Urban, Suburban and Regional Rail Research Roadmap

ERRAC-ROADMAP WP03: (SUB)URBAN TRANSPORT
(including modal shift, suburban and regional rail, light rail and metro, and sustainable urban mobility)

SUB-WP03 – RAIL

JUNE 2012

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INTRODUCTION

This research action is supporting the works of the ***European Rail Research Advisory Council (ERRAC)*** set up in 2001. ERRAC is an advisory body to the EU Commission representing Member States and all stakeholders in the sector ranging from operators and infrastructure managers, to manufacturers, freight customers, passengers and academics. Its mission is to develop recommendations regarding European research impacting the rail sector across the EU and beyond.

The ERRAC-ROADMAP CSA addresses the five 'activities' reflecting the strategic and policy challenges facing Europe, as defined by the Commission for the FP7 Transport Work Program sub-theme "Sustainable Surface Transport":

WP01 The **greening** of surface transport,
WP02 Encouraging modal shift and **decongesting** transport corridors,
WP03 Ensuring **sustainable urban transport**,
WP04 Improving **safety and security**,
WP05 **Strengthening competitiveness**

Work package 03 is led by UITP, representing several categories of stakeholders and mainly European local public transport operators (see www.uitp.org). Ansaldo STS supports UITP in its coordination work on behalf of UNIFE representing all the major manufacturers in the European R&D.

Work Package 03 covers two sub-Work Packages:

- **WP03-RAIL**, which includes on the one hand suburban and regional rail systems and on the other urban rail systems like tramway, light rail and metro;
- **WP03-URBAN MOBILITY**, which targets modal shift and sustainable urban mobility.

This deliverable addresses the final sub-WP03-Rail Roadmap. It is the third update of the WP03-Rail Roadmap which was published first in June 2010 and second in May 2011.

CHAPTER I: PRESENT SITUATION

1. Overview of the present situation

Efficient urban, suburban and regional transport systems are critical elements of the sustainable development of urban areas, where already some 80% of Europe's citizens live.

Urban public transport and especially rail systems have numerous advantages, which shall never be shared by private car transport in terms of e.g. speed, capacity, safety, environmental friendliness, energy savings and urban space consumption. At the same time, car ownership and car use is increasing every day due to a great variety of attractive technical innovations which are easy to standardise and to implement on private vehicles and on roads or streets in comparison to rail systems. Rail systems and especially (sub)urban rail systems are indeed far more complex technically than road systems and they involve for their management many more (public) stakeholders than private or commercial vehicles traffic management. In addition, local rail transport services are operated under public transport contracts following public service requirements, which represent a heavy financial burden on local authorities for rail services financing and rail systems funding as long as negative external costs of motorised road vehicle are not internalised. As a consequence (sub)urban rail will not be able to compete with private cars without an important improvement of public transport attractiveness, and a reduction in investment and operating costs.

This implies an important investment in rail research, a strong support from public authorities, and an agreement between local/regional/national public authorities, rail operators (railway undertakings and infrastructure managers), and railway manufacturers to coordinate across Europe for technical harmonisation of products and services where it allows to bring European added value. This is the major challenge of WP03. At the same time, the European rail manufacturing industry is a world leader for urban rail systems (metro, tramway and light rail) and has achieved significant innovation for the benefit of the customer (e.g. low floor tram), but has to remain competitive for most promising markets in Europe and outside Europe, especially in China and other Asian markets.

In this perspective, the goal of WP03 is twofold. The current deliverable presents only the Rail part. The other is described in the **WP03-Urban Mobility Roadmap.**

From the rail point of view, the goal of the project is to contribute to achieving a European approach and vision of what is at stake in Europe and outside Europe and of what should be achieved for (sub)urban rail research, and to set up a roadmap for (sub)urban rail research at European level, with a view to:

- **improving cost effectiveness** of investment and operation of rail systems, and more generally of integrated high quality public transport systems, and developing more competitive rail related transport products and services, enabling Europe to strengthen its position within Europe and outside Europe as the world leader for rail public transport;
- **increasing the attractiveness** of integrated public transport systems for existing passengers and for potentially new customers, meeting end-users expectations for all categories of populations and trip purposes, and achieving more attractive rail related transport products and services.

In order to better understand what is at stake regarding the urban, suburban and regional rail sector, the project includes one small additional task, in order to clarify the current and potential evolution of the tramway, metro and light rail market and its relationship with research goals relevant for this sector. **The study "Light Rail and metro systems in Europe"** produced by ERRAC in 2004, has been updated and complemented by information on urban rail passenger traffic. It includes facts **on the current and potential evolution of Eastern countries light rail market**, especially in relation to the current grade of protection of tram and light rail right-of-ways from the general traffic congestion. The final report of this task is presented as a separate document, entitled: "METRO, LIGHT RAIL AND TRAM SYSTEMS IN EUROPE – 2009 - Report of a study carried out by the UITP on market perspectives and research implications."

2. Policy drives and constraints

2.1. Challenges to face for the (sub)urban rail sector

There are many challenges to face for **(sub)urban rail**, especially when taking into account the long life cycle of rail systems and the difficulty to renovate and/or upgrade existing systems (e.g. light rail systems in Eastern Europe and most successful – and therefore congested - metro lines in mega cities like Paris or London). New concepts for operation and maintenance of (sub)urban rail systems, sub-systems and components are needed, as well as a better understanding of what makes railway transport attractive for the end user (include quality of services and interfaces between transport modes), in order to produce new and more cost effective services, rolling stock and equipment. Innovation and improvement in these fields will also be brought through technical harmonisation of interfaces and major characteristics, regarded as a prerequisite for more competitive products: in this case, the objective will be to achieve at European level (and even worldwide, thanks to standardisation) interchange ability of railway sub-systems and products facilitating "plug-and-play" replacement for their renovation or upgrade, taking into account the specificities of each category of rail system (non-interoperable metro, tramway and light rail systems, interoperable or not suburban and regional rail systems, mixed systems like tram-train). This approach, clarifying the urban rail systems architecture

and interfaces, will also provide new opportunities for SMEs in the innovation process and in the supply of "plug-and-play" new railway products.

More and more large and medium-sized European cities introduce or extend metro and/or light rail systems which represent a very large –and growing– market in Europe and worldwide. In Europe, the systems are all operated under public service contracts. In that regard, integration between rail modes and road based public transport modes (buses, shared taxis…) (and sometimes also waterborne services like city ferries) will be a key for success, whereas "seamless" public transport improved cost effectiveness and increased attractiveness will be the most important objectives, thanks to increased accessibility, increased regularity or punctuality - depending on the frequency - , increased comfort and security, better information before and during trip within vehicles, stations and connecting spaces, and reduced and guaranteed door-to-door travel time.

Concerning the developments of the **suburban and regional rail services** based on conventional (interoperable) rail systems, two situations have to be faced:

- in the remote low density areas, regional rail services have to be operated and designed in order to make them attractive enough to avoid their cancellation (e.g. through the creation of new regional train services or of tram-train services, as it has been successfully achieved in Western Europe in the recent years);
- in the densely populated regions and/or around the larger cities, suburban and regional rail systems will be constantly extended and improved in terms of frequency, user-friendliness, reliability, seamless ticketing and pre-trip, during trip and after trip information. Co-modality with other transport modes – and especially urban public transport - will be better co-ordinated. Moreover, technology will enable the railways to guarantee a high level of perceived personal security in these 'open' systems. This will go hand in hand with the trend of decreasing quality of road transport in and around cities (due to congestion), resulting in a modal shift from road to rail on these very large markets.

New Member States have also specific requirements regarding local rail, for maintaining and improving the passenger transport rail market share in these countries where private car ownership is growing rapidly.

2.2. Recent European Commission Communications

Several EC legislative texts have been taken into account as input for the roadmap:

- The Communication COM(2009) 279 (final) adopted in June 2009 "*A sustainable future for transport: towards integrated, technology led and user-friendly system*" on which every European representative rail association has taken a position.
- The outcomes of the EC conference on a "*Sustainable Future of Transport*" organised on 20th November 2009 (with UITP participation).

- **The new White Paper on Transport COM(2011) 144 final "*Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system*" published on 28th March 2011.**
- The set of five proposals for the post-2013 Union Research Budget adopted on November 30th, 2011:
  - A communication COM(2011) 808 Final "**Horizon 2020 - The Framework Program for Research and Innovation**"
  - A proposal COM(2011) 809 Final for a regulation establishing "Horizon 2020 – the Framework Program for Research and Innovation (2014-2020)" which lays down the general objectives, rationale and Union added value, the financial envelope and provisions on control, monitoring and evaluation;
  - A proposal COM(2011) 810 Final for a regulation laying down the rules for the participation and dissemination in "Horizon 2020 – The Framework Program for Research and Innovation (2014-2020)" including the modes of funding and reimbursement of costs, conditions for participation, selection and award criteria and the rules on ownership, exploitation and dissemination of results;
  - A proposal COM(2011) 811 Final for a Council Decision establishing the Specific Program implementing "Horizon 2020 – The Framework Program for Research and Innovation (2014-2020)" laying down the implementation modalities and the content in terms of the broad lines of activities;
  - A separate proposal COM(2011) 812 Final for the part of Horizon 2020 corresponding to the Euratom Treaty.

The White Paper on Transport "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" is directly influencing the recommendations of the report as well as the content of the last FP7 SST calls and of the next European Research Framework Programme.

Within this policy context, the set of proposals "**Horizon 2020 - The Framework Program for Research and Innovation**" focuses resources on three key priorities, all of which are relevant for rail:

- **Excellent Science**
- **Industrial Leadership**
- **Societal Challenges**

All these priorities have been already supported by the rail sector, and four of the societal challenges are particularly relevant for rail:

  - **Secure, clean and efficient energy;**
  - **Smart, green and integrated transport;**
  - Climate action, resource efficiency and raw materials;
  - **Inclusive, innovative and secure societies.**

CHAPTER II: STATE OF THE ART, RECENT PROJECTS, ONGOING RESEARCH

1. EU R&D rail projects: a long story of cooperation between the rail associations and the European Commission

Since the adoption of a European Union rail transport policy about 20 years ago, the main line rail operators and their associations (UIC, CER, EIM and UITP) have been involved with the rail manufacturing industry coordinated by UNIFE in major EU R&D rail projects. Indeed the three pillars for a more competitive European railway industry are:

- European legislation,
- Standardisation and technical harmonisation,
- European Research.

The more detailed story regarding Rail European Research starts on 14th May 2001, when the rail associations presented to Commissioner Busquin (Research) a document named "*Joint Strategy for European Rail Research 2020 – Towards a Single European Railway System"*. Further to this presentation, Commissioner Busquin proposed to the rail organisations to continue elaborate the document, together with the Commission services, in the context of the European Research Area, from which a strategic research agenda could be derived and implemented through collaboration between EU, national and private organisations. The aims was to improve synergy, to better serve society's needs, to lead to sustainable transport (as highlighted by the Gothenburg Summit and the White Paper on Transport policy) and, finally, to strengthen the competitive leadership of the European rail industry. A "*Memorandum of Understanding*" on this issue has been signed in Naples on 8th June 2001 by the rail organisations and by the Transport and Energy Commissioner Loyola de Pallacio.

Rail organisations welcomed the idea of developing a long standing commitment by all stakeholders – rail industry, rail operators, infrastructure managers, public authorities and regulators, research institutes and academia – to work in closer partnership, with the aim of strengthening and reorganising research and development efforts in Europe. To this end the Commission and the rail organisations agreed to establish the "European Rail Research Advisory Council – ERRAC", launched in Köln on 26th November 2001 during the World Conference on Railway Research (WCRR). An ERRAC Strategic Rail Research Agenda 2020 was then prepared – which has been updated in 2007 – in order to optimise the rail research potential within the Union, materialising the concept of a "European Research Area" in this industrial sector.

The State-of-the-Art with regard to research needs and actions focusing on rail systems has been described in various documents presented on ERRAC website (see www.errac.org).

ERRAC members have also been partners of an FP6 project called EURNEX, the

European rail Research Network of Excellence (2004-2008; Budget: M€6, EC grant 100%). EURNEX was composed of:

- 63 universities and research centres from 18 EU member states and Russia;
- More than 600 researchers;
- The international associations UNIFE, UIC and UITP representing the research customers: operators and supply industry incl. SMEs

EURNEX has successfully turned into a self standing legal entity by November 2007. EURNEX developed a Knowledge Management System for Rail Research projects (EURNEX KMS) which can be consulted at: http://www.eurnex.net/kms.shtml

2. EU R&D urban rail projects: a joint cooperation between the UITP, UNIFE and the European Commission

From November 1997, the urban rail industry has developed through UITP (operators) and UNIFE (manufacturers), their representative associations, a close partnership in order to improve the internal market in rail mass transit (tramway, Light Rail and metro and other rail systems which are not interoperable within the European community railway system). In that regard, from early 1998, both associations have had a close joint cooperation with the European Commission in three domains:

- **Technical harmonization and standardization.** UITP and UNIFE launched in March 1998 the joint initiative MARIE – Mass Rapid transit Initiative for Europe - under the aegis of two EC Commissioners, Transport and Industry1, which produced a number of recommendations before being relayed by EU R&D projects and more specific joint UITP and UNIFE actions (see hereinafter). Far more recently, in February 2011, and following a joint initiative of the joint UITP-UNIFE "Urban Rail Platform" (see next paragraph) the European Commission gave the mandate M/486 EN to the European Standardisation Organisations CEN, CENELEC and ETSI for "Programming and Standardisation in the field of Urban Rail". This mandate stipulates that: "While developing standards for urban rail, where appropriate, principles, elements, concepts and technical specifications applied for conventional rail should be taken into account. Where appropriate, the results of the research projects such as "LibeRTiN"(FP5), "MODURBAN" (FP6), "URBAN TRACK" (FP6) and "MODSAFE" (FP7) should be taken into account" (see below information about these projects).
- **Legislation**. UITP and UNIFE created in 2003 a "Draft Urban Rail Directive" – DURD – Working Group, in partnership with DG Enterprise, in order to prepare a proposal for a Directive on tramway, Light Rail and metros systems, all those systems which are not "interoperable" with the European Community rail system. This initiative failed after an official European consultation in 2004 and 2005 launched on the basis of a draft Directive prepared by the DURD Working Group, since the proposal was opposed by some countries. UITP and UNIFE replaced in November 2007 the DURD Working Group by the "Urban Rail Platform", which proposed to the EC Directorate General for

[1] Neil Kinnock (transport) and Martin Bangemann (Industry).

