InteGRail

Intelligent Integration of Railway Systems

Funding: European (6th RTD Framework Programme)
Duration: Jan 2005 - Mar 2009
Status: Complete with results
Total project cost: €19,927,652
EU contribution: €11,230,455

Call for proposal: FP6-2003-TRANSPORT-3
CORDIS RCN : 74794

Background & policy context:

The growing demand for mobility in Europe requires an efficient and well-integrated railway system; one which can cope with all the technical, logistical and environmental constraints, to enable sustainable growth of the enlarged European Union.

ERRAC, the European Rail Research Advisory Council, proposed the target of doubling rail passenger traffic and tripling rail freight traffic by the year 2020. Responding to ERRAC's challenge, the InteGRail project intended to improve railway performance by better cooperation and information exchange between the different subsystems, allowing for a global optimisation at system level.

Currently, increasingly larger amounts of information are accessible from all of the railway subsystems. A number of information systems are also available where information is stored for immediate or later usage. Unfortunately, most information is produced in proprietary formats and its circulation is limited to specific subsystems and applicative platforms. This can create or increase barriers to a wider flow and usage of information, as is required by new and advanced methodologies. These problems are emphasised when considering an international context, for example one of the European corridors, where the number of systems, actors and networks involved can become huge and ad hoc solutions are impossible.

Objectives:

The InteGRail project aimed to create a holistic, coherent information system, integrating the major railway sub-systems in order to achieve higher levels of performance of the railway system in terms of capacity, average speed and punctuality, safety and the optimised use of resources. Building on results achieved by previous projects, InteGRail proposed new intelligent procedures and contributed to the definition of new standards, in accord with EC directives and technical specifications for interoperability (TSI).

The project will not replace existing systems but it will be used in conjunction with them. InteGRail favours a higher level of interoperability of railway information systems, easier information sharing and increased global optimisation and performance.

Meeting ERRAC's goal means reducing costs and enhancing environmental sustainability, while maintaining a high level of safety, compared to other transport modes. InteGRail is crucial to meeting these challenges.

The specific goals included:

- reliability improved by up to 50% for targeted systems through optimised maintenance;
- 30% availability improvement and reduction in irregularities;
- 10% reduction in maintenance costs;
- 5% increase in punctuality;
- increased capacity in line with ERRAC objectives;
• information sharing within the railway community, enabling optimisation of decision-making for improved performance.

**Methodology:**

Due to its size and complexity, the project was divided into a number of sub-projects (SP):

- **SP1**: Project management, integration activities and horizontal support.
- **SP2**: System requirements, architecture and continuous assessment, identifying information that needs to be shared.
- **SP3A**: Intelligent system monitoring and control to ensure that the right information can be obtained.
- **SP3B**: Intelligent system maintenance, identifying ways of using information more effectively for maintenance optimisation.
- **SP3C**: Intelligent system management, identifying ways of combining and using information effectively for management requirements.
- **SP3D**: Advanced system communication, ensuring that information can be transmitted effectively to decision-makers.
- **SP4**: System integration, testing and validation, demonstrating performance improvement.

By creating innovative concepts in the areas of train control and monitoring, maintenance, management and communications, InteGRail set out to re-define the basic elements required by each system. The project assessed the needs of rolling stock, infrastructure, traffic management (including the European Rail Traffic Management System, ERTMS), train operations and proposed intelligent procedures to process all available additional information to its best advantage.

**Parent Programmes:**

FP6-SUSTDEV-3 - Global Change and Ecosystems

**Institute type:** Public institution

**Institute name:** European Commission

**Funding type:** Public (EU)

**Lead Organisation:**

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<th>Union Of European Railway Industries</th>
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<td>BRUXELLES</td>
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<td><a href="http://www.unife.org">http://www.unife.org</a></td>
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**Partner Organisations:**

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### Alstom Transport Sà

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### Interuniversitair Micro-Electronica Centrum
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### Institut National De La Recherche Sur Les Transports Et Leur Securite

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<td>Hungarian State Railways Corporation</td>
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<td>Seebyte Ltd.</td>
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Technologies:

Rail operations
Common and interoperable train-to-ground communication system

Development phase: Research/Invention

Key Results:

InteGRail developed an enabling technology to allow transparent access to existing information systems, be it databases, monitoring systems or existing user applications. For this purpose InteGRail defined a standard approach for architecture and common information representation on a European scale. Using this standard approach a number of example applications were developed.

InteGRail produced two types of results:
- a Reference Technology Platform, as an open railway specification, to become a standard;
- a number of Application Prototypes in different railway areas where there is a potential for improvement.

The Reference Technology Platform is the core of InteGRail solution and the basis for all InteGRail applications. It is a middleware providing a common interface between applications and the existing network infrastructure. It includes two main layers:

- the application-to-application layer, which defines how to properly represent, retrieve, process and finally understand information;
- the high-level communication layers (Intelligent Communication framework – ICOM), which are responsible for transferring information, moving it from an application to another, wherever they are located and independently from the available infrastructure.

Altogether, the Reference Technology Platform is able to provide a number of services, decoupling the applications from the details of the supporting networks and avoiding that each time a new system interconnection is built, such services will again be developed from scratch.

The key results composing the Reference Technology Platform are:

- An Information System Architecture;
- A Railway Domain Ontology;
- Distributed Reasoning;
- ICOM – Intelligent Communication Framework;
- The Key Performance Indicator assessment framework.

The key results composing the Application Prototypes are:

- The Network Statement Checker;
- The Infrastructure Availability Checker;
- The Event Analyser;
- The Wheel Trend Analyser;
- The Track Trend Analyser;
- The Symptom Agent;
- The Predictive Maintenance Server;
- The Intelligent