SAFEINTERIORS
Train Interior Passive Safety for Europe

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FP6-031-260 SAFEINTERIORS

Project Summary

- *Proposal full title:* ***Train Interior Passive Safety for Europe***
- *Proposal acronym:* ***SAFEINTERIORS***
- *Research domain addressed:* ***4.13 Developing integrated safety systems which are reliable and fault tolerant (preventive, active and passive) taking into account human-machine interface concepts focusing on the system implementation.***
- *Project Funding:* ***3.7 MEuro***
- *Project Length:* ***42 months commencing 11 July 2006***

Partners

- Bombardier Transportation (coordinator)
- Alstom Transport
- Association of Train Operating Companies
- The University of Bolton
- Fundación para la Investigación y Desarrollo en Automoción
- Deutsche Bahn AG
- Grupo Antolin Transport
- Institut National de Recherche sur les Transports et leur Sécurité
- Instituto Superior Técnico
- MIRA Ltd.
- Rail Safety and Standards Board
- Newrail
- Siemens AG Transportation Systems
- Société nationale des chemins de fer français
- Association of the European Railway Industries
- VÚKV a.s.

Proposal abstract

There is still an ongoing major effort, to identify, formulate and implement proper solutions for safety issues in guided transportation systems.

This includes in general:

- ***Collision avoidance, were the main objective is to develop active safety systems to prevent the occurrence of accidents.***
- ***Accident survivability involving passive safety requirements for structural crashworthiness and vehicle interior solutions that contributes for the reduction of severity in terms of occupant injuries.***

Proposal abstract

This new interior passive safety platform will provide tangible and commercially viable solutions and a systems approach to methodically reduce injuries and fatalities by combining and exploiting in a cost efficient and optimised manner the already well matured railway structural crashworthiness (closely linked with primary collisions events), with injury biomechanics, directly associated with secondary collisions.

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Train vehicle occupant survivability

A function of:

- **The kinematic behaviour of the train set**
- **Integrity and collapse characteristics of the structure**
- **Overall interior configuration of a compartment**
- **Occupant/surfaces contact characteristics.**

Train crash events two phases:

- **First phase - primary collision**
  - Initial kinetic energy is progressively dissipated
  - Plastic structural deformation
  - Resulting from crash generated impact loads
  - Occupant compartment integrity and acceptable vehicle acceleration levels are the most important design requirements
- **Second phase - secondary collision**
  - Occupant will be subject to a great variety of contacts
  - Design requirements involve interior layouts, severity levels and biomechanical response
  - Friendliness of the compartment interior is major design issue.

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Methodology

Developed within the projects TRAINCOL, SAFETRAIN and SAFETRAM includes:

- Review of past accidents to identify reference collision scenarios
- Establishment of a set of reference collision scenarios
- Development of a general framework for structural crashworthiness design
- Guidelines for design validation procedures
- Demonstrate the feasibility of optimised carbody structures to present an improved safety level to occupants
- Recommendations for a European Standard
- Reduction of risks stemming mainly from active safety and structural crashworthiness
- Now consider areas of risk and determine survivability measures

Methodology

Occupant survivability in any rail vehicle accident is dependent on:

- Type and severity of the accident
- Degree of crashworthiness in the overall vehicle design
- Crash pulses and potential interior contacts
- These vary considerably within large-interior volumes, such as the case of railway passenger compartments and driver's cabins

Without restraint systems and improved compartment features, occupants have little chance to survive even in moderate speed accidents. Several conditions contribute to this:

- Build up of high relative velocities between occupant and compartment
- Large variety of interior features
- Seats facing in various directions
- Seated and standing occupants
- Loose objects, such as luggage.