Transport (DG TREN - now DG MOVE) a specific approach for urban rail systems which has been endorsed by the EC and by the Member States (through the RISC, Railway Interoperability and Safety Committee) in November 2008 and originated the mandate M/486.

- **European Research**. UITP and UNIFE have been both active in the setting up and support of ERRAC. Their joint action towards EU R&D has always been to develop jointly - and with the active support of a critical mass of their members - major projects aiming at producing guidelines for technical harmonisation or recommendations for standardisation of urban rail systems.

3. Major references of EU projects in the field

UITP and UNIFE and their members have been directly involved as partners or coordinators in numerous EU R&D rail projects:

- Under FP5: LibeRTiN - *Light Rail Thematic Network*
  (2002-2005; Budget: M€1.1, EC grant: 100%; 7 partners; coordinator: TTK - Transport Technologie - Consult Karlsruhe GmbH).

- Under FP6:
  - EURNEX - *Network of Excellence* (see above clause 2.1)
  - MODURBAN - *Modular Urban Guided Rail System* - (2005-2009; Integrated Project; Budget: M€19.1, EC grant M€10.4; 39 partners; coordinators: ALMA and UNIFE)
  - URBAN TRACK - (2006-2010; Integrated Project; Budget: M€18.6, EC grant M€10; 28 partners; Coordinator: D2S International)
- Under FP7:
  - MODSafe - *Modular Urban Transport Safety and Security Analysis* - (2008-2012; Collaborative Project; Budget: M€5.2, EC grant M€3.5; 22 partners, coordinator: TÜV Rheinland InterTraffic GmbH - TRIT)
  - OSIRIS - *Optimal Strategy to Innovate and Reduce energy consumption In urban rail Systems* - (2012-2014; Integrating Project; Budget: M€7.4, EC grant M€4.3; 16 partners; Coordinator: UNIFE)

3.1. LibeRTiN (FP5)

The first joint UITP-UNIFE project – in line with the first ERRAC SRRA - was "LibeRTiN", for *Light Rail Thematic Network*. Its purpose was:

- first to inventory and to question the various technical standards used for Light Rail in the EU countries,
- then to develop recommendations approved by both UNIFE and UITP for the simplification and harmonisation of these standards at the European level[2].

[2] At the time it was also expected to help the preparation of a future directive on urban rail by the Commission.

The outcomes of LibeRTiN (see Annex 1, clause 1.1 for more details) have been presented by CEN TC256 Chairman (Dee Razdan) in UITP Helsinki World Congress, June 2007:

- TC256 has been made aware of the Libertin project in 2005 and requested top ten needs for light rail. These were produced.
- Wherever possible the emerging European standards (EN) have covered the requirements of Light Rail. About 30 ENs have been impacted.

3.2.MODURBAN (FP6)

MODURBAN - *Modular Urban Guided Rail System* – was the follow-up of a FP5 project developed from March 2002 to March 2004, UGTMS – Urban Guided Transport Management System – equivalent for urban rail systems of the ERTMS project for main line.

The main target of the MODURBAN project was to design, develop and test an innovative and open common core system architecture and its key interfaces (this covers Command Control, energy saving and access subsystems), paving the way for the next generations of urban-guided public transport systems and applicable to both new lines and to the renewal and extension of existing lines. MODURBAN has produced numerous deliverables of great interest for the tramway, light rail and metro sector, some of which fully public and some others partially public (see Annex 1, clause 1.2 for more details).

These deliverables are presented in the following pages:

Fully public MODURBAN deliverables

Public deliverables are available in their entirety to anyone for free use and can be downloaded at: http://www.modurban.org/

Item N°	Detailed Name	Subproject
D10	Intelligent Automatic Driver Specification and Simulation Report	MODONBOARD
D11*	Intelligent Driving Prototyping	MODONBOARD
D12*	Integration and Validation Plan and Reports	MODONBOARD
D13*	Demonstration on Test Track	MODONBOARD
D39*	Data Communication System Functional Requirements	MODCOMM
D46	Requirements, list of relevant Standards for Onboard PIS	MODACCESS
D115	Requirements, list of relevant Standards for Wayside PIS	MODACCESS
D47	Functional Interface specification for PIS (onboard + wayside)	MODACCESS
D116	Report on Optimised Application of Video and Audio Surveillance Systems	MODACCESS
D48	Information for Passengers both in Driverless Trains	MODACCESS

	and on Platform	
D49	Passenger Related Functions in Degraded Modes, Passenger Emergency Functions	MODACCESS
D50*	Final report: validation of results	MODACCESS
D51	Guidelines/definition of Requirements for Door Systems on Innovative Driverless Urban Transport Systems	MODACCESS
D52	Guidelines/definition of Requirements to Interface with Platform Screen Doors	MODACCESS
D53	Define PSD Functional and Non Functional, including Interfaces Requirements + Develop PXSS Concept	MODACCESS
D54	Definition of Installation Requirements for (New) & Existing Stations	MODACCESS
D129*	Global Glossary	MODSYSTEM
D80	Comprehensive Operational, Functional and Performance Requirements	MODSYSTEM
D86	Safety Conceptual Approach for Functional and Technical Prescriptions	MODSYSTEM
D87	Human factors and System Design – Integrated system for "Auditing" Safety Levels of Urban Guided Systems	MODSYSTEM
D128	Risk Assessment based on Human Factors	MODSYSTEM
D126	Preliminary Safety Plan	MODSYSTEM
D127	Preliminary Hazard Log	MODSYSTEM
D90	Generic Model / Guidelines for Risk Analysis	MODSYSTEM
D91	Database of Non-Conformity Events	MODSYSTEM

Partially public MODURBAN Deliverables

In order to safeguard the Intellectual Property Rights (IPR) and other confidential information of some MODURBAN consortium members, only selected parts of these deliverables are available to anyone for free use and can be downloaded at: http://www.modurban.org/.

Item N°	Detailed Name	Subproject
D26	Tools Benchmarking Report including Formal Language Selection	MODWAYSIDE
D40	Data Communication System Performance, Reliability and Maintenance Requirements	MODCOMM
D42	MODURBAN DCS Interface and User's Guide	MODCOMM
D59	Final version of Optimisation Software and Test	MODENERGY
D66	Description and Specification of the three Design Concepts using Light Weight Materials	MODENERGY
D67	Quantification of Energy Savings and Economic Benefits	MODENERGY
D121	Examples of Mass Transit Operation scenarios and of Migration Paths	MODSYSTEM
D85	MODURBAN Architecture, Identification of Key	MODSYSTEM

	Interfaces and some Preliminary FIS	
D88	Requirements and Specification for Data Collection Tool of Non-Conformity Events	MODSYSTEM
D93	Conformity Assessment, Guidelines for Functional and Technical Specifications	MODSYSTEM
D97	Test Reports	MODSYSTEM

The project MODSAFE underway (see below § 2.1.2.4) is a follow-up of MODURBAN.

3.3. URBAN TRACK (FP6)

The title is self explaining. This four year research project aimed at developing, testing and validating innovative products for urban rail track infrastructure, in full accordance with the ERRAC 2020 vision: high capacity, reliability, high comfort & safety, easy access, seamless travel. Building blocks and a comprehensive toolbox have been developed with five innovative new products, six innovative analysis methods, and three innovative reference documents (see Annex 1, clause 1.2 for more details).

The projects deliverables publicly disseminated are available at:
http://www.URBANTRACK.eu

They are as follows:

No	*Title*
D1.3	Report on "Design of green tram tracks"
D1.4	Small prototypes of green tram tracks for lab tests
D1.5	Report on "Design of interface between rail and street pavement"
D1.6	Small prototypes of new interface between rail and street pavement for lab tests
D1.9	Report on "Rapid installation methods for modular track systems"
D1.10	Small prototypes of modular tram systems required for lab testing of fast installation methods
D1.12	Report on "Damping models for urban rail systems"
D2.1	Report on "New low cost renewal & refurbishment methods for tracks in tunnels and on bridges"
D2.2	Report on "New low cost renewal & refurbishment methods for tracks at grade with segregated right of way"
D2.3	Report on "New low cost renewal & refurbishment methods for embedded tram tracks
D2.4	Proposal for "European Standard for Track Inspection and Maintenance"

D2.5	Report on "Improved Monitoring Techniques"
D2.6	Report on "Tribological behaviour in wheel/rail contact with lubrication and its effect on preventive maintenance
D2.7	Report on "Optimised predictive maintenance tools" (using dynamic bayesian methods)
D2.8	Report on "Rail wear in curves and special track work for trams"
D4.1	Specification for a LCC model software (restricted access)
D4.6	Report on "Methodology for socio-economic costs of track installation for residents"
D4.7	Application report on "Socio-economic costs of track installation for residents at validation sites (SP3)"
D5.3/4	Reports on "Functional specifications for track infrastructure" (First/Final)
D6.1	Technical consolidation report on all conceptual designs and selected methods: new modular track system installation methods, renewal methods, maintenance methods
D6.2	Technical consolidation report on all validation results
D6.3	Report on the creation of the Network of Operators (UITP) and of the Network of Industries (UNIFE)
D6.4	Final report on the actions achieved by UITP and UNIFE with regard to the Network of operators and Industry
D6.5	Communication/dissemination plan
D6.6	Report on actions taken to raise stakeholders participation and awareness

3.4.MODSafe (FP7)

MODSafe – *Modular Urban Transport Safety and Security Analysis* – is a four year project which started on 1st September 2008 and uses as a basis a number of MODURBAN deliverables. MODSafe project is addressing Safety Requirements, Safety Models, Responsibilities and Roles and Safety Approval, Acceptance and Certification Schemes of Urban Guided Transport (tram, Light Rail and metro) and defines recommendations on the full Safety Life Cycle which can be applied on a voluntary basis throughout Europe (see Annex 1, clause 2.1 for more details).

The projects deliverables publicly disseminated are available at:
http://www.modsafe.eu

They are – or shall be soon - as follows:

Deliverable	**Deliverable name**
D1.1	First Draft-State of the art on Safety responsibilities and Certification
D1.2	Final report – State of the art on Safety responsibilities and Certification

Deliverable	Deliverable name
D2.1	First List of Hazards, Preliminary Hazard Analysis (PHA)
D2.2	Consistency Analysis and Final Hazard Analysis
D2.3	MODSafe Risk Analysis
D3.1	Preliminary Hazard Control and Safety Measures Analysis
D3.2	Final Hazard Control and Safety Response Measures Analysis
D4.1	State of the Art Analysis and Compilation of Previous Projects
D4.2	Analysis of Common Safety Requirements Allocation for MODSafe continuous Safety Measures and Functions
D4.3	Analysis of On Demand Functions and Systematic Failures
D5.1	Urban Guided Transport Object Safety Model
D5.2	Combined Object/Function Guided Transport Model
D5.3	Safety Attributes Allocation Matrix
D6.1	Survey of current safety life cycle approaches
D6.2	Comparison of current safety life Cycle approaches
D6.3	Proposal of a common safety life cycle approach
D7.1	Review of current AAC procedures
D7.2	List of elementary activity modules
D7.3	Generic model of AAC processes
D7.4	Proposal of an exemplary AAC process
D8.1	Review of existing means and measures for security systems
D8.2	Guiding principles for the case by case definition of preliminary requirements for technology procurement and application
D8.3	Guiding principles for security and emergency prevention and management
D9.1	Hazard scenarios related to security aspects
D9.2	Database for classification of risks associated to security
D9.3	Proposals for mitigating security risks and threats

3.5. TRANSFEU (FP7)

TRANSFEU – *Transport Fire Safety Engineering in the European Union* –, is an ongoing focused research project involving UNIFE and some UITP members (UITP could not participate for lack of internal resources) which started on 1st April 2009 for 42 months (Budget: M€5.58, EC grant M€3.7; 21 partners; coordinators: UNIFE and ALMA).

TRANSFEU develops a holistic approach of fire safety-performance based-design methodology able to support the finalisation of the CEN EN 45545 Part 2 for a dynamic measure of toxicity and to propose an alternative to the current Fire safety regulation and standard (Technical Specifications for Interoperability – TSI - on Safety in Railway Tunnels and TS 45545) (see Annex 1, clause 2.2 for more details).

