operators, national authorities, government, intelligence agencies, etc.)
- Improve the record system of criminal occurrences in different transport modes
- Use of dogs as explosive detectors
- Extension of the list of prohibited articles (air security)
- Implementation of a security culture involving society in general and security players in particular

Q7. Do you have any <u>past experience with cross-modal activities</u> in your organization? Please specify.

11 stakeholders indicated that they have previous experience with cross-modal activities, while 1 stakeholder did not respond to this question.
The stakeholders specified various activities such as:

- Management of security in the implementation of various events such as local festivals, marathons and other operations where there is a joint coordination of resources and procedures between the various transport modes, civil protection agents and municipal services
- Partnerships at the level of emergency management, with common emergency plans elaboration and simulation actions across various transport modes
- Regular meetings and know-how transfer with road administration
- Designing integrated bomb-explosion detection systems for critical infrastructures
- Workshops on security in public transportation
- Potential collaboratin with other modes (e.g. railway) for the use of explosive detection dogs
- Road and railway video surveillance data treatment and systems resilience assessment
- Research activities in different transport modes

Q8. What do you think are the common challenges to increase security across modes?

The respondents indicated the following common challenges to increase security across modes:

- Having a set of available tools (technological and procedural) that could increase system resilience and disseminate them across different transport modes
- Increase effective technological monitoring
- Specific training of the security forces to increase security in public transport
- Extracurricular training on security regulations and procedures in different transport modes
- Anti-terrorism preventive action
- Collaborative work to define a common security policy involving the public security forces and public and private operators
- Introduction of CCTV in transport vehicles (mainly road and rail modes)
- Data disclosure
- Shared information with other modes about the entry of problematic passengers in a given mode in order to improve the response readiness
- Recording crime data occurrences in different transport modes (statistics production and analysis)
- Background check of the candidates to staff in all modes
- Adequate training
- Delineation of security sensitive areas + CCTV introduction + control of accesses
- Expanded list of prohibited articles (air mode)
- Regular checking of security equipments
- Lack of interoperability between security system components used by different modes operators
- Inadequate increase of security system against cyber attacks
- Technology development to allow early threat detection
- Collaborative work between different stakeholders and authorities in order to share information and data, consultation for decision making, sharing of best practices among stakeholders
- Effective communication between companies, security forces and other administrations about threats
- Balancing the security requirements with privacy demands of passengers
- Sufficient financial support for the implementation of security measures
- Lack of awareness regarding radioactive material in the area of rail cargo: the challenge is to develop a decision tool in order to calculate the probability assessment of a threat in rail stations/infrastructures
- Increased use of virtual reality in training by creating a virtual reality of the target area that needs to be assessed: this measure would be cost-effective, as it would save monetary resources from performing real-live assessments of various infrastructures and could be applied to air, maritime and rail modes

Q9. Have you been involved in any cross-modal activities in this area (security)? If yes, please elaborate or specify.

10 stakeholders indicated that they have been involved in cross-modal activities in security, while 2

respondents did not answer to this question. The following examples were provided:

- Security management in the implementation of various events such as local festivals, marathons and other operations
- Collaborative work and joint coordination of resources and procedures between different transport modes, civil protection agents and municipal services
- Partnerships and cooperation on emergency management, with common emergency plans elaboration and simulation actions with different transport modes
- Regular meetings and know-how transfer
- Design of integrated bomb-explosion detection systems for critical infrastructures
- Workshops on security in public transportation
- Possibility of collaboration between modes (e.g. railway) for the use of explosive detection dogs
- Road and railway video surveillance data treatment and systems resilience assessment
- Research activities in different transport modes

Q10. What <u>opportunities</u> do you think there are for cross-modal research in enhancing transport security?

