ERRAC Project Evaluation Group

EU research on Fire and Safety in tunnel

Project acronym: Fire in tunnel Projects – FIT, DARTS, SAFETUNNEL, SIRTAKI, VIRTUALFIRES, UPTUN, SAFET
FP: 5
Programme acronym: see each project
Project Reference: see each project
Call identifier: see each project
Total Cost: all projects 27.449.777 EURO
EU Contribution: 15.494.020 EURO
Timescale: 2001-2006
EU Project Officer: see each project
Project Coordinator: see each project
Web references: see each project

☑ Presented by: L. Velardi
☑ Date evaluation: 08.07.2009?
☑ Market uptake:
☑ Follow up projects: COSUF
☑ Other related Projects:
EU research projects on safe and efficient tunnels

Premise:

A major objective of several programs within the 5th Framework was to support actions for competitive and sustainable growth of European industry.

In view of progress towards this general objective, the European Commission together with other actions in the legislative domain has embarked upon a major review of tunnel safety (both for road and railways), especially in consequence of severe fire accidents in road and rail tunnels happened in the last 12 years (1996 Channel Tunnel, 1999 Mont Blanc and Tauern Tunnels, 2001 Gotthard Tunnel).

An important means of achieving progress is innovation in technology and holistic interactive evaluations of safety levels.

7 projects were launched in the period 2001-2003.

(from the abstract by George Katalagarianakis, DG Research, 1st International Symposium on Safe & Reliable Tunnels, Prague 2004)
EU funded projects, on tunnel fire and safety within the 5th Framework

<table>
<thead>
<tr>
<th>Project</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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</thead>
<tbody>
<tr>
<td>FIT</td>
<td>Consultable databases &amp; guidelines</td>
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<td>DARTS</td>
<td>Cost-optimal &amp; durable new design</td>
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<td>Safe Tunnel</td>
<td>Preventive safety measures</td>
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<tr>
<td>Sirtaki</td>
<td>Advanced tunnel management</td>
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<tr>
<td>Virtual Fires</td>
<td>Tunnel fire simulator</td>
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<tr>
<td>UPTUN</td>
<td>Upgrading of existing tunnels - innovation</td>
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<td>SafeT</td>
<td>Harmonised European Guidelines</td>
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No evaluation (only for automotive sector)
EU funded projects, on tunnel fire and safety within the 5th Framework

<table>
<thead>
<tr>
<th>Projects</th>
<th>Coordinator</th>
<th>N° partners</th>
<th>Total funding</th>
<th>Eu funding</th>
<th>Main achievements</th>
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</thead>
<tbody>
<tr>
<td>FIT</td>
<td>Alfred Haack</td>
<td>33</td>
<td>1.478.550</td>
<td>1.451.400</td>
<td>Consultable DBs &amp; guidelines</td>
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<td>DARTS</td>
<td>A. Steen Jacobsen</td>
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<td>1.656.624</td>
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<td>4.942.959</td>
<td>2.223.048</td>
<td>Preventive safety measures</td>
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<tr>
<td>Sirtaki</td>
<td>Antonio Marques</td>
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<td>3.003.585</td>
<td>1.453.256</td>
<td>Advanced support for tunnel management</td>
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<tr>
<td>Virtual Fires</td>
<td>Gernot Beer</td>
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<td>1.786.200</td>
<td>1.509.765</td>
<td>Tunnel fire simulator</td>
</tr>
<tr>
<td>SafeT</td>
<td>Frans Gubbi</td>
<td>21</td>
<td>999.450</td>
<td>999.450</td>
<td>Guidelines for Tunnel Mngt. System, Probabilistic risk assessment</td>
</tr>
</tbody>
</table>

|               |                           |             | 123            | 27.449.777  | 15.494.020                                                                         |
EU research projects on safe and efficient tunnels: FIT

Main objective:
Fire In Tunnels (FIT) project launched as “Thematic Network” of 33 partners from 10 European countries, aimed to enhance the exchange of knowledge and develop a European consensus on fire safety for road, rail and metro.
European Rail Research Advisory Council

Fire In Tunnels - FIT: Background

Details
- Project Reference: G1RT-CT-2001-05017
- Total Cost: 1.478.550 EURO
- EU Contribution: 1.451.400 EURO
- Timescale: 01.03.2001 - 28.02.2005
- Project Coordinator: Mr. Alfred Haack (recently retired)

STUDIENGESELLSCHAFT FÜR UNTERIRDISCHE VERKEHRSANLAGEN E.V. (Private Consulting Company) and the former president of COSUF