The projects deliverables publicly disseminated shall be made available at:
http://www.transfeu.eu

3.6. OSIRIS (FP7)

OSIRIS – *Optimal Strategy to Innovate and Reduce Energy Consumption In Urban Rail Systems* – started on 1 January 2012 for 36 months (Budget M€7.3, EC grant M€4.3; 17 partners: coordinator UNIFE with AREVA as technical leader). Its focus is energy efficiency in local rail systems (systems and operations).

OSIRIS objectives are as follows:

- reduction of the overall energy consumption **within Europe's urban rail systems of 10% compared to current levels by 2020**
- develop a systematic wide ranging evaluation and bench marking of energy consumption (AC and DC) in urban rail systems, including; rolling stock, infrastructure and operations
- provide energy consumption KPIs and decision support tools for system selection and operation
- allow storage/reuse of energy especially regenerative energy coming from braking - not only on board vehicles but also within stations or on the wayside
- Identification of the safety risks for the customer and the staff associated with the new technologies for energy storage
- Solutions to avoid heat dissipation in tunnels, stations and rolling stock.

Main expected results are:

- Definition of standard urban rail duty cycles
- Holistic model framework with interfaces to company specific multi-train tools, but with the innovation of the 'thermal' aspects
- Safety risk assessment of onboard energy storage systems
- Technical Recommendations for the use of onboard energy storage systems
- Validation and demonstration based on real use cases

OSIRIS should also address some specific technological innovations:

- auxiliary converter and innovative transformer development;
- onboard storage Li-Ion development;
- infrastructure HVAC system efficiency improvement through heat pump;
- smart grid...

OSIRIS website: http://www.osirisrail.eu

3.7. Projects non-rail but impacting the local rail sector

Some additional important projects for urban rail systems have a scope which is not limited to rail but which covers as well other urban public transport systems (road based like bus or waterborne like ferries). Such projects e.g. COUNTERACT (fight against terrorism), EURFORUM (European recommendations for research impacting urban mobility), IFM-Project (recommendations for Interoperable contactless

Ticketing Management in Europe) and SECUR-ED (*Secured Urban Transportation - European Demonstration*) are presented in the ERRAC WP03 ROADMAP on Urban Mobility.

4. Recent proposals EU R&D projects covering urban, suburban and regional rail

The partners of WP03-Rail Roadmap have been associated to the works of the various research support actions of ERRAC since the creation of the ERRAC European Technology Platform. They have **contributed each year to the identification of research actions** to be proposed to DG RTD for the next call. All the projects above mentioned in clause 2.2 are part of these research actions.

In December 2011, several WP03 partners proposed under SST call 2012 ("call 5") of Summer 2011 various proposals. UITP and UNIFE joined one "rail" proposal as partners under the acronym "**e-rail50**" - European mobility by electrified rail: planning towards 2050 - lead by UIC, under Activity 7.2.2 Encouraging modal shift and decongesting transport corridors, Area 7.2.2.4. Quality of rail service, addressing the topic SST.2012.2.4-1. Planning rail towards 2050 (CP-FP, max 3).

CHAPTER III: VISION

1. ERRAC SRRA 2020 and UITP PT X 2

ERRAC has produced a vision 2020 for the European Rail transport system and a Strategic Rail Research Agenda (SRRA 2020) first published in 2002 and updated in 2007. ***The SRRA 2020 of 2007 is a basic reference document for the current ERRAC-ROADMAP research action. It is presented on ERRAC website (www.errac.org).***

ERRAC SRRA sets out a Railway Business Scenario based on:

- **Rail doubling its share of both the freight and passenger markets by 2020, and**
- **Rail tripling its freight and passenger market volumes in 2020 as compared with 2000.**

The ERRAC-ROADMAP CSA project provides the coordination and guidance to implement what is needed to turn the ERRAC vision of rail future and ERRAC SRRA recommendations into a reality.

It has to be noted that the ERRAC vision has been in June 2009 enlarged by UITP to all public transport modes, when UITP set out an ambitious aim to double the market share of public transport worldwide by 2025. This ambition goes by the name of '**PTx2**'. Whilst this aim is undoubtedly bold, it is not unrealistic: many cities have already taken up the challenge and are working towards this goal, in line with their specific political, geographical and historical contexts. More information can be found at: http://www.ptx2uitp.org/

2. Insights from the new White Paper on Competitive and Sustainable Transport

The White Paper sets out a "vision" which includes many issues impacting the urban rail sector.

It would be inappropriate to extract from the White Paper all the references potentially involving local rail. However, some of them which are particularly relevant for this sector are quoted below:

(Clause 2.2.) An efficient core network for multimodal intercity travel and transport

(22). In the intermediate distances, […]. More resource-efficient vehicles and cleaner fuels are unlikely to achieve on their own the necessary cuts in emissions and they would not solve the problem of congestion. They need to be accompanied by the consolidation of large volumes for transfers over long distances. This implies greater

use of buses and coaches, rail and air transport for passengers and, for freight, multimodal solutions relying on waterborne and rail modes for long-hauls.

(23). Better modal choices will result from greater integration of the modal networks: airports, ports, railway, metro and bus stations, should increasingly be linked and transformed into multimodal connection platforms for passengers. Online information and electronic booking and payment systems integrating all means of transport should facilitate multimodal travel. An appropriate set of passengers' rights has to accompany the wider use of collective modes.

(Clause 2.4.) Clean urban transport and commuting

(31). A higher share of travel by collective transport, combined with minimum service obligations, will allow increasing the density and frequency of service, thereby generating a virtuous circle for public transport modes. Demand management and land-use planning can lower traffic volumes. Facilitating walking and cycling should become an integral part of urban mobility and infrastructure design.

(32). […]. Road pricing and the removal of distortions in taxation can also assist in encouraging the use of public transport and the gradual introduction of alternative propulsion.

(33). The interface between long distance and last-mile freight transport should be organised more efficiently. The aim is to limit individual deliveries, the most 'inefficient' part of the journey, to the shortest possible route. The use of Intelligent Transport Systems contributes to real-time traffic management, reducing delivery times and congestion for last mile distribution. […]

(Clause 2.5.) Ten Goals for a competitive and resource efficient transport system: benchmarks for achieving the 60% GHG emission reduction target

Developing and deploying new and sustainable fuels and propulsion systems

(1) Halve the use of 'conventionally-fuelled' cars in urban transport by 2030; phase them out in cities by 2050; achieve essentially CO_2-free city logistics in major urban centers by 2030[3].

Increasing the efficiency of transport and of infrastructure use with information systems and market-based incentives

(8) By 2020, establish the framework for a European multimodal transport information, management and payment system.

(9) By 2050, move close to zero fatalities in road transport. In line with this goal, the EU aims at halving road casualties by 2020. Make sure that the EU is a world leader in safety and security of transport in all modes of transport.

3 This would also substantially reduce other harmful emissions.

(10) Move towards full application of “user pays” and “polluter pays” principles and private sector engagement to eliminate distortions, including harmful subsidies, generate revenues and ensure financing for future transport investments.

CHAPTER IV: ROADMAP DEVELOPMENT

1. The input from ERRAC SRRA

The ERRAC SRRA 2020 identified 7 priority research clusters for the rail sector:

1. **Intelligent Mobility**
2. **Energy and Environment**
3. **Personal Security**
4. **Test, Homologation and Safety**
5. **Competitiveness and enabling technologies**
6. **Strategy and Economics**
7. **Infrastructure**

Based on detailed research topics proposed in the ERRAC SRRA[4], and on other documents prepared by ERRAC (e.g. RAIL 21) or by UITP (UITP SRA), a questionnaire[5] has been issued[6] to specify the level of priority for research (on a scale 1 to 5, 1 being the highest priority and 5 a low priority) as well as the possible involvement of the responder in case a research action would be selected (leader, partner, member of a "users' group" or no involvement). The questionnaire has been largely disseminated in UITP and UNIFE membership, through e.g. for UITP the three rail committees (Suburban and Regional Rail Committee, Light Rail Committee, Metro Committee), the European Union Committee, and several UITP Commissions (e.g. Transport and urban life, Marketing, Academic network…).

The Rail questionnaire was first sent out in April 2010 with a reply request before the end of the month. A second step to the consultation was sent out in August 2010 (with a deadline for response of September 2010).

2. The input from stakeholders

As a whole 21 comprehensive answers to the above mentioned questionnaire were received from the following organisations:

- **Industries:**
  - Altpro
  - CAF
  - Thales Transportation Systems Division
  - Bombardier Sweden
  - Faiveley Transport
  - Dellner Couplers
  - Vae GmbH

[4] http://www.errac.org/IMG/pdf/SRRA-2007.pdf
[5] See Annex 2
[6] Another questionnaire has been produced for WP03-Urban Mobility.

- Euromaint Rail AB
- Ansaldo STS
- Ansaldobreda

- **Operators:**

  - Ferrocarrils de la Generalitat de Catalunya
  - Stuttgarter Straβenbahnen AG
  - RATP
  - Transports Metropolitans de Barcelona
  - NPC

- **Organising Authorities:**

  - Nexus
  - OASA, Athens

- **Consultants & Research Institutes:**

  - IFSTTAR-Leost & IFSTTAR-Estas
  - DLR Institute of Transport Research
  - DLR
  - International Air Rail Organisation
  - WSP Analysis & Strategy, Sweden

Based on the results of this consultation, EXCEL files[7] have been produced. These files include the detailed answers as well as an analysis of the results for each research topic by:

- calculating the **average priority** from all responses, as well as the **number of answers per category of stakeholders** (manufacturers, operators, organizing authorities and consultants/academics). Colours have been used to highlight the main priorities:

  - **Yellow** for average priority lower than 2.5 (medium priority)
  - **Green** for average priority lower than 2.2 (high priority)
  - **Orange** for a level of participation with more than 5 Leaders or Partners

- summing up the number of answers on the **level of potential participation** as leader (L), partner (P) or member of a "users' group" (U).

[7] See Annex 3 to see one of those Excel files summing up the results.

3. The input from the White Paper on Competitive and Sustainable Transport

The White Paper on Transport of the European Commission is detailing in its Annex 1 numerous initiatives which shall contribute to the realisation of the "vision" presented in above clause 3.2. The initiatives which are relevant for urban, suburban and regional rail research are listed below.[8]

White Paper on Competitive and Sustainable Transport List of local rail relevant initiatives and (actions)

(abstracts)

1. AN EFFICIENT AND INTEGRATED MOBILITY SYSTEM

1.1. A Single European Transport Area

(1) A true internal market for rail services

- Open the domestic rail passengers market to competition, including mandatory award of public service contracts under competitive tendering.
- Achieve a single vehicle type authorisation and a single railway undertaking safety certification by reinforcing the role of the European Railway Agency (ERA).

- Develop an integrated approach to freight corridor management, including track access charges.
- Ensure effective and non-discriminatory access to rail infrastructure, including rail related services, in particular through structural separation between infrastructure management and service provision[9].

(7) Multimodal transport of goods: e-Freight

Create the appropriate framework to allow tracing goods in real time, ensure intermodal liability and promote clean freight transport:

- Put in practice the concepts of 'single window' and 'one-stop administrative shop'; by creating and deploying a single transport document in electronic form (electronic waybill), and creating the appropriate framework for the deployment of tracking and tracing technologies, RFID etc.).
- Ensure that liability regimes promote rail, waterborne and intermodal transport.

1.2. Promoting quality jobs and working conditions

(11) An evaluation of the EU approach to jobs and working conditions across

[8] The numbering of paragraphs is that of the White Paper.

[9] The preferred options for unbundling should ensure the development of competition, continued investment and efficiency in the cost of service provision.

transport modes

- Conduct an appraisal of the sectoral social dialogue processes taking place in the various segments of the transport sector to the end of improving social dialogue and facilitating its effectiveness.
- Ensure employee involvement, in particular through European Works Councils, in transnational companies in the sector.
- Address quality of work in all transport modes, with respect to, notably, training, certification, working conditions and career development, with a view to creating quality jobs, developing the necessary skills and strengthening the competitiveness of EU transport operators.

1.3. Secure Transport

(14) Land transport security

- Work with Member States on the security of land transport, establishing as a first step a permanent expert group on land transport security and introducing further measures where EU action has added value. Special focus will be put on urban security issues.

(15) 'End-to-end' security

- Increase the level of security along the supply chain without impeding the free flow of trade. 'End-to-end' security certificates should be considered taking into account existing schemes.
- Joint Security Assessment covering all modes of transport.
- Integrate potential effects of terrorist and criminal attacks in the preparation of mobility continuity plans (cf. Initiative 23)
- Pursue international cooperation in the fight against terrorism and other criminal activities like piracy. The external dimension (cf. Initiative 40) is crucial.

(19) Rail safety

- Progressively achieve a sector-wide approach to safety certification in the rail transport sector, building on existing approaches for infrastructure managers and railways undertakings and evaluating the possibility to rely on a European standard.
- Enhance the role of ERA in the field of rail safety, in particular its supervision on national safety measures taken by National Safety Authorities and their progressive harmonisation.
- Enhance the certification and maintenance process for safety critical components used to built rolling stocks and railway infrastructures.