The respondents indicated the following opportunities for cross-modal research, related to increasing security:

- There are projects funded by the EU in this area, very interesting and that were never implemented. It would be a good idea to start by listing those projects and try to understand what could be done with those that have potential
- Greater integration between the security forces and critical infrastructures operators
- Aviation anti-terrorism procedures and technologies should be implemented in high-speed rail
- Conventional solutions are harder to implement in urban and suburban rail transport because of discomfort to the user and the opportunity is to identify less intrusive measures of policing and surveillance
- Digital footprint approaches are an important way to trace criminal activity
- Cooperation between public and private entities in combating urban criminal activity
- The hubs of greater interoperability (with different modes) because they are more challenging to manage due to the high influx of users and the impact they have in terms of operation
- Implementation of a security culture at society level using younger generations as a modelling agent (e.g. like what has been done regarding waste recycling)
- Improvement of the AVSEC for all modes, that is, appropriate regulation + adequate training of human resources + technology improvement
- Better and secure communication between partners/players
- Common training sessions for all transport modes
- Combining Standardized Onion-Skin (SOS) Principle, e.g., multiple security layers with increasing security level towards the target area to be protected with Vital Area Security (VAS) Concept
- Opportunity of sharing best practices among stakeholders
- Direct communication between all transport modes companies (technical engineers, decision making entities, etc.) especially in crisis management

- Opportunities for data and best practices exchange

Q11. Would your organization be interested in practical involvement for transferring best practices across modes? If yes, please elaborate.

10 stakeholders indicated that they would be interested participating in transferring best practices across modes, with the conditions that the specific activity would have to be related to specific topics linked to their area of interest. Examples include participation in expert groups, exchange of information through cooperation/partnerships between various stakeholders and society in general, participation in cross-modal projects regarding specific themes (cyber security, surveillance systems, training methods, etc.), using existing technologies to create security systems for cross-modal transport components and developing work on security improvement (for road and railway systems).