Partners
- Italian Agency for new Technology, Energy and the Environment - IT
- Gesellschaft für Anlagen und Reaktorsicherheit MBH – DE
- Fire Safety Design AB – SE
- Centre for Civil Engineering Research and Codes – NL
- University of Greenwich – UK
- COWi Consulting Engineers and Planners AS– DK
- Deutsche Montan Technologie GmBH – DE
- SESM- Sistemi ESperti per la Manutenzione –IT
- Fogtec Brandschutz GmBH&Co KG – DE
- Groupement Européen d’Intérêt économique Alpetunnel – FR
- Altransit Gotthard AG – CH
- Centre d’Etudes des Tunnels – FR
- France – Manche SA – FR
- Metro de Madrid SA – ES
- Regie Autonome des Transports Parisiens – RATP – FR
- Sund & Bält Holding A/S – DK
- Stockholm Fire Brigade – SE
- Kent Fire Brigade – UK
- RFI – IT Giorgio Micolitti
- Consejo Superior de Investigaciones Científicas – ES
- Institut National de l’Environnement Industriel et des Risques– FR
- Mott MacDonald Ltd. – UK
- Ove Arup Partnership Ltd. – UK
- SP Swedish National Testing and Research Institute – SE
- Technical Research Centre of Finland – FI
- Hochtief AG – DE
- Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO – NL
- Traficon NV – BE
- Graz University of Technology – A
- Building Research Establishment Ltd. – UK
- Health and Safety Executive – UK
- Grupo Dragados SA - ES
European Rail Research Advisory Council

FIT Background

Project description: the solution approach

In order to achieve its goal, the project approach was:

✓ gathering of existing information related to guidelines on fire safe design and best practices for fire response management

✓ developing consultable databases on fire in tunnel
FIT Background

Achievements (see the website [www.etnfit.net](http://www.etnfit.net)):

- Evaluation of guidelines and recommendations for the tunnel design

- Optimized measures for evacuation, assisted rescue and fire fighting

- 6 databases available to registered members on research projects, test sites, numerical models, equipment, fire accidents and tunnel upgrade activities
FIT is a European Thematic Network on Fire in Tunnels. FITT provides a European platform for dissemination and information of up-to-date knowledge and research on Fire & Tunnels. FITT represents 33 members from 12 European Countries.

The final reports of the FIT network are presented below:

- General approach to tunnel fire safety
- Technical report part 1: Design fire scenario’s
- Technical report part 2: Fire safe design
  - Road tunnels
  - Rail tunnels
  - Metro tunnels
- Technical report part 3: Fire response management

Please note that the content of this website is no longer kept to date.
Main objective:

Safety Improvement in Road and rail Tunnels using Advanced information technologies and Knowledge Intensive decision support models (SIRTAKI) aimed at developing an advanced tunnel management system that specifically tackled safety issues and emergencies and was fully integrated in the overall network management.

Major validation site:

The validation of the SIRTAKI results was brought in 5 test sites with different requirements (urban/interurban, road/railway etc.) in France, Germany, Italy and Spain.
Safety Improvement in Road&rail Tunnels using Advanced Information Technologies and Knowledge Intensive decision support models - SIRTAKI : Background

Details
- FP5
- Project Reference: IST-2000-28303
- Total Cost: 3.003.585 EURO
- EU Contribution: 1.453.256 EURO
- Timescale: 01.09.2001 - 31.08.2004
- Project Coordinator: Mr. Antonio Marques
  ETRA Investigacion y desarrollo SA - ES

Partners
- Regie Autonome des Transports Parisiens – RATP – FR
- SITAF SpA – Società italiana Traforo Autostradale del Frejus – IT
- Servicios y Obras del Norte SA – ES
- Dalle Molle - Istituto di studi sull’intelligenza artificiale - CH
- Risoe National Laboratory – DK
- FIT Consulting Srl – IT
- SINELEC-Società per Azioni – IT
- SAFETEC Nordic AS – NO
- Research Centre of the Athens University of economics and business – GR
- Ajuntament de Barcelona - ES
The work began with the identification of:

✔ the needs of the users related to a decision support system for safety and emergency management in road and rail tunnels

✔ the relevant users (tunnel operators, local authorities, emergency services etc.)