(20) Transport of dangerous goods

Streamline the rules for the intermodal transport of dangerous goods to ensure interoperability between the different modes.

1.5. Service quality and reliability

(21) Passengers' rights

- Develop a uniform interpretation of EU Law on passenger rights and a harmonised and effective enforcement, to ensure both a level playing field for the industry and a European standard of protection for the citizens.
- Assemble common principles applicable to passengers' rights in all transport modes (Charter of basic rights), notably the 'right to be informed', and further clarify existing rights. At a later stage, consider the adoption of a single EU framework Regulation covering passenger rights for all modes of transports (EU Codex).
- Improve the quality of transport for elderly people, Passengers with Reduced Mobility and for disabled passengers, including better accessibility of infrastructure.

…//…

- Complete the established legislative framework on passenger rights with measures covering passengers on multimodal journeys with integrated tickets under a single purchase contract as well as in the event of transport operator's bankruptcy.
- Improve the level playing field at international level through the inclusion of care quality standards in bilateral and multilateral agreements for all modes of transport, with a view to further passengers' rights also in the international context.

(22) Seamless door-to-door mobility

- Define the measures necessary for further integrating different passenger transport modes to provide seamless multimodal door-to-door travel.
- Create the framework conditions to promote the development and use of intelligent systems for interoperable and multimodal scheduling, information, online reservation systems and smart ticketing. This could include a legislative proposal to ensure access of private service providers to travel and real time traffic information.

(23) Mobility Continuity Plans

Ensure the definition of mobility plans to ensure service continuity in case of disruptive events. The plans should address the issue of prioritisation in the use of working facilities, the cooperation of infrastructure managers, operators, national authorities and neighbouring countries, and the temporary adoption or relaxation of specific rules.

2. INNOVATING FOR THE FUTURE: TECHNOLOGY AND BEHAVIOUR

2.1. A European Transport Research and Innovation Policy

(24) A technology roadmap

Fragmentation of research and development efforts in Europe is most harmful, and

joint European efforts will bring the greatest European added value in areas such as:

- Clean, safe and silent vehicles for all different modes of transport, from road vehicles to ships, barges, rolling stock in rail and aircraft (including new materials, new propulsion systems and the IT and management tools to manage and integrate complex transport systems).
- Technologies to improve transport security and safety.
- Potential new or unconventional transport systems and vehicles such as unconventional systems for goods distribution.
- A sustainable alternative fuels strategy including also the appropriate infrastructure.

- Integrated transport management and information systems, facilitating smart mobility services, traffic management for improved use of infrastructure and vehicles, and real time information systems to track and trace freight and to manage freight flows; passenger/travel information, booking and payment systems.
- Intelligent infrastructure (both land and space-based) to ensure maximum monitoring and inter-operability of the different forms of transport and communication between infrastructure and vehicles.

(25) An innovation and deployment strategy

Identify the necessary innovation strategies including the appropriate governance and the financing instruments in order to ensure a rapid deployment of results developed in the research process. Examples are:

- Deployment of smart mobility systems such as the European rail traffic management system (ERTMS) and rail information systems, ITS, and the next generation of multimodal traffic management and information systems.
- Definition and deployment of an open standard electronic platform for vehicle on board units, performing various functions.
- Development of a plan for investment in new navigation, traffic monitoring and communication services to allow for the integration of information flows, management systems and mobility services based on a European Integrated Multimodal Information and management Plan. Demonstration projects for intelligent transport systems focussing in particular on those urban areas where air quality levels are frequently exceeded.

(26) A regulatory framework for innovative transport

Identify the necessary regulatory framework conditions through standardisation or regulation:

- Appropriate standards for CO_2 emissions of vehicles in all modes, where necessary supplemented by requirements on energy efficiency to address all types of propulsion systems;
- Vehicle standards for noise emission levels;
- Ensure that CO_2 and pollutant emissions are reduced under real-world driving conditions by proposing at the latest by 2013 a revised test cycle to measure emissions;
- Public procurement strategies to ensure rapid up take of new technologies;

- Rules on the interoperability of charging infrastructure for clean vehicles;
- Guidelines and standards for refuelling infrastructures;
- Interface standards for infrastructure-to-infrastructure, vehicle-to-infrastructure, and vehicle-to-vehicle communications;
- Access conditions to transport data for safety and security purposes;
- Specifications and conditions for transport related smart charging and payment systems;
- Better implementation of existing rules and standards.

2.2. Promoting more sustainable behaviour

(27) Travel information

- Promote awareness of the availability of alternatives to individual conventional transport (park & drive, intelligent ticketing etc.)

(29) Carbon footprint calculators

- Encourage business-based GHG certification schemes and develop common EU standards in order to estimate the carbon footprint of each passenger and freight journey with versions adapted to different users such as companies and individuals. This will allow better choices and easier marketing of cleaner transport solutions.

(30) Eco-driving and Speed limits

- Include eco-driving requirements in the future revisions of the driving licence directive and take steps to accelerate the deployment of ITS applications in support of eco-driving.
- Fuel saving techniques should also be developed and promoted in other modes.

2.3. Integrated urban mobility

(32) An EU framework for urban road user charging

- Develop a validated framework for urban road user charging and access restriction schemes and their applications, including a legal and validated operational and technical framework covering vehicle and infrastructure applications.

(33) A strategy for near- 'zero-emission urban logistics' 2030

- Define a strategy for moving towards 'zero-emission urban logistics', bringing together aspects of land planning, rail and river access, business practices and information, charging and vehicle technology standards.

3. MODERN INFRASTRUCTURE AND SMART FUNDING

3.1. Transport infrastructure: territorial cohesion and economic growth

(34) A core network of strategic European infrastructure – A European Mobility Network

- Concentrate European action on the components of the TEN-T network with the highest European added value (cross border missing links, intermodal connecting points and key bottlenecks).
- Deploy large scale intelligent and interoperable technologies (ITS, etc.) to optimise the capacity and the use of infrastructure.
- Ensure that EU-funded transport infrastructure takes into account energy efficiency needs and climate change challenges (climate resilience of the overall infrastructure, refuelling/recharging stations for clean vehicles, choice of construction materials…).

(36) Ex-ante project evaluation criteria

- Introduce ex-ante project evaluation criteria ensuring that infrastructure projects duly demonstrate the EU added value or are based on 'services rendered' and generate sufficient revenue.
- Streamline procedures for projects of overriding European interest, in order to ensure:
  - reasonable time limits for completing the whole cycle of procedures;
  - a communication framework that is in line with the project implementation; and
  - integrated planning which takes environmental issues into account in early stages of the planning procedure.
- Introduce PPP-screening to the ex-ante evaluation process to ensure that the option of PPP has been carefully analysed before a request for EU funding is being asked.

3.2. A coherent funding framework

(37) A new funding framework for transport infrastructure

- Provide EU support for developing and deploying technologies that improve infrastructure use efficiency and decarbonisation (new road network pricing and tolling systems, ITS and capacity improvement programs).

(38) Private sector engagement

- In the context of the cooperation framework established between the Commission services and EPEC, encourage MS to use more PPPs, while acknowledging that not all projects are suitable for this mechanism, and provide relevant expertise to Member States.
- Participate in designing new financing instruments for the transport sector, particularly the EU project bond initiative.

3.3. Getting prices right and avoiding distortions

(39) Smart pricing and taxation

Phase I (up to 2016)

- Transport charges and taxes should be restructured. They should underpin transport's role in promoting European competitiveness, while the overall burden for the sector should reflect the total costs of transport in terms of infrastructure and external costs.
- Revise motor fuel taxation with clear identification of the energy and CO_2 component.
- Phase in a mandatory infrastructure charge for heavy-duty vehicles. The scheme would introduce a common tariff structure and cost components such as the recovery of wear and tear, noise and local pollution costs to replace the existing user charges.
- Proceed with the internalisation of external costs for all modes of transport applying common principles while taking into account the specificity of each mode.
- Create a framework for earmarking revenues from transport for the development of an integrated and efficient transport system.
- Issue guidelines providing clarification concerning public funding to the different modes of transport and to transport infrastructure, where necessary.
- Reassess transport taxation where necessary, namely by linking vehicle taxation to environmental performance, reflecting on possible way forward to review the current VAT system concerning passenger transport, and favour the deployment of clean vehicles.

Phase II (2016 to 2020)

- Building on Phase I, proceed to the full and mandatory internalisation of external costs (including noise, local pollution and congestion on top of the mandatory recovery of wear and tear costs) for road and rail transport. […]

4. THE EXTERNAL DIMENSION

(40) Transport in the World: The external dimension

Transport is fundamentally international. Because of this, most actions in this White Paper are linked to challenges related to the development of transport beyond the EU borders. Opening up third country markets in transport services, products and investments continues to have high priority. Transport is therefore included in all our trade negotiations (WTO, regional and bilateral). Flexible strategies will be adopted to ensure the EU's role as a standard setter in the transport field. To that end, the Commission will focus on the following areas of actions:

- Extend internal market rules through work in international organisations (WTO, ICAO, IMO, OTIF, OSJD, UNECE, the international river commissions etc) and, where relevant, attain full EU membership. Promote European safety, security, privacy and environmental standards worldwide. Reinforce the transport dialogue with main partners.
- Take action in multilateral forums and bilateral relations to promote policy targeted at the energy efficiency and climate change goals of this White Paper.
- Continuously use multilateral (in ICAO, IMO and WCO) and bilateral layers to tackle the issue of terrorism, envisaging international agreements and

enhanced security dialogues with strategic partners, starting with the US. Cooperate on joint threat assessments, training of third countries officers, joint inspections, piracy prevention, etc. Ensure recognition of the EU concept of 'one stop security' system internationally.

- Develop a cooperation framework to extend our transport and infrastructure policy to our immediate neighbours, to deliver improved infrastructure connections and closer market integration, including in the preparation of mobility continuity plans.
- Build on established research and innovation partnerships to find common answers to the challenges related to interoperability of transport management systems, sustainable low carbon fuels, security and safety.

4. Combination and analysis of information

For what concerns urban, suburban and regional rail issues, the priorities identified by the ERRAC SRRA as analysed thoroughly by the WP03 members have been confronted with the initiatives put forward by the new White Paper on Transport as mentioned above.

The result of this are the priorities presented in the pictorial view in Chapter 5.

Research priorities appearing to be first in range for local rail are those targeting technical harmonisation of major sub-systems or interfaces between sub-systems, and some system based issues, in particular:

- Building up on the results of a former European Research project (MODURBAN), an important project could focus on the **development of train control systems that increase the capacity of urban rail systems through standardised interfaces in an open and modular architecture**. This would advance the harmonisation of CBTC (Communication Based Train Control) systems which could increase the capacity of urban rail systems whatever their grade of automation and/or to reduce the LCC cost of metro lines.

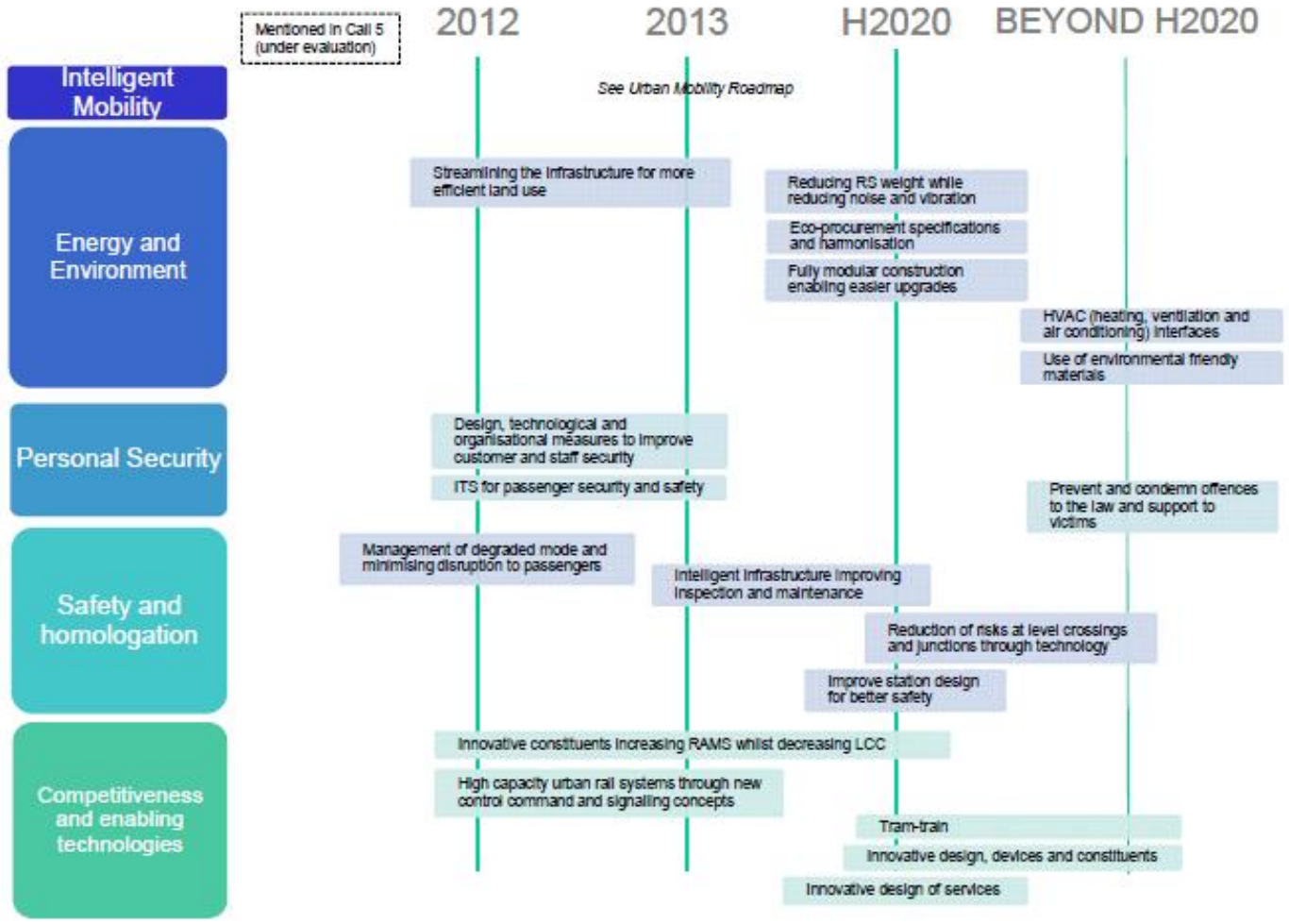
- The choice of the location of a local rail station can be a tool for driving the densification of the urban fabric and lead to the development of activities around and within stations. Hence to reach a more efficient functional and layout design, as well as more profitable operations, research is needed on the "**urban rail stations of tomorrow**", and "**urban rail interchanges of tomorrow**". This would encompass looking into the design and management - independent or not from the railway undertaking - of the various categories of urban, suburban and regional rail stations (including local metro and regional rail stations and major multimodal interchange stations), their internal characteristics as well as their relationship with the surrounding urban fabric (with the aim of both improving the accessibility to the station from/to existing urban activities, and to concentrate future appropriate urban development in the surroundings of the station).