10 Appendix D Summary of the 2nd Stakeholder Workshop

10.1 Posters

Figure 22 USE-iT WP3 2nd Workshop Poster with cross-modal challenges

Figure 23 USE-iT WP3 2nd Workshop Poster – Safety

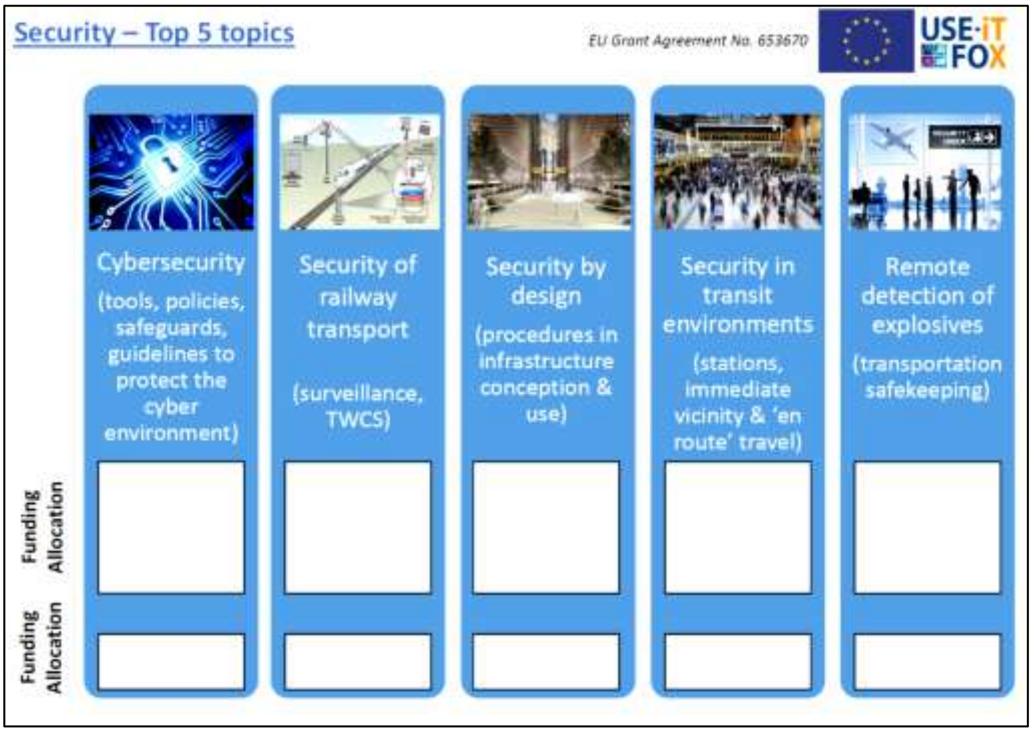


Figure 24 USE-iT WP3 2nd Workshop Poster - Security

10.2 Handouts

Safety Challenges

1. Availability and sharing of high-quality data across transport modes
2. Human factors and safety education
3. Lack of cooperation and data openness between transport operators
4. Interaction between transport modes in a safe and efficient manner
5. Reducing number of fatalities, injuries and number of accidents
6. Driver state monitoring
7. Automation in the context of multimodal transport
8. Exchange of know-how and best practices between different modes
9. Future developments, future technologies and demands and their influence on safety

Description of main research topics for Safety

Data Sharing – A Safety Data pool focusing on cross-modal sharing of data between agencies, authorities

Source: http://www.gs1.org/healthcare/share-data

Currently, there is a lack of in-depth cooperation between agencies and authorities of different transport modes. As mobility becomes more and more cross-modal, a database with highly detailed information across all transport modes (e.g. incident data, fatalities data) could have potential to increase safety. Common data formats and protocols should be taken into account. An example of a database that currently holds incident data is ECCAIRS; it was originally an aviation database that was extended to also include railways and maritime data. Another benefit of this concept could be the detection of weak signals for various trends.

Education and human factors – Updating license acquiring processes including regular training in simulators

Source: http://www.usd.edu/arts-and-sciences/human-

Human error represents the primary cause for accidents. Increasing safety through education has a very big potential. “Drivers” in air, water and rail transport modes are professionally trained, while the training of road drivers cannot be considered so. However, with the coming and implementation of various in-vehicle systems and moreover vehicle automation, the process of acquiring a driver’s license should be updated (e.g. the handover process from the vehicle to the driver, especially in a critical situation should be included in the training). A possible solution would be to have regular training in vehicle simulators.

<u>Safety management strategies</u> <u>at regional/national level to improve safety performance</u>

Setting safety targets at regional/national level is a method that has been proved to increase road safety performance. A similar methodology could be applied to waterborne transport, where according to ETCS (European Transport Safety Council), there are no general safety related strategies. A safety management system could also enable data collection, which would help establish a "safety observatory".

Source:http://www.mtr.com.hk/en/corporate/sustainability/2014rpt/safe-intro.php

<u>Driver state monitoring</u> <u>– Alcohol interlock and Fatigue warning</u>

Human error represents the primary cause for accidents. Therefore the evaluation of drivers' fitness, combined with appropriate mitigation measures could increase safety, e.g. monitoring the driver's state through systems such as alcohol interlock and fatigue warning. It was found that alcohol and drug use is an increasing cause of maritime accidents. Alcohol interlock can prevent road drivers from starting their cars. A similar system could be implemented in maritime transport. Fatigue warning can control the vigilance of a driver and demands feedback at certain intervals. This system, researched for rail transport, could be applied other modes such as road and water.

Source:https://safetycompass.files.wordpress.com/2014/07/drowsydriving.jpg

<u>V2V and V2I communication</u> <u>– Cross-modal communication</u>

Cooperative systems share information using Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) communications. In so doing, the systems can give advice or take actions with the objective of improving safety, while also contributing to transport sustainability and efficiency. Currently, this technology is being implemented in road transport; however, one potential application would be a cross-modal communication between vehicles – cars and trains, especially at level crossings. The vehicle could not only receive warnings about a train passing, but could also automatically brake before a level crossing.

http://www.findingdulcinea.com/news/Americas/2009/feb/Video-of-Near-Misses-Tries-to-Contain-the-Number-of-Rail-Incidents-.html

<u>Automation in transport</u> <u>(e.g. truck/freight platooning, for maintenance work, etc.)</u>

Automation in transport has a high potential to increase safety primarily, but also influence efficiency, travel time, etc. Automation in road transport is still under development at various levels (e.g. fully autonomous vehicles are still in the future); nevertheless, best practices can be applied into other modes. For example,

Source: http://www.citymetric.com/transport/how-will-driverless-cars-change-world-1875 work areas are still a cause for many accidents and automation could bring benefits not only in roadworks but also in rail maintenance work.