Then the users requirements were traced into technical specifications of the system.
SIRTAKI Background

Achievements:

The Decision Support System is a prototype composed by 4 modules:

- Tunnel Control model (helpful for an easier customisation to any tunnel characteristics)
- Inference Module (a real time decision support system by identifying potentially dangers)
- Knowledge Basis (a learning tool for training and decision taking by applying previous experiences)
- Working Environment

Consortium partners planned to exploit the final product in order to increase tunnel safety and security.
EU research projects on safe and efficient tunnels: Virtual Fires

Main objective:
Virtual Fires (Virtual Real Time Fire Emergency Simulator) aimed at developing a system for assessing the fire safety of tunnels, training of rescue personnel, planning rescue scenarios with real fire tests.

Major validation sites:
The validation of the Virtual Fires simulator was brought in 3 test sites: Mt.Blanc tunnel in France and Gleinalm tunnel in Austria (ventilation system), Dortmund subway station (temperature distribution).
VIRTUAL real time emergency simulator- VIRTUALFIRES:

Background

Details
- FP5
- Project Reference: IST-2000-29266
- Total Cost: 1.786.200 EURO
- EU Contribution: 1.509.765 EURO
- Timescale: 01.11.2001 - 30.04.2004
- Project Coordinator: Mr. Gernot Beer
  Technische Universität Graz – A

Partners
- Ministere de l’Equipement, des Transports et du logement – FR
- Kungliga Tekniska Hoegskolan (Stockholm) – SE
- Lyon Turin Ferroviaire (LTF) – Fr
- Berufsfeuerwehr Dortmund - DE
- European Virtual Engineering, SA – ES
- Christian Doppler Laboratory for applied computational thermofluidodynamics at the University of Leoben – A
- Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung EV– DE
Virtual Fires Background

Project description: the solution approach

In order to cope with emergencies, the project approach was developing a simulator, using a computer generating virtual environment. This was a low-cost and environmentally friendly alternative to real fire fighting exercises involving burning fuel in a disused tunnel. The simulator could also be used to test the fire safety of a tunnel and the influence of mitigating measures on its fire safety level.
Virtual Fires Background

**Achievements:**

The simulator consists of sw and specialized hw components (CAVE and Head Mounted Display technology implementation) which allows the three-dimensional visualization of results of combustion simulations (Computational Fluid Dynamics*), run concurrently with the visualization.

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*One of the branches of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the millions of calculations required to simulate the interaction of fluids and gases with the complex surfaces used in engineering.*
EU research projects on safe and efficient tunnels: UPTUN

Main objective:

UPTUN intended to develop:

- validate and promote innovative, sustainable and low-cost measures, where appropriate, to limit the probability and consequences of fire in existing tunnels

- demonstrate and promote a holistic evaluating and upgrading procedure for existing tunnels to allow owners, stakeholders, designers and emergency teams to evaluate and upgrade human and structural safety levels
Cost-effective sustainable and innovative UPgrading methods for fire safety in existing TUNnels - UPTUN : Background

Details
- Project Reference: G1RT-CT-2002-00766
- Total Cost: 11,925,764 EURO
- EU Contribution: 6,200,477 EURO
- Timescale: 01.09.2002 - 31.08.2006
- Project Coordinator: Mr. Jan Alexander Dekker

Partners
- Ministry of Transport Public Works and Water management - NL
- Norwegian Public Roads administration – NO
- Mediterranean Council for Burns and Fire Disasters – IT
- Geoconsult zt GmbH – A
- Cervenka Consulting – CZ
- University of Maribor – SI
- Eltodo Dopravn Systemy SRO – CZ
- Vilnius Gediminas Technical University - LT
- University of Lodz – PL
- Studiengesellschaft für unterirdische Verkehrs anlagen E.V. - DE
- Centre for Civil Engineering Research and Codes – NL
- SP Swedish National Testing and Research Institute – PT
- Servizi di Ricerche e Sviluppo Srl – IT
- Traficon NV – BE
- Padova Ricerche Scpa – IT
- CTG SpA- Centro Tecnico di Gruppo – IT
- Italian Agency for new Technology, Energy and the Environment – IT
- Association for Research and Industrial Development of Natural Resources - ES
- COWI Consulting Engineers and Planners AS– DK
- Transport Research Centre – CZ
- Fire Safety Design AB – SE
- Centre d'Etudes des Tunnels - Fr
- Institut National de l’Environnement Industriel et des Risques- FR
- Centre for Research and Technology Hellas – GR
- Institute of Structural Engineering – A
- Norwegian Fire Research laboratory A/S - NO
- Building Research Establishment Ltd. – UK
- Fogtec Brandschutz GmbH&Co KG – DE
- CW Obel Maritime A/S – DK
- Wormald Ansul (UK) Ltd. - UK
- Deutsche Montan Technologie GmbH – DE
- APT Engineering Srl - IT
- Lindstrand Balloons Ltd. – UK
- Mines rescue Service Ltd. – UK
- Centre for economics and business Research Ltd. – UK
In order to achieve its objectives, the project approach was to build a consortium covering all relevant expertise (more than 30 partners from 18 different EU Member States), with sufficient mass to ensure adoption of deliverables throughout Europe. It focused on:

- improving fire detection and localisation
- fire and smoke control
- human behaviour and escape guidance
- mitigation of damage to the tunnel construction
- development of a holistic safety concept and large scale tests
- courses for upgrading of tunnels
**UPTUN Background**

**Achievements (see the website [www.uptun.net](http://www.uptun.net):**

- Design fire curves data
- Validation of fire mitigation sets with respect to heat, toxicity and smoke stresses in large fires
- Human behaviour and escape guidance (tunnel users information, rescue teams/tunnel operators selection and training)
- Development of innovative methods for tunnel damage detection and repair (assessment of real fire damage in Great Belt and Channel Railway Tunnel, Mont Blanc Road Tunnel)
- Test on functional equipment operability (cables, doors and signs) and on structural component (suspended ceiling)
ITA COSUF Committee on Operational safety of underground facilities.

Click here for information and registration:

Flyer
Work Programme
Membership Subscription Form

Cost-effective, Sustainable and Innovative Upgrading Methods for Fire Safety in Existing Tunnels

Welcome to the UPTUN home page
UPTUN is the acronym for Cost-effective, Sustainable and Innovative Upgrading Methods for Fire Safety in Existing Tunnels; a European RTD-project funded by the European Commission in FP5.

The UPTUN project main objectives are:
To develop innovative technologies where appropriate and where relevant comparing to and the assessment of existing technologies for tunnel application. Focus is on technologies in the areas of detection and monitoring, mitigating measures, influencing human response, and protection against structural damage.

To develop, demonstrate and promote procedures for rational safety level evaluation, including decision support models; and knowledge transfer.

Click here to download a brief description of the UPTUN project.
EU research projects on safe and efficient tunnels: Safety Tunnels

Main objective:
Safety Tunnels (SafeT) intended to draft harmonized European guidelines for tunnel safety drawing upon the knowledge accumulated and developed in the other EU funded projects but with a focus on the management and cross-border issues.
Safety in Tunnels - SafeT : Background

Details

- FP5
- Project Reference: GTC2/53013/2001
- Total Cost: 999,450 EURO
- EU Contribution: 999,450 EURO
- Timescale: 01.04.2003 - 31.03.2006
- Project Coordinator: Mr. Frans Gubbi

Nederlands Organization for Applied Scientific Research - NL

Partners

- Autobahnen und Schnellstrassen Finanzierungsaktiengesellschaft – A
- HB – Verkehrsrscnsult GmBH- DE
- SITAF SpA Società Italiana del Traforo del Frejus - IT
- Institute for Structural Analysis/ Situ- research – A
- ETRA Investigation Y Desarrollo SA – ES
- Research Centre of the Athens University of Economics and Business – GR
- Sociedad Iberica de Construcciones Electricas - ES
- Deutscher Verkehrssicherheitsrat – DE
- SESM – Sistemi Esperti per la Manutenzione – IT
- Deutsche Montan Technologie GmbH – DE
- European Commission Joint Research Centre – IT
- Norwegian Public Roads Administration – NO
- Ministerio de Fomento - ES
- Generalitat de Catalunya. Departament d'Interior Escola de Bombers i Seguretat Civil de Catalunya– ES
- Ministerie van Verkeer en Waterstaat Directoraat Generaal Rijkswaterstaat - NL
- Netherlands Institute for Fire Service and Disaster Management - NL
- Ministere de la Region de Bruxelles-Capitale – BE
- ENCONET Consulting GES M.B.H. – A
- Fire Safety Design AB – SE
- Gesellschaft für Anlagen und Reaktorsicherheit (GRS)– DE
- Kuratorium für Schutz und Sicherheit – A
The project adopted a global approach consisting of:

- gathering information on current practice in tunnel safety
- recommending for the enhancement of preventive tunnel safety
- dealing with evacuation and intervention management
- collecting and analysing tunnel accident data
- harmonised risk assessment
SafeT Background

Achievements (see the website www.safetunnel.net):

- guidelines for tunnel safety management system
- tools for probabilistic risk assessment
Welcome to the SafeT homepage

SafeT is a "Safety in Tunnels" Thematic Network on development of European guidelines for upgrading tunnel safety. The European Thematic Network is funded by the European Commission in the 5th Framework Programme.