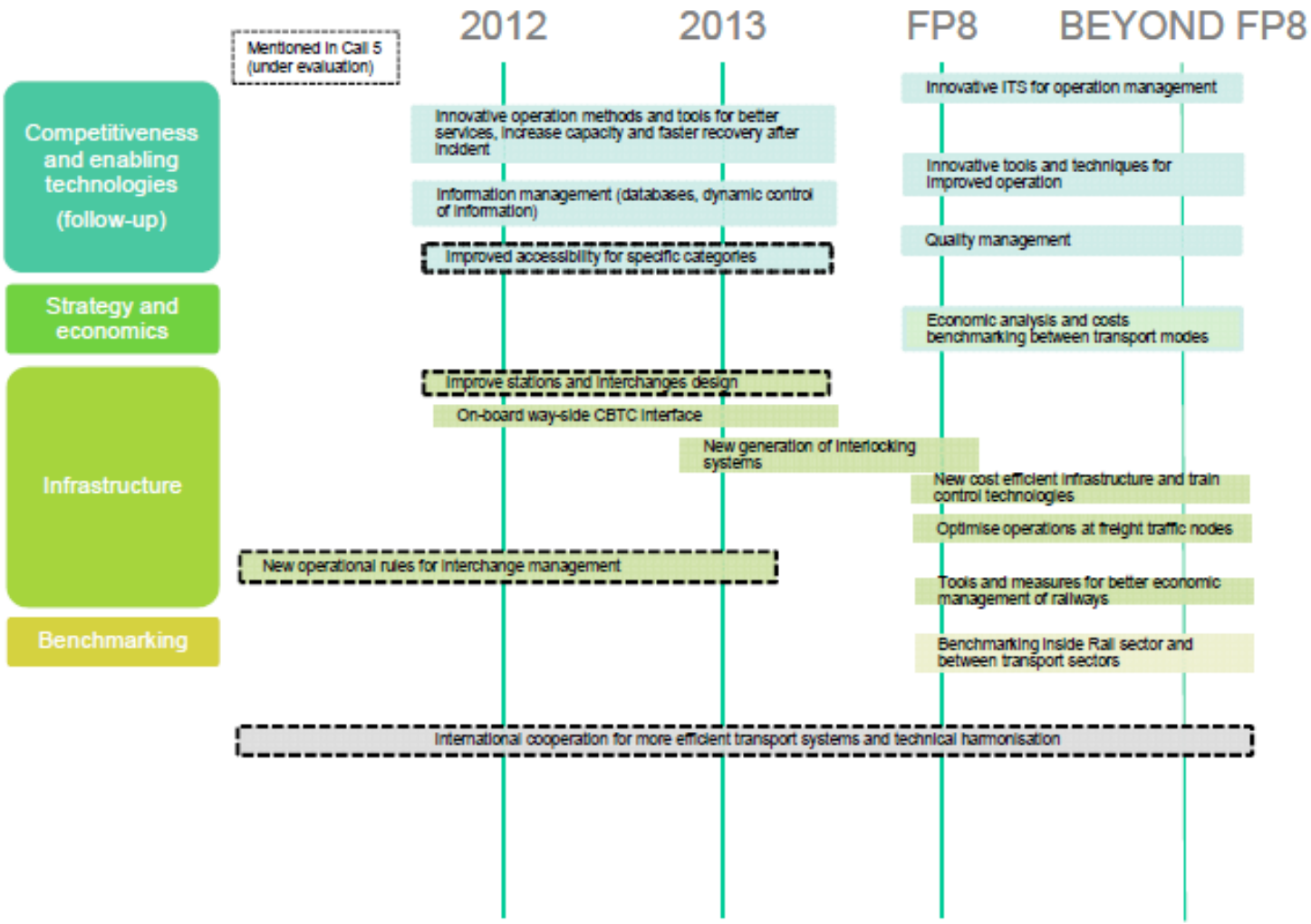
- In order to offer real alternatives to the use of private car in urban areas, customers must be able to rely as much as possible on safe, secure, performing regular and comfortable rail services. A concern of rail operators is to be able **to minimize service disruption in case of (local or regional) incidents on the urban rail system**. This would entail to propose satisfactory information to passengers in a very short time and to put in place more quickly alternative transport solutions for customers during the rail service disruption as well as solutions speeding up the recovery of normal operations conditions for the whole public transportation system.

- In line with raising environmental concerns and in order to make urban rail systems attractive for customers without negative effects on local dwellings, research is also needed **limiting noise and vibrations emissions of both rolling stock and infrastructure, whilst reducing weight of metro, tram and light rail vehicles**. This objective requires research on new materials and other innovative solutions, as well as the preparation of technical recommendations which will be shared by the urban rail sector.

Several other rail research topics are addressing similar targets as other urban transport systems, so they are presented in the WP03 Roadmap on Urban Mobility.

CHAPTER 5: PICTORAL VIEW




2012
2013
FP8
BEYOND FP8
Mentioned in Call 5 (under evaluation)
Competitiveness and enabling technologies (follow-up)
Strategy and economics
Infrastructure
Benchmarking
Innovative operation methods and tools for better services, increase capacity and faster recovery after incident
Information management (databases, dynamic control of information)
Improved accessibility for specific categories
Improve stations and interchanges design
On-board way-side CBTC interface
New generation of interlocking systems
New operational rules for interchange management
Innovative ITS for operation management
Innovative tools and techniques for improved operation
Quality management
Economic analysis and costs benchmarking between transport modes
New cost efficient infrastructure and train control technologies
Optimise operations at freight traffic nodes
Tools and measures for better economic management of railways
Benchmarking inside Rail sector and between transport sectors
International cooperation for more efficient transport systems and technical harmonisation

ANNEX 1: EU R&D STATE OF THE ART: Major projects impacting urban, suburban and regional rail

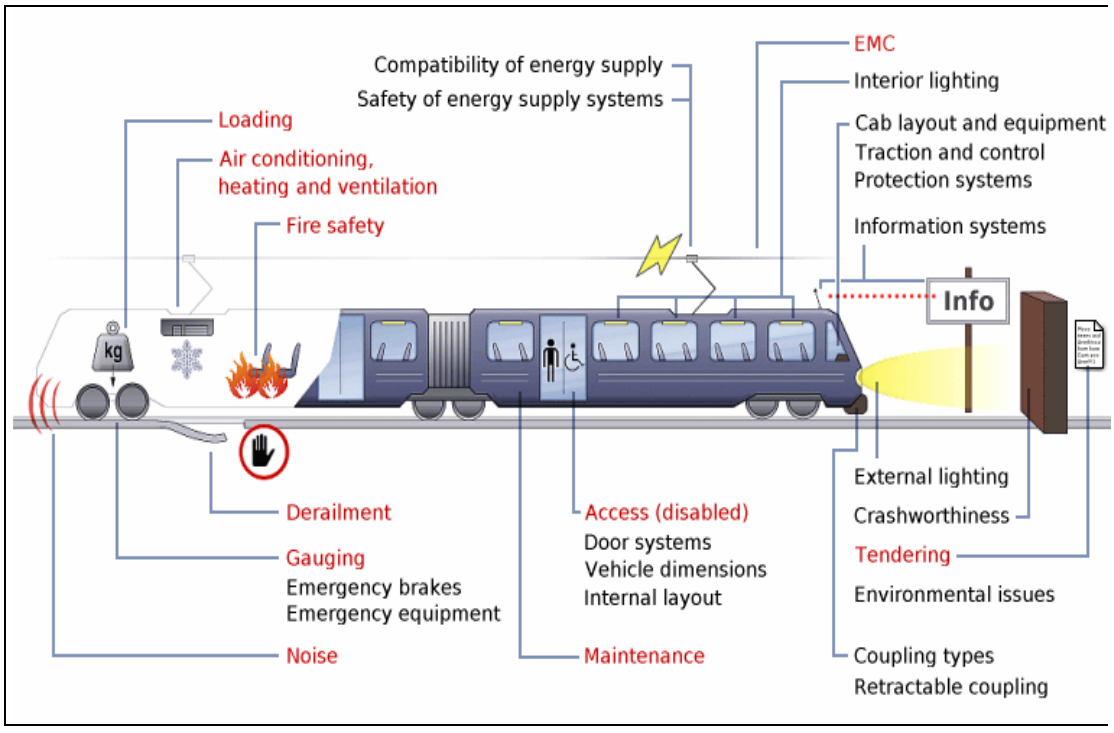
1. Past EU R&D projects on urban rail systems

1.1. LibeRTiN

The Libertin Thematic Network (LibeRTiN: Light Rail Thematic Network) has been undertaken as a "Thematic Network" (EU Grant: 100%) under the 5th European Framework Program from 1 September 2002 until 28 February 2005. The overall budget was 1 100 000 Euros. It had 7 main partners with UITP and UNIFE as initiators and head organisations, and was coordinated by TTK (Transport Technologie - Consult Karlsruhe GmbH).

The LibeRTiN Project was the first joint UITP-UNIFE project targeting urban rail systems, and especially in this case tram and Light Rail systems.

The following 10 topics have been investigated in detail:



Working Groups for each of the 10 topic areas were established. The output of these groups was of varying nature and included:

- Official requests for changes to existing standards sent to CEN / CENELEC, or advice to existing CEN / CENELEC working groups in order to cover adequately the LRT sector.
- Recommendations directly applicable voluntarily by the LRT sector (e.g. access, derailment etc.), as "Joint UITP/UNIFE recommendations".

- Proposals for FP6 and FP7 follow-up research actions (see below), some of which are closed (FP6: MODURBAN; URBAN TRACK), and other still going on (FP7: MODSAFE).

Part of what had been planned (development of an Urban Rail Directive) could not be implemented. However the outcomes of the project have been used as input to CEN TC256 standardization program, and are under consideration in the current works of the "Urban Rail Platform" of UITP and UNIFE and of the "Urban Rail Survey Group" of CEN-CENELEC-ETSI.

The LibeRTiN outcomes have been presented by CEN TC256 Chairman (Dee Razdan) in UITP Helsinki World Congress, June 2007:

- TC256 has been made aware of the Libertin project in 2005 and requested top ten needs for light rail. These were produced.
- Wherever possible the emerging EN's have covered the requirements of Light Rail.