Security challenges

1. Cybersecurity
2. Reduction of suicides in railway transport
3. Ensuring security in transit environments while maintaining privacy demands of passengers
4. Crime prevention through environmental design
5. Lack of cooperation between operators, law enforcement, managers and technicians
6. Efficient threat detection (e.g. explosives, terrorism, etc.)
7. Assessment of potential vulnerability in cases of criminal acts or intentional disasters

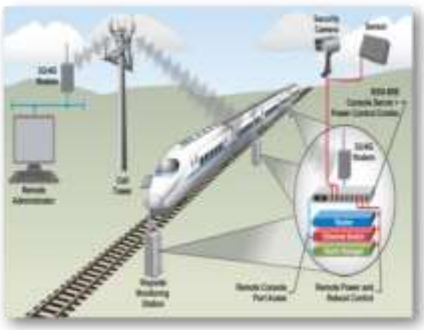
Description of main research topics for Security

Cyber security – collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and user's assets.

Source: http://security.cs.umass.edu/

Cyber security affects surface transportation electronic devices and signalling, transit systems, transport infrastructure, passengers and cargo vehicles. The potential vulnerabilities in transport infrastructure and vehicles need to be mitigated by security protocols and plans ahead of time. It is necessary to understand critical systems, interdependencies and the importance of cyber physical control systems, traffic control and operations management systems, safety management systems, traveller and operator services (511, e-commerce, e-payment). The creation of a cyber security system that incorporates security into the design process, develop policies and procedures for cyber security and improving systems and operations resilience, would bring benefits and motivate users with training, exercises & "hot triggers".

Security of railway transport – This topic aims at developing integrated technology and measures for railway transport security, namely TWCS (train to wayside communication systems).



Source: http://www.wti.com/t-managing-network-devices-in-wayside-railroad-applications.aspx

TWCS makes use of existing commercial telecom infrastructure and combines them with private wireless technologies. Several video analytics solutions have reached a reasonable level of maturity, such as, video tracking, face recognition, intrusion detection and crowd detection. The main barriers are the limited use of TWCS to highways, tunnels entrances, stations or bridges. Other modes (e.g. road, water) could benefit from the security approach developed for rail, namely human/animals trespassing by automatic intrusion detection or tunnel entrance intrusion minimizing unnecessary traffic interruptions and maintenance.

<u>Security by design</u> – <u>There is a considerable scope in the design and planning of station infrastructure to include proven and effective security measures to prevent, mitigate or deter attacks from terrorists.</u>

The measures to improve security include the implementation of appropriate physical secure stations/terminals against bomb blast, CBRN (Chemical, Biological, Radiological and Nuclear) attacks involving particle dispersion and fire events); security procedures (screening, materials detection, intrusion detection systems, and tracking applications) should be considered at all stages of station development. The containment (where possible) of building services and power supplies, locating public car parks as far away from station buildings, creating a distinct separation with other 'crowded places' are examples of possible measures.

Source: http://www.lat27.com.au/projects/qr-2020-station-upgrades/

<u>Security in transit environments</u> – <u>refers to the security of buses stops, stations and interchanges, to the immediate vicinity of transport stops and stations and to the 'en route' travel (on board of different modes)</u>.

Criminal acts are a result of 1) the environment of the transport node itself (e.g., design of platforms, CCTVs, dark corners, hiding places) and, 2) the social interaction within those environments (e.g., poor guardianship, crowdedness). A multi- and interdisciplinary approach is required to tackle transit security and demands more integrated, holistic and cross-disciplinary approach. Also, the identification and assessment of transport infrastructure vulnerabilities regarding man-made threats can contribute to the strengthening of the resilience of the European Transport Network against various man-made hazards, by providing road owners and operators with an easy to manage, practice-oriented tool for the assessment of the infrastructure.