Rationale

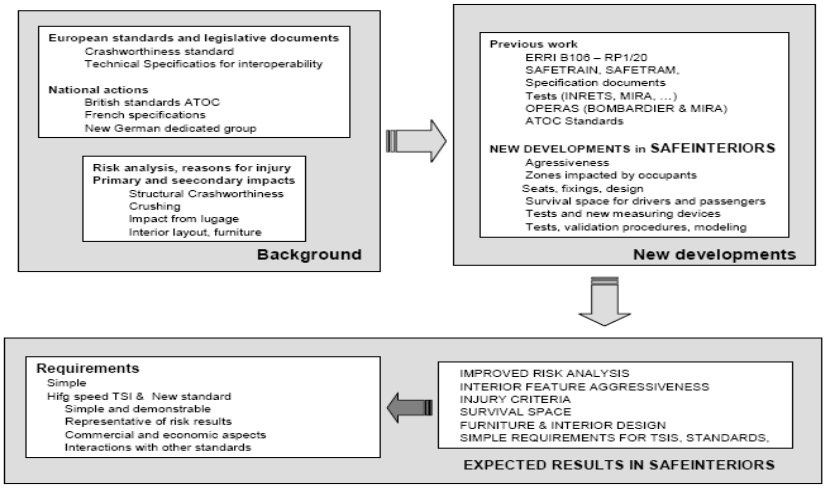

Figure 1 – Rational of project SAFEINTERIORS

Current work

- Recommendations from Traincol, Safetrain, Safetram, Trainsafe, and EU Drivers Desk
- Links and input from ongoing projects such as Modtrain
- Links to parallel proposal SAFEPASS for passenger safety in egress
- Biomechanics research carried out by INRETS and MIRA
- SNCF – Vehicle specification and research work with INRETS
- Bombardier – Assessment procedures and Interior Design Guidelines
- MIRA – Transfer from Automotive and Injury Criteria Studies
- DB – Interiors dedicated group and vehicle specifications
- RSSB – Ongoing research to establish ATOC standards
- France - Centre of Competence for Passive Safety
- Germany – Interior Passive Safety Project “Safe Journey”

Methodology

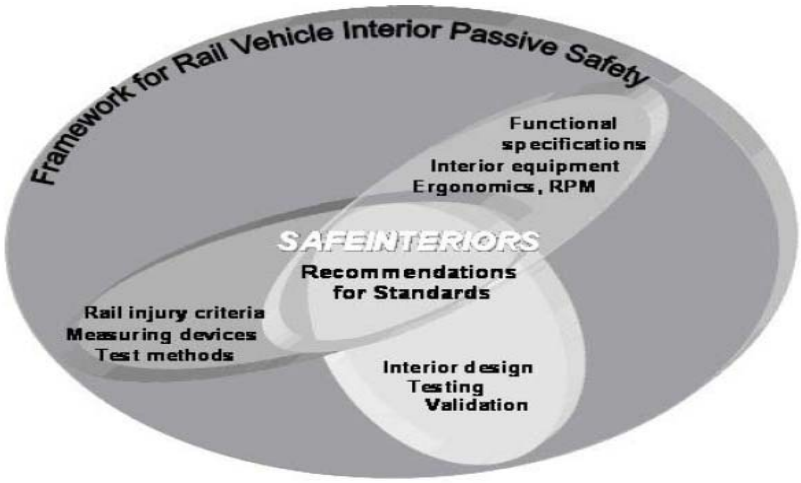

Figure 2 – SAFEINTERIORS Methodology

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Milestones

	Year 1				Year 2				Year 3				Year 4	
	Sem. 1	Sem. 2	Sem. 3	Sem. 4	Sem. 1	Sem. 2	Sem. 3	Sem. 4	Sem. 1	Sem. 2	Sem. 3	Sem. 4	Sem. 1	Sem. 2
WP1 Management														
1.1 - Management														
1.2 - Dissemination														
WP2 Framework for rail vehicle interior passive safety														
2.1 - Current design practices														
2.2 - Relevant regulation (railway and other)														
2.3 - Ergonomics and PRM														
2.4 - Accident analysis														
2.5 - Crash pulses														
WP3 Rail injury criteria, measuring and testing														
3.1 - Injury criteria for relevant body parts														
3.2 - Measuring devices														
3.3 - Test procedures and methods														
WP4 Functional specifications, for interior equipment														
4.1 - Layout and ergonomic requirements														
4.2 - Design specifications for equipment														
4.3 - Specifications for PRM														
WP5 Interior design and validation														
5.1 - Design of different layouts (4)														
5.2 - Manufacturing														
5.3 - Testing (experimental and virtual)														
5.4 - Validation														
WP6 Synthesis and recommendations for standards														
6.1 - Synthesis														
6.2 - Recommendations for standards														

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Workpackage 1

Workpackage number	WP1 - Management and Dissemination			Start date or starting event:	M1
Participant id	BT	CIDAUT	INRETS	IST	MIRA
Person-months per participant:	7	1	0.5	3.5	0.5
Participant id	RSSB	SIEMENS	SNCF	UNIFE	
Person-months per participant:	0.5	0.5	0.5	4.5	