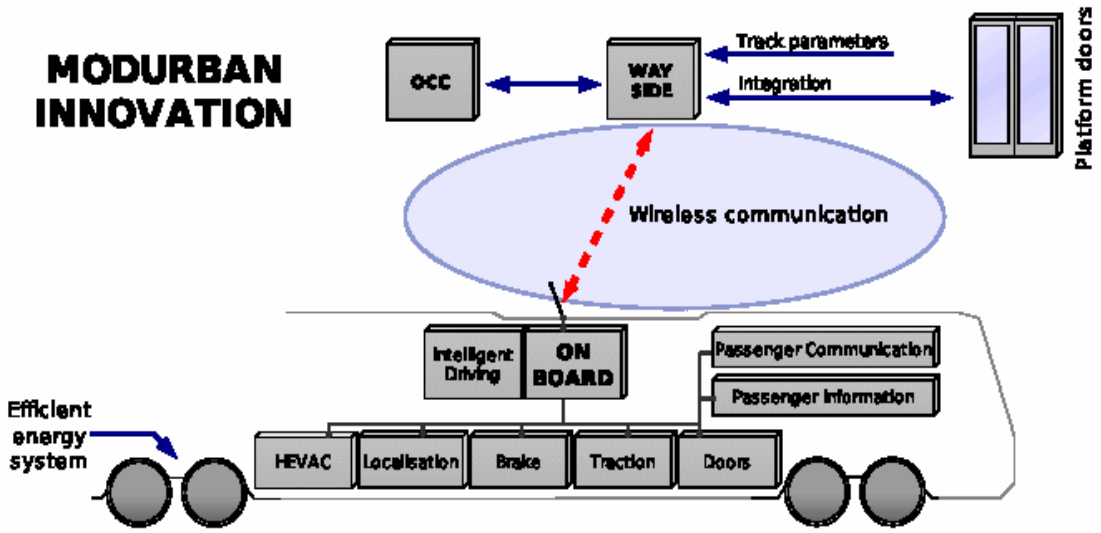
There are many examples where the specific requirements of LRV have been considered such as (as presented in Helsinki):

  - Braking – EN 13452-1,-2, 14531-1, 14478, 14535-1
  - Air Conditioning - EN 14750-1,-2 : 2006
  - Crashworthiness – prEN 15227 CRM complete 2007
  - Suspension components – EN 13597, 13913, 14817, 13802, 13298 etc.
  - Flange lubrication – prEN 15427
  - Axle boxes – EN 12080, 12081, 12082, prEN 14865
  - Structural – EN 12663 [in revision]
  - Rail– EN 13145, 13146, 13230, 13481, 13674-4, 14730,14811, 14969 and prEN's 14587 and 15594.
  - Others – EN 14752(doors), 13272 (lighting) etc.

1.2. MODURBAN

The *Modular Urban Guided Rail System* project, or in short MODURBAN, was a FP6 R&D M€19.1 Integrated Project, with a M€10.4 EC grant. It has been developed from 1st January 2005 until March 2009 by a consortium of 39 partners including UITP and UNIFE (coordinators: ALMA and UNIFE), building up on the results of a former FP5 project, UGTMS).

MODURBAN impacts and interfaces were the following:



Background/ the need for MODURBAN:

With an increasing concern from operators, confirmed by a worldwide UITP survey, interoperability[10] within one network and line extensions of urban rail systems is more and more a necessity nowadays. What is needed is a system approach regarding items of control command and signalling, communication systems, access and passenger information systems and energy savings models.

Therefore, the MODURBAN project was launched with the aim of providing common functional specifications for operators and a common technical architecture for manufacturers.

UITP Survey results have shown that:

- 80% of operators see an advantage in interoperability in their network
- 60% see an advantage to have independence between on-board and wayside equipment
- 40% are prepared to support higher initial cost due to interoperability
- 60% are interested in participating in a group applying the same common specifications for tenders.

[10] Interoperability in urban rail is different to what it is traditionally referred to in the conventional, high speed or freight rail segment. Interoperability needs for urban rail networks mean for example to be able to take one train set from one line and run it on another line within one given urban rail network.

Consortium and structure:

MODURBAN was the first of its kind Europe wide joint pre-competitive R&D project. It brought together all major rail industry suppliers (integrators and system suppliers), all major European rail operators, and universities.

The project was divided into 6 subprojects:

- MODONBOARD, Onboard subsystem,
- MODWAYSIDE, Wayside subsystem,
- MODCOMM, Data communication subsystem,
- MODACCESS, Passenger and access related subsystem,
- MODENERGY, Energy savings related subsystem,
- MODSYSTEM, System approach for functional + technical specifications and global risk assessment

Moreover, the project also set up a "users group" which consisted of operators who were not direct members of the consortium, however their input and feedback on key deliverables was important in order to validate and disseminate some of the results.

The final conference and demonstration event were organised on the Metro de Madrid Line 9, on December 16th-17th, 2008, Madrid, and were a very successful event.

MODURBAN has produced numerous deliverables of great interest for the tramway, light rail and metro sector, some of which fully public and some others partially public.

These deliverables are presented above in clause 2.1.2.2.

The project MODSAFE underway (see below § 3.2.2) is a follow-up of MODURBAN.

1.3. FP6: URBAN TRACK

"Urban Track" was a FP6 R&D M€18.6 Integrated Project aiming at the development of innovative track products for urban rail systems (tramway, Light rail, metro…), which benefited from a M€10 EC grant. It started on 1 September 2006 with duration of 4 years. It has been developed by a consortium of 28 partners including UITP and UNIFE. It was coordinated by D2S International (Belgium). The "Final conference" of Urban Track has been organised on 24-25 June 2010 in Prague.

The objectives assigned to the project were fully in line with ERRAC SRRA 2020 vision: low life cycle cost, high performance, modular approach, high level of safety, low level of noise and vibration.

Similar to MODURBAN, Urban Track set up a "Network of Operators" in charge of monitoring the draft outcomes of the project and commenting them so that the final

deliverables could result in a large consensus facilitating the future market uptake. A total of 11 companies not members of the consortium joined the Network of Operators in addition to the 8 operators which were consortium partners.

Urban Track also set up a "Network of Industries" formed by infrastructure system integrators & track suppliers and by the 4 industries members of the IP Infrastructure for heavy rail (INNOTRACK) and the EFRTC (European Federation of Rail Track-work Contractors).
The project aimed at developing for the urban track sector **five innovative new products, six innovative analysis methods,** and **three innovative reference documents**:

The **five innovative new products:**

- Prefabricated track modules
- Green LRT/tram tracks
- (Removable) Embedded metro tracks
- Alternative low cost tracks for floating slab in tunnel and at grade
- Maintenance free interface between rail and street pavement for embedded tracks

The **six innovative analysis methods**:

- Innovative track installation methods (new tracks)
- Automated track installation
- Fast renewal and refurbishment methods (LRT/tram)
- Cost/benefit analysis method for urban rail infra works (LRT/tram)
- Preventive and predictive maintenance for metro tracks
- Techniques reducing wear in curves and turnouts (LRT/tram)

The **three innovative reference documents**:

- Guidelines for 'Rail Transit Track Inspection and Maintenance' (metro)
- Harmonised LCC calculation method
- Harmonised functional performance specifications

The validation of the project was carried out in ten networks (each validating a type of infrastructure or solution), with an evaluation based on Life Cycle Cost. As part of the innovative new products are very resiliently supported booted sleepers, very resilient fasteners and new slab foundations.

Urban Track was organised in 7 Sub-Projects, as follows:

- SP1 – Low cost modular new track systems & fast installation methods
- SP2 – Cost effective track maintenance, renewal & refurbishment methods
- SP3 – Design & implementation of solutions at test sites
- SP4 – Life Cycle Cost (LCC) calculation
- SP5 – Functional requirements

- SP6 - Consolidation – Quality assurance – Dissemination
- SP7 – Management

The projects deliverables publicly disseminated are available at:
http://www.URBANTRACK.eu

They are presented above in clause 2.1.2.3.

2. On going EU R&D projects covering urban, suburban and regional rail

The most important EU R&D project currently underway in terms of involvement of urban rail operators and manufacturers is "MODSAFE". The project "OSIRIS" which started in January 2012 is not detailed below, and is presented above in clause 2.1.2.6.

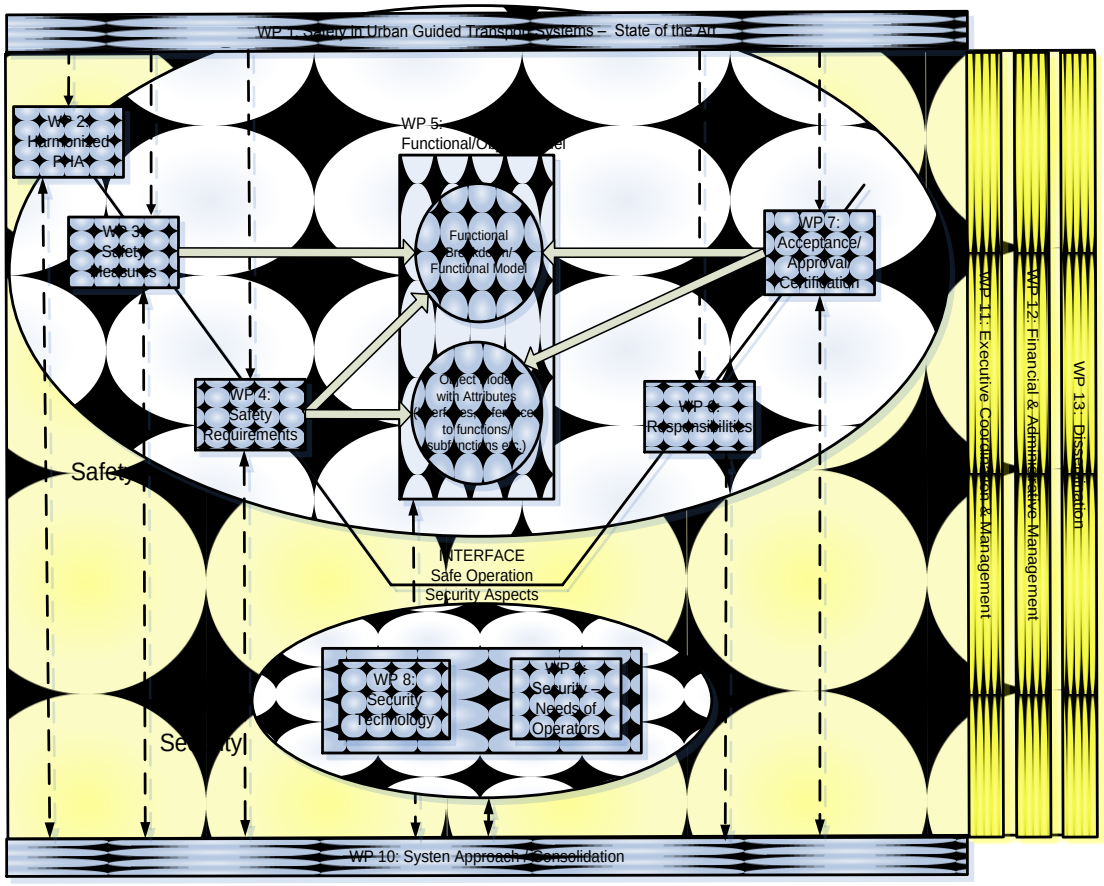
2.1.FP7: MODSAFE

MODSafe - Modular Urban Transport Safety and Security Analysis – is a FP7 R&D M€5.2 million Collaborative Project, among which M€3.5 EC grant. It covers a 4 years period starting on 1st September 2008 and gathers 22 partners. It is coordinated by TÜV Rheinland InterTraffic GmbH (TRIT).

MODSafe project – which is using a number of outcomes from MODURBAN - intends to define recommendations on the full Safety Life Cycle of urban guided transport (tram, Light Rail and metro) which could be applied on a voluntary basis throughout Europe in order to improve the functioning of the internal market. Indeed, this rail sector is characterized by a highly diversified landscape of Safety Requirements, Safety Models, Responsibilities and Roles and Safety Approval, Acceptance and Certification Schemes. The safety life cycle differs from country to country and sometimes even within one country, and clarifying what is the current situation across Europe and how it could be improved is a real challenge, knowing that the approach followed for mainline railways is not appropriate.

The project answers as well a request from the call for proposals, which was to cover some security issues and to look after some convergences between the safety and the security analysis. For this part of the project, another FP6 project is used as input, called COUNTERACT which is dealing with fight against terrorism targeting public transport systems (the scope covered as well energy networks). COUNTERACT is presented in the WP03- Urban Mobility Roadmap.

The MODSafe overall work plan structure is graphically supported by the below representation, and arranged into a V-Model-like structure as requested per EN 50126, with on the left side the active Safety Analysis and Model tasks and on the right branch all those tasks that relate to Verification, Testing, Validation, Approval, Acceptance, Certification etc. The project addresses the full Safety Life Cycle of urban guided transport systems rather than only some dedicated tasks.



MODSafe project is organised into 13 work packages as follows:

Work package No	**Work package title**
1	Description of the State of the Art
2	MODSafe Hazards and Risks Analysis
3	Hazard Control and Safety Measures Analysis
4	Common Safety Requirements
5	Functional and Object oriented Safety Model
6	Safety Life Cycle Responsibilities
7	Acceptance, Approval, Certification
8	Level of sophistication and relevant technology of security surveillance systems
9	Global approach for Integrated security needs
10	System Approach / Consolidation
11	Project Coordination and Management
12	Financial and Contractual Management
13	Dissemination and website

The public deliverables of MODSafe shall be as follows:

Deliverable	Deliverable name
D1.1	First Draft-State of the art on Safety responsibilities and Certification
D1.2	Final report – State of the art on Safety responsibilities and Certification
D2.1	First List of Hazards, Preliminary Hazard Analysis (PHA)
D2.2	Consistency Analysis and Final Hazard Analysis
D2.3	MODSafe Risk Analysis
D3.1	Preliminary Hazard Control and Safety Measures Analysis
D3.2	Final Hazard Control and Safety Response Measures Analysis
D4.1	State of the Art Analysis and Compilation of Previous Projects
D4.2	Analysis of Common Safety Requirements Allocation for MODSafe continuous Safety Measures and Functions
D4.3	Analysis of On Demand Functions and Systematic Failures
D5.1	Urban Guided Transport Object Safety Model
D5.2	Combined Object/Function Guided Transport Model
D5.3	Safety Attributes Allocation Matrix
D6.1	Survey of current safety life cycle approaches
D6.2	Comparison of current safety life Cycle approaches
D6.3	Proposal of a common safety life cycle approach
D7.1	Review of current AAC procedures
D7.2	List of elementary activity modules
D7.3	Generic model of AAC processes
D7.4	Proposal of an exemplary AAC process
D8.1	Existing countermeasures and technologies supporting transit security
D8.2	Regulations in force and technologies in service
D8.3	Security strategies in Urban guided transport systems
D9.1	Global approach for integrated security needs: Review of existing threats to urban transport guided systems
D9.2	Threat scenarios in Urban guided transport systems
D9.3	Security means & measures in Urban guided transport systems

2.2. FP7: TRANSFEU

This project does not involve UITP, due to the lack of internal resources faced by the association for its participation in numerous important EU R&D projects. However, the importance of the topic has been highlighted and supported by UITP through ERRAC, which contributed to the selection of the research action. Important UITP members are partners of the project.