Second International Symposium ?Safe & Reliable Tunnels - Innovative European Achievements & ITA COSUF Inauguration?  
At the Polydome in Lausanne, Switzerland  
On May 30 and 31, 2006
In total more than 100 companies, research institutes and governmental bodies worked together with at least twice as many involved persons in these seven multinational EU research projects and networks with a common end date in the period 2004-2006.

It would have been a great loss if their outcomes had been wasted with the contract deadline. So in May 2005 was launched the “Committee on Operational Safety of Underground Facilities - COSUF” under the aegis of the International Tunnelling and underground space Association (ITA), with the scope of safety in operation regarding tunnels and other underground facilities.

The main goals are:

✓ maintaining and developing a knowledge exchange network

✓ promoting safety by fostering innovation, raising awareness and confidence of stakeholders, helping to the development of regulations

✓ facilitating world-wide cooperation and possible international funding.
COSUF is led by a Steering Board which consisted originally of representatives from the EU research projects and now has been enlarged to representatives of the major stakeholders within the Consortium; the chairman coming from ITA while the vice chairman is from PIARC - the World Road Association; both are responsible for the annual General Assembly of ITA.

COSUF is structured in 3 Activity Groups (AG):

AG1: interaction with European and international initiatives
AG2: regulation and Best Practice
AG3: research and new findings

The AGs do not conduct studies, research or similar commercial work which could be done by institutes or companies. They should develop Centres of Excellence for world-wide exchange of information and know-how regarding safety and security of tunnels.
EU research projects on safe and efficient tunnels: follow ups
1. Were the results implemented in the design of the new products and services?
   – The results were used in terms of data and models by the tunnel engineers throughout the projects deliverables first and the COSUF Consortium after.

2. Were these new products/services put into commercial operation?
   – At the moment, it isn’t well known. No further information has been yet provided by COSUF.

3. Is new legislation and standardization based on findings from these research projects?
   – No it isn’t, since the research projects were developed considering the legislation’s outcomes. FIT results were used as input for TSI Safety.

4. Are the results of the projects implemented across Europe or only in a small number of Member States?
   – They were spread in the Member States of the project partners.
EU research projects on safe and efficient tunnels: Evaluation

5. Are the results of the projects implemented outside Europe before being accepted in Europe?
   – At the moment, it is not known.

6. Did the projects increase competitiveness of the European railway sector abroad with regard to products, services, standards and system design?
   – No, it has not been specifically tested.

7. Did the projects increase competitiveness of the railway transportation compared to other transport modes?
   – No, as safety also according to the Italian market research is not considered a modal choice variable.

8. Are the results of the project taken into consideration when preparing public tenders?
   – No.
9. Does the implementation of the project results help facilitate cross-border operations by problem-solving in the domain of interoperability?
   – Not directly. Nevertheless the drafted safety guidelines and the risk analysis models proposed might represent a first step towards harmonization of procedures and safety measures and thus toward interoperability.

10. Does the implementation of the project results help facilitate inter-modal operations by problem-solving in the domain of inter-modality?
   – No, there is not any application in this field, at the moment.

11. Can benefits be assessed in financial terms?
   – Yes, they can (i.e. virtual drills) even though the financial benefits seem not have been considered an overall requirement.

12. Applicability of results to future scenarios.
   – The results set up a benchmark and useful parameters and COSUF is a profitable vehicle of promotion.

13. Usefulness of research procedures for future projects (incl. modeling)
   - Some procedures mostly developed in UPTUN and Virtual Fires projects can be the basis for further applications.
EU research projects on safe and efficient tunnels: Reasons for outcome

A big effort has been made by the EU in order to deep and settle the tunnel safety problems during the last years. So the main achievement has been:

✔ building up a projects network

✔ establishing a consortium aimed at keeping the project results alive and fostering applications and innovation all around the world
EU research projects on safe and efficient tunnels: Lessons learnt

So the main achievement has been:

✓ building up a projects network

✓ establishing a consortium aimed at keeping the project results alive and fostering applications and innovation all around the world

✓ research projects that are built in order to address specific technical issues are usually those that are most successful.