Objectives

To ensure timely and qualitative performance of the project (Technical management) and to provide timely and efficient administration and financial co-ordination. Identify all the relevant and impacting information and knowledge inevitable to be transferred from the project to the interested parties, Transfer and consolidate the exploitable knowledge, information and other results of the project. Provide and consolidate the feed-back information to the project, especially with regard to the aspects of involving the key actors in evaluating the vital aspects of using the project results and their implementation

Workpackage 2

Workpackage number	WP2 - Framework for rail vehicle interior passive safety			Start date or starting event	M1
Participant id	RSSB	ALSTOM	ATOC	BT	DB
Person-months per participant:	7	1	3	3	2
Participant id	GAT	INRETS	IST	MIRA	SAIRA
Person-months per participant:	1	1	2	2	2
Participant id	SNCF	VUKV			
Person-months per participant:	3	2			

Objectives:

To review the current design practices and the conclusions of previous projects relevant to passive safety of train interiors, appraise the compatibility with other relevant regulations, carry an analysis of existing accident data and to select the crash pulses required to analyze the rail vehicle interiors isolated from the structures and structural devices for energy management during the crash.

Workpackage 3

Workpackage number	WP3 - Rail injury criteria, measuring and testing			Start date or starting event:	Month 1
Participant id	INRETS	MIRA	CIDAUT	GAT	RSSB
Person-months per participant:	31	32	7	2	4
Participant id	SAIRA	VUKV			
Person-months per participant:	2	6			

Objectives

Identification of the relevant injury criteria for different body parts of the rail vehicle occupant taking into account the selected crash scenarios and the interior layout of rail vehicles, identify measuring devices to quantify injury for the body parts relevant to rail occupant analysis and to define relevant test procedures that can be used during the interior design and during interior passive safety validation of solutions.

Workpackage 4

Work-package	WP4 – Functional Specifications for interior Equipment			Start date or starting event	M9
Participant id	SIEMENS	ALSTOM	ATOC	BOLTON	BT
Person-months per participant:	9	1	3	2	6
Participant id	DB	GAT	SAIRA	SNCF	VUKV
Person-months per participant:	4	2	5	5	4
Participant id					
Person-months per participant:					

Objectives

Identification of operational and commercial requirements; Define the most relevant interior layouts; Definition of preliminary requirements for the interior layouts including seats, bulkheads and other relevant interior equipment; Identification of potential for use of emerging technologies, new materials; Cost benefit analysis

Workpackage 5

Work-package	WP5 – Interior Design and Validation			Start date or starting event	M15
Participant id	CIDAUT	IST	ALSTOM	BOLTON	BT
Person-months per participant:	28	23	22	14	22
Participant id	DB	GAT	INRETS	MIRA	SAIRA
Person-months per participant:	4	19	13	10	15
Participant id	SIEMENS	SNCF			
Person-months per participant:	23	6			

Objectives

Development, manufacturing, testing and validation of 4-5 different scenarios selected from bay seating, row seating, lateral seating, longitudinal seating, standing passengers, wheel chair restraint, driver new interior component designs to the enhancement of occupant interior passive safety levels. Other objectives are to assess the suitability of the new component design requirements, to appraise the use new test methods, measuring devices and injury criteria.

Workpackage 6

Work-package	WP6 – Synthesis and recommendations for standards			Start date or starting event	M37
Participant id	SNCF	ALSTOM	ATOC	CIDAUT	DB
Person-months per participant:	2	1	2	1	3
Participant id	IST	RSSB			
Person-months per participant:	4	1			
Participant id					
Person-months per participant:					

Objectives

Compilation of the main results and overall conclusions. Critical appraisal of followed methodology, injury criteria, measuring and testing. Assessment of new design requirements and suitability for implementation. Technical support the production of the European norm and a relevant TSI chapter to be issued as complement to the structural crashworthiness norm. Provide the technical background for new feasible passive safety interior solutions and recommendations on occupant protection.

SAFEINTERIORS - Deliverables

- Appraisal of state-of-art design practices for interiors and identify gaps in design practices, plus definition of ergonomic measures
- Requirements for People with Reduced Mobility (PRM) with identification of other associated functionalities of vehicle interiors
- Analysis of accident statistics collected by rail operators and European agencies aim to select accident risks and identify relevant injuries.
- Identification of relevant crash pulses
- New injury criteria for rail vehicle occupants based on biomechanical data from recent research work.
- New appropriate measuring devices to reproduce loading on the dummies and on the vehicle interior elements. Bio-fidelity of devices used to predict human injury
- New test procedures and methods for full validation program
- New design specifications for interior equipment, furniture and layouts
- New and advanced tests for interior layouts
- Recommendations for TSI and CEN

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