Indeed, the long stride towards reaching the "European Fire Safety Standard", TS 45545, started in 1991. The initial reason given for the preparation of a document such as TS 45545 was to ensure "Minimal Trade Barriers" among European countries. After extensive studies, an interim Technical Specification, TS 45545, was released in 2009. Within this framework, studies have continued in recent years on conceiving new European laws, or the Technical Specifications for Interoperability (TSI) on Safety in Railway Tunnels.

A particular problem faced by the CEN Committee developing TS 45545 was that each major European state had their own individual test methods - usually based on local building regulations - for their local specifications. Naturally, all of these national regulations would be obsolete as soon as TS 45545 was to be adopted. Furthermore, the lack of a generally accepted comparative measure to quantify standards had slowed down the adaptation process.

TRANSFEU - Transport Fire Safety Engineering in the European Union – is a FP7 R&D M€5.58 million Collaborative Project, among which M€3.7 EC grant. It covers a 42 months period starting on 1st April 2009 and gathers 21 partners. It is coordinated by UNIFE and ALMA.

The main goal of TRANSFEU is to develop a holistic approach of fire safety-performance based-design methodology able to support efficiently European surface transport standardisation. In particular, the project will directly contribute to the finalisation of the CEN EN 45545 Part 2 for a dynamic measure of toxicity and to use FSE and simulation as a possible alternative to current Fire safety regulation and standard (TSI and TS 45545).

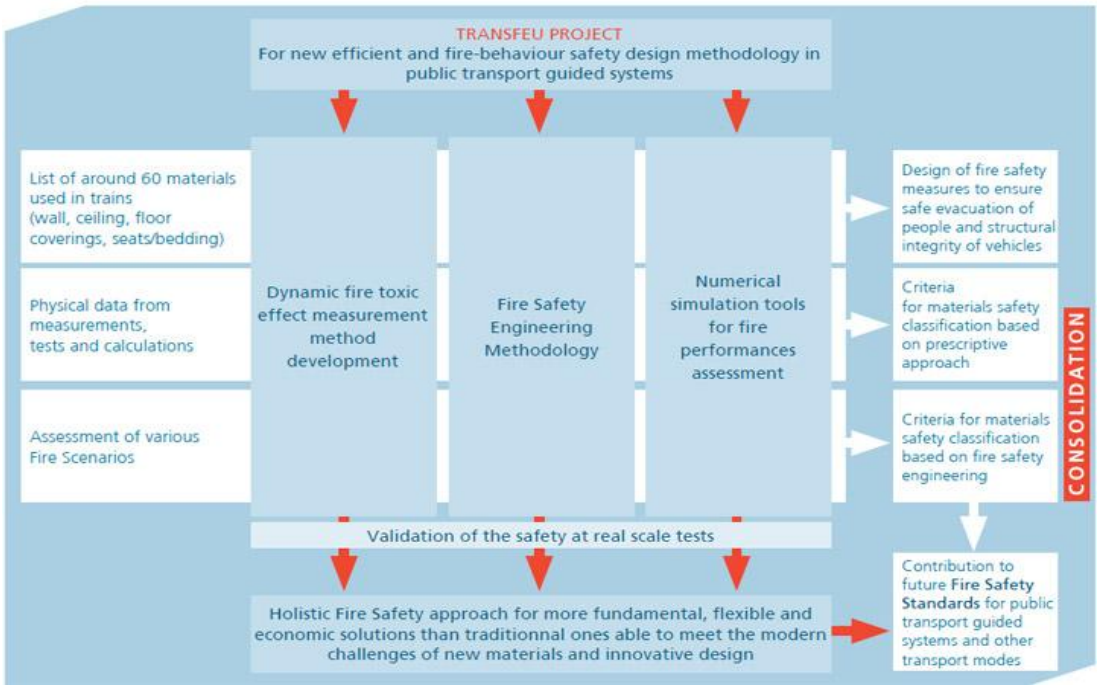
It will be based on:

- A new, accurate measurement tool for toxic gas fire effluents under dynamic conditions for Public Transport Guided Systems. This new tool will allow a continuous record of toxic gas concentrations versus time to be determined;
- A deeper understanding and measurement of underlying dynamic phenomena governing fire initiation, growth under typical railway vehicle scenarios, which can predict the real scale burning behaviour of products and assemblies;
- The adoption of fire safety engineering methodology that offers the necessary modelling tools for establishing realistic and acceptable economic levels of fire safety without unnecessary constraints in vehicle or vessel design. This will be supported by the development of original simulation tools;
- The application and validation of the tests, methods and tools in public transport guided systems fire safety scenarios and standardization with potential to other surface transports.

The expected results are:

- A new generation of realistic dynamic measurement methodology of the emission of toxic fumes in case of fire;
- Cost-effective methods and modelling tools for fire safety design able to predict realistic fire behaviour and the time to reach critical conditions within passenger rail vehicles. Simulation tools will provide fire guidance on the design, on fire safety measures and a way to explore alternative designs;
- Validation of the new fire safety methods and tools in railway scenarios and of the toxic fire effluents classification criteria from products used on trains;
- Significant contribution to future fire safety standards for all means of surface transport.

The general organisation of the project is as follows:



Information on the deliverables are presented at:
http://www.transfeu.eu

ANNEX 2: QUESTIONNAIRE “What are your research priorities for urban, suburban and regional rail?”

Date: *Organisation:* *Name:*

What are your research priorities for urban, suburban and regional rail?
(sources: "Strategic Rail Research Agenda 2020, ERRAC", "Strategic Research Agenda for urban, suburban and regional public transport and urban mobility in the European Union, UITP" and "Rail 21 Sustainable Rail Systems for a Connected Europe, ERRAC")

At the end of every topic, you are invited to describe any suggestion you propose in the line : "Any suggestion?"

Major compo-nents	Topics	Research actions	Research priority (1 to 5)
1. Intelligent mobility	*Fill in other questionnaire on research priorities for Urban Mobility*		
2. Energy and environ-ment	2.1. Reducing weight (reducing deadweight per passenger) and limiting noise and vibrations emissions of rolling stock and infrastructure (new materials, new standards, improved design of sub-systems and interfaces...)		
	2.2. Design of rail installations and especially vehicle constituents using recycling materials and research on their operational effects (consequences for maintenance, new industry…)		
	2.3. Eco-procurements specifications and harmonisation		
	2.4. Alternatives for all hazardous materials still used in new and refurbished trains		
	2.5. Development of more energy efficient rail traction and train control systems		

	2.6. Standardised methodologies for measuring the energy efficiency of vehicles		
	2.7. Fully modular construction enabling easier upgrades		
	2.8. For both metro and light rail, technical harmonisation of the interfaces between the vehicles and the heating, ventilation and air conditioning equipment leading to significant reduction in the cost of such equipment		
	2.9. Reducing the temperature on metro systems through alternative ways of cooling vehicles and stations		
	2.10. Streamlining the infrastructure for more efficient land use (improved operation and higher density of dwelling and/or activities around the stations)		
	2.11. Low frequency sub-station noise based on research in other sectors		
	2.12. Research into the optimisation of the GSM-R network to remove capacity constraints		
	Any suggestion?		
3. Personal security	3.1. Technological and organisational measures, including the training of staff and covering threat analysis, risk prevention, assessments of cost and emergency and crisis management as well as new unobtrusive technologies to improve staff and customer security without introducing feelings of insecurity		
	3.2. Guidelines for a design of infrastructure, stations (including surroundings) and rolling stock improving security of staff and customers		
	3.3. Development of innovative technologies and advanced communications for use on passengers' mobile phones, based on satellite based location and contact-less cards, to look after passengers throughout their journey when they ask for it		
	3.4. Subtle monitoring and instant communications with security and train staff in order to optimise passenger safety		
	3.5. Research on and dissemination of innovative solutions to prevent and condemn offences to the law and to support victims of assaults or attacks		
	Any suggestion?		
4. Safety and homolo-gation	4.1. Tools and methods	4.1.1. Intelligent infrastructure allowing for remote condition monitoring and inspection	

	improving infrastructure safety (see also points “Competitiveness” and “Infrastructure”):	4.1.2. New operational and possession management techniques making maintenance activity more efficient and safer		
		4.1.3. Reduction of risks at level crossings and junctions through the provision of either grade separation at affordable costs (standardised flat pack bridges…) and/or obstacle detectors		
	4.2. Improving the performance of the network and minimizing disruption due to system failure (better management of degraded mode operation that minimise disruption to passengers and allows for quick recovery of normal operation)			
	4.3. Improved station design to reduce both perceptions of risk and actual risk			
	4.4. Automated methods of inspection, maintenance and construction of infrastructure to reduce the need to work on the live railway			
	Any suggestion?			
5. Competi-tiveness and enabling techno-logies (improving cost effecti-veness)	5.1. System design (see also “Safety” and “Infrastructure”)	5.1.1. Innovative design of systems and constituents (see also “Safety”)	5.1.1.1. Research on innovative constituents increasing Reliability, Availability, Maintainability and Safety (RAMS) whilst decreasing life cycle cost (LCC)	
			5.1.1.2. Research on the specific issue of tram-train (especially in the case of cross-border services)	
			5.1.1.3. Research on a new “customer friendly” design of vehicles and installations	
			5.1.1.4. Innovative high capacity urban, suburban and regional rail vehicles and high-performance urban rail infrastructure supported by new control-command and signalling concepts	
			5.1.1.5. Innovative devices for improving passenger comfort (air conditioning, ITS connection points in vehicles and stations, accelerated walkways…)	
			5.1.1.6. Development of modular constituents for both new and upgraded urban rail installations based on functional and technical harmonisation	
		5.1.2. Innovative design of services	5.1.2.1. Development of “seamless”[1] mass transit services based on clock-faced[2] and “rendez-vous”[3] on the basis of principles harmonised at the European level	
			5.1.2.2. Co-ordination and/or integration of transport on demand services into regular services	

	5.2 Operation management	5.2.1. Innovative ITS	5.2.1.1. Further development of data transmission techniques taking new research findings of the sector of communications technologies into consideration	
			5.2.1.2. Fleet management : innovative ITS on board of PT vehicles and innovative strategies : -for a better control and management of PT vehicles under operation (at company or city level), and - for advanced and intelligent maintenance of PT vehicles (diagnostic devices…).	
			5.2.1.3. New operation methods for full automation of existing urban rail systems (automatic vehicle operation)	
		5.2.2. Innovative operation methods and tools	5.2.2.1. Integrated technical platforms for intermodal communication and real-time “rendez-vous” between vehicles (different lines, different modes, different operators, different authorities…)	
			5.2.2.2. Development of dynamic methods for adaptation to capacities : on-line capacity control	
			5.2.2.3. New operation methods and tools to recover normal operating conditions after an incident	
			5.2.2.4. Innovative tools for managing public transport companies; new services and technologies for staff training and traffic management such as virtual reality and simulation tools	
			5.2.2.5. Innovative marketing techniques	
			5.2.2.6. Development of innovative low labour technologies such as remote monitoring of the integrity of bridges and tunnels; track-train interaction models to aid predictive maintenance; degradation modelling of infrastructure to support predictive maintenance; and the use of embedded devices to check tolerances and displacements (see also “Safety” and “Infrastructure”)	
	5.3. Information management	5.3.1. Harmonised frame for databases on supply (timetables, real time adjustment…), traffic and incident management for urban, suburban and regional public transport (rail or road or waterborne)		
		5.3.2. Dynamic control of passenger information in intermodal urban interchanges and on-board vehicles (including real time information on connecting modes)		
	5.4. Quality management	5.4.1. Quality objectives expressed in terms of results for the customer and assessment by detailed criteria, e.g. timeliness measured by the number of affected customers rather than by the number of trains delayed		
		5.4.2. Harmonisation of the methods used to check passenger numbers and deviations to time-tables		