Source: https://www.techinasia.com/ibm-create-smarter-singapore-starting-transport-system

<u>Remote detection of explosives</u> – <u>Recent developments on explosive remote detection are based on advanced optic technology.</u>

A laser system can precisely identify the atomic and molecular structure of the explosives and the device can rapidly and remotely scan the steering wheel or the door of a vehicle (also applicable to luggage, opaque container) and pick up trace residue. The wheeled platform gives the system the necessary portability to the areas to be patrolled (car park, street). Security agents can control the platform remotely from a portable ruggedized lab-computer that receives the results obtained by the detection system. This technology was identified with potential to be applied to maritime transportation.

Source: https://www.tangerinetravel.com/How-to-Expedite-Getting-Through-Security

Main questions for discussion

1. What needs to happen for these technologies/approaches to be implemented?
2. What are the gaps in knowledge?
3. How can different transport modes work together?
4. What are the common research topics for more than 2 transport modes?

10.3 Summary of the 2nd Workshop findings

The Workshop itself was split into two sessions, the first for "Safety" and the second for "Security", in order to leave more time for detailed discussions. Both sessions were kicked-off with a discussion on the **main cross-modal challenges** – there was a common agreement that all relevant challenges have been covered. All participants were in-line with the current considerations (as well as the findings of the stakeholders' interviews). Key drivers for potential cross-modal activities are future vehicle concepts, automation in transport, security of critical infrastructures (natural & man-made hazards), data sharing & cyber security.
After the procedure of funding allocations (i.e. investing virtual money on the specific topics), the implementations issues of the top points, including gaps and research opportunities, were openly discussed.

Safety

The main procedures were explained to the participants (7 in total; all internal USE-iT WP3 partners)
Safety cross-modal challenges were discussed explicitly with all.

1. Availability and sharing of high-quality data across transport modes
2. Human factors and safety education
3. Lack of cooperation and data openness between transport operators
4. Driver state monitoring

The procedure of funding allocation was also explained and fully understood.
Questions and observations arose from the discussion:

- There are many different "players" even in a single mode, which could make it complicated
- What is the need behind big data? It would be better to call it "data processing" (meaning increased capacity to communicate and prevent further problems)
- Driver state monitoring must include human error monitoring
- Handover in automation is crucial and a lesson learnt can be used from aviation (human/machine interaction)

Final rating result (using the funding allocation) was:

1. *Automation (6)*
2. *Driver state monitoring (in-vehicle technologies, alcohol interlock) (5)*
3. *Data sharing (data exchange, big data) (3)*
4. *Safety management strategies (safety targets, risk models) (3)*
5. *Vehicle communication (2)*
6. Education (human factors, driver license processes) (1)

Putting research into practice procedure (and the discussion related):
ad AUTOMATION
What needs to happen for the technology /approach to be implemented?

Implementation *depends on*

- € (cost)/ownership
- Business model
- Discount/incentives
- Safety culture (regulatory) – in connection with ownership of vehicles
- Driver control or NOT (participants thought the driver should be out of the loop – SAE Level 5 automation)
- Regulatory aspects
- Standards
- Education & liability

What could bring together private and professional drivers (a point which really separates cross-modal initiatives)?

- Insurance
- Enforcement

Security

All of the participants (10 in total; 3 external stakeholders) were experts in the topic of security and the discussions were very lively (although strong and contradictory arguments ensued, results were still guaranteed). For some concepts, the meaning and real scope were discussed in detail. Several implications on using some of the concepts selected (from the list of five) should be discussed and incorporated in the final list.

Final rating result (using the funding allocation) was:
The results of the funding allocation procedure were (with an equal result to the 2nd, 3rd and 4th):

1. *Security by design (8)*
2. *Security in transit environments (7)*
3. *Remote control of explosives (7)*
4. *Cybersecurity (7)*

Putting research into practice procedure (and the discussion related):

- Cybersecurity is a fundamental cross modal issue in its nature.
- Security by design is in the early stages of a complex process to provide security, which belongs to the construction of an infrastructure. Real world testing is needed.
- There was not a consensus about the scope of remote detection of explosives (transportation safekeeping). Some would call it remote detection of threats (automated image-processing is already done – even high resolution videos are used). Include social aspects, physical characteristics, education…
- Insurance policies, risk analyses, liability and ownership are key points to implementation
- Reinforcement of collaborations (regulatory); lack of communication cooperation