		5.4.3. Benchmarking studies on PT costs and PT efficiency (priority should be given to investment costs and to comparison with other urban transport modes or other sectors)	
	5.5. In addition, for all above:	5.5.1. Explore the potential of Galileo for developing the communications capability (specific programmes & structural funds at EU level)	
		5.5.2. Improved accessibility to PT systems in airports and high speed train stations for persons with reduced mobility, tourists etc.	
	Any suggestion?		
6. Strategy and economics	6.1. Better understanding of how suburban and regional rail on the one hand, as well as urban rail on the other can contribute to economic development and strengthen the case for investment in schemes where rail is the most effective solution (by raising more of the costs of the scheme from the direct beneficiaries, the subsidy from government is reduced)		
	6.2. Cost comparison (economic – including external costs - and financial evaluation) between transport modes (rail, road, waterborne…) for investment purposes and for encouraging the establishment of level playing field		
	6.3. Demonstrating how best to implement programmes for rail interoperability (suburban and regional rail) in order to improve the value for money delivered by the setting of rail standards		
	Any suggestion?		
7. Infrastruc-ture	7.1. Improve station design (the 'station of tomorrow') in order to attract passengers, to improve staff and customer security and access and to ensure lowest life time cost. Interchange has to be organised not only between the various rail market segments, but also between rail and other modes of transport		
	7.2. Automated track and structures inspection and maintenance ultimately leading to zero maintenance through the use of high reliability equipment in order to reduce the maintenance cost of infrastructure both to sustain the competitive position of railways and to release funds for investment in additional capacity (see also point "safety" and "competitiveness" above)		
	7.3. Identify ways of building new capacity on the existing network at less cost through cheaper methods of grade separation and the replacement of level crossings with low cost bridges (see also point "safety" and "competitiveness" above)		
	7.4. Develop the use of new train control technologies such as ETCS level 3 to increase capacity (suburban and regional rail)		
	7.5. Development of train control systems to increase capacity (urban rail), while separating on-board and wayside equipment through a standardised interface		
	7.6. Develop specifications and hardware for a new generation of interlocking systems to facilitate the introduction of ERTMS (suburban and regional rail)		

	7.7. Optimise operations at freight traffic nodes	
	7.8. Comprehensive implementation of LCC-strategies for infrastructure	
	7.9. Low cost infrastructure construction methods but increasing the quality of infrastructure	
	7.10. Development of new operational rules and timetables for the railway that optimize capacity and interchange between rail services	
	7.11. Tools that can predict deterioration of both track and train as traffic levels increase, leading to scientifically based track access charges including classification of vehicles and track that reflect the damage inflicted on track and train.	
	7.12. Creating a sustainable market environment for both self-financing and public supported railways	
	7.13. Developing incentives for vehicle manufacturers to design track friendly vehicles and for infrastructure managers to provide vehicle friendly tracks	
	7.14. Improvements in the European urban environment as city centre stations are redeveloped	
	Any suggestion?	
8. Benchmarking	Analysis of products, services and technological developments outside the rail sector through regular benchmarking of emerging technologies and monitoring of their deployment in other industries in order to pinpoint areas of possible transfer. Identify research fields where co-operation with other transport research institutes could be beneficial to the rail mode	

ANNEX 3: RAIL QUESTIONNAIRE RESULTS

What are your research priorities for urban, suburban and regional rail?

(Sources: "Strategic Rail Research Agenda 2020, ERRAC",
"Strategic Research Agenda for urban, suburban and regional public transport and urban mobility in the European Union, UITP"
and "Rail 21 Sustainable R ail Systems for a Connected Europe, ERRAC")

Sources for priorities: 21 answers to relevant UITP questionnaire

High priorities are in green when below 2.2 and in yellow when below 2.5 (highest priority is 1, lower is 5)
Some priorities higher than 2.5 are presented when number of potential participants as leader or partner is higher than 5 (highlighted in brown)
Other results are presented on the files providing all the answers to the relevant questionnaire

Major compo-nents	Topics	Research actions	Research Action Number	*Average priority (A)*	Number of potential participants			Answers from supply industry					Answers from operators					Answers from organising authorities					Answers from consultants/academics				
					Leader (L)	Partner (P)	User group (U)	Number	*Priority*	Participation			Number	*Priority*	Participation			Number	*Priority*	Participation			Number	*Priority*	Participation		
								N	*A*	L	P	U	N	*A*	L	P	U	N	*A*	L	P	U	N	*A*	L	P	U
1. Intelligent mobility	*See specific file on research priorities for Urban Mobility*																										
2. Energy and environment	2.1. Reducing weight (reducing deadweight per passenger) and limiting noise and vibrations emissions of rolling stock and infrastructure (new materials, new standards, improved design of sub-systems and interfaces...)		2.1	***2.3***	1	6	1	5	***1.8***	1	4	1	3	***2.7***		1		2	***4***				4	***1.8***		1	
	2.3. Eco-procurements specifications and harmonisation		2.3	***2.5***	1	5		4	***2.3***	1	1		5	***2.6***		3		2	***2.5***				4	***2.5***		1	

	2.5. Development of more energy efficient rail traction and train control systems	2.5	***2***	1	6	4	6	***2.3***		3	2	3	***2***		1	1	2	***1.5***			1	4	***1.8***	1	2	
	2.6. Standardised methodologies for measuring the energy efficiency of vehicles	2.6	***2.4***	2	6	1	5	***2***	1	3		3	***2***		1	1	2	***3.5***				4	***2.5***	1	2	
	2.7. Fully modular construction enabling easier upgrades	2.7	***2.4***	1	4		5	***2.2***	1	2		3	***3***		1		2	***3.5***				4	***1.8***		1	
	2.9. Reducing the temperature on metro systems through alternative ways of cooling vehicles and stations	2.9	***2.9***	1	6		4	***2.5***	1	3		4	***2.75***		2		2	***3***				4	***3.3***		1	
	2.10. Streamlining the infrastructure for more efficient land use (improved operation and higher density of dwelling and/or activities around the stations)	2.10	***2.2***	2	4	1	3	***2.7***				4	***2.5***	1	1		2	***1.5***			1	4	***1.8***	1	3	
	Any suggestion?	Yes	***2.2***	2	3		2	***2***	1	2		1	***1***	1								2	***3***		1	
3. Personal security	3.1. Technological and organisational measures, including the training of staff and covering threat analysis, risk prevention, assessments of cost and emergency and crisis management as well as new unobtrusive technologies to improve staff and customer security without introducing feelings of insecurity	3.1	***2.1***	2	6	1	4	***2***	1	1	1	5	***2.4***		2		2	***3***				5	***1.6***	1	3	
	3.2. Guidelines for a design of infrastructure, stations (including surroundings) and rolling stock improving security of staff and customers	3.2	***2.3***	2	5		4	***2.3***		1		5	***2.2***	1	2		2	***4***				4	***1.8***	1	2	
	3.3. Development of innovative technologies and advanced communications for use on passengers' mobile phones, based on satellite based location and contact-less cards, to look after passengers throughout their journey when they ask for it	3.3	***2.4***	1	6	2	4	***2.5***			2	5	***2.4***		2		2	***4.5***				5	***1.6***	1	4	

	3.4. Subtle monitoring and instant communications with security and train staff in order to optimise passenger safety		3.4	***2.4***		4	1	3	***2.7***			1	4	***2.3***		2		2	***3.5***				5	***2***		2	
4. Safety and homo lo-gatio n	4.1. Tools and methods improving infrastructure safety (see also points "Competitiveness" and "Infrastructure"):	4.1.1. Intelligent infrastructure allowing for remote condition monitoring and inspection	4.1.1	***1.9***		5		4	***2.3***		1		4	***1.8***		2		2	***2***				5	***1.8***		2	
		4.1.3. Reduction of risks at level crossings and junctions through the provision of either grade separation at affordable costs (standardised flat pack bridges…) and/or obstacle detectors	4.1.3	***2.4***	3	3		4	***2***		1		3	***4***				2	***2.5***				5	***1.6***	3	2	
	4.2. Improving the performance of the network and minimizing disruption due to system failure (better management of degraded mode operation that minimise disruption to passengers and allows for quick recovery of normal operation)		4.2	***2.1***	1	5	1	4	***2.3***		1		3	***2.7***		1	1	2	***2.5***				5	***1.4***	1	3	
	4.3. Improved station design to reduce both perceptions of risk and actual risk		4.3	***2.4***	2	4		3	***2.3***				4	***2.8***	1	1		2	***3***				4	***1.8***	1	3	
	4.4. Automated methods of inspection, maintenance and construction of infrastructure to reduce the need to work on the live railway		4.4	***2.1***	1	5	1	4	***2.3***		1		4	***2***		1		2	***1.5***			1	5	***2.2***	1	3	1
	Any suggestion?		Yes	***1.8***	2	3							1	***2***	?								3	***1.8***	2	3	
5. Comp eti-	5.1. Syste m	5.1. 1. Inno	5.1.1.1. Research on innovative	5.1. 1.1	***2.1***	1	6	3	7	***2***		3	2	3	***2.7***			1	2	***2***				5	***2***	1	3	

tivenes s and enabli ng techn o- logies (impr oving cost effecti - venes s)	desig n (see also “Safe ty” and “Infra struct ure”)	vativ e desi gn of syst ems and cons titue nts (see also “Saf ety”)	constituents increasing Reliability, Availability, Maintainability and Safety (RAMS) whilst decreasing life cycle cost (LCC)																														
			5.1.1.2. Research on the specific issue of tram-train (especially in the case of cross-border services)	5.1. 1.2	***3.4***	1	5		4	***2.3***		2		3	***5***				2	***4***				5	***3***	1	3	
			5.1.1.3. Research on a new “customer friendly” design of vehicles and installations	5.1. 1.3	***3***	1	5		5	***2.8***		2		3	***4***		1		2	***4***				4	***2***	1	3	
			5.1.1.4. Innovative high capacity urban, suburban and regional rail vehicles and high-performance urban rail infrastructure supported by new control-command and signalling concepts	5.1. 1.4	***2.3***	2	4	1	3	***2.7***				4	***2.5***		2		2	***2***			1	5	***2***	2	2	
			5.1.1.5. Innovative devices for improving passenger comfort (air conditioning, ITS	5.1. 1.5	***2.8***	1	5	1	5	***2.8***		2	1	5	***3***		2		2	***2.5***				4	***2.5***	1	1	

			connection points in vehicles and stations, accelerated walkways…)																									
	5.2 Operation management	5.2.2. Innovative operation methods and tools	5.2.2.1. Integrated technical platforms for intermodal communication and real-time “rendez-vous” between vehicles (different lines, different modes, different operators, different authorities…)	5.2.2.1	***2.4***	1	4	1	3	***2.7***				4	***2.5***		1	1	2	***3***				5	***2***	1	3	
			5.2.2.2. Development of dynamic methods for adaptation to capacities : on-line capacity control	5.2.2.2	***2.1***	1	3	1	3	***2***				3	***3***		1		2	***1.5***			1	4	***1.8***	1	2	1
			5.2.2.3. New operation methods and tools to recover normal operating conditions after an incident	5.2.2.3	***2.3***	1	3		3	***1.7***				3	***3***		1		2	***3***				4	***1.8***	1	2	
	5.3. Information management	5.3.1. Harmonised frame for databases on supply (timetables, real time adjustment…), traffic and incident management for urban, suburban and regional		5.3.1	***2.5***	1	2	1	3	***2.3***				3	***2.7***			1	2	***3***				4	***2.3***	1	2	

		public transport (rail or road or waterborne)																										
		5.3.2. Dynamic control of passenger information in intermodal urban interchanges and on-board vehicles (including real time information on connecting modes)	5.3.2	***1.9***	1	4		3	***2***				4	***2.5***		1		2	***2***				5	***1.2***	1	2 (+1)	
	5.5. In addition, for all above:	5.5.2. Improved accessibility to PT systems in airports and high speed train stations for persons with reduced mobility, tourists etc.	5.5.2	***2.2***	2	3	2	3	***2***				4	***2.5***	1	1		2	***3***			1	4	***1.5***	1	2	2
	Any suggestion?		Yes	***1.3***		2	2	2	***1***		1	2	1	***2***		1											
7. Infrastructure		7.1. Improve station design (the 'station of tomorrow') in order to attract passengers, to improve staff and customer security and access and to ensure lowest life time cost. Interchange has to be organised not only between the various rail market segments, but also between rail and other modes of transport	7.1	***2.5***	2 (+1?)	4		3	***2.7***				5	***2.4***	1 (+1?)	1		2	***3***				4	***2.3***	1	3	
		7.2. Automated track and structures inspection and maintenance ultimately leading to zero maintenance through the use of high reliability equipment in order to reduce the maintenance cost of infrastructure both to sustain the competitive position of railways and to release funds for investment in additional capacity (see also point "safety" and "competitiveness" above)	7.2	***2.1***	2	6		4	***1.8***	1	2		4	***2.8***		2		2	***3***				5	***1.6***	1	2	

	7.5. Development of train control systems to increase capacity (urban rail), while separating on-board and wayside equipment through a standardised interface	7.5	***2***		6		4	***1.5***		2		4	***2.3***		2		2	***3***				5	***1.8***		2	
	7.6. Develop specifications and hardware for a new generation of interlocking systems to facilitate the introduction of ERTMS (suburban and regional rail)	7.6	***2.5***	2	4		4	***2***	1	2		4	***3***		1		2	***4.5***				2	***4***	1	1	
	7.9. Low cost infrastructure construction methods but increasing the quality of infrastructure	7.9	***2.4***	1	5		4	***2.5***		1		4	***2.3***		2		2	***2***				4	***2.8***	1	2	
	7.10. Development of new operational rules and timetables for the railway that optimize capacity and interchange between rail services	7.10	***2.2***	1	5		3	***2.7***				4	***2.5***		2		2	***3***				5	***1.4***	1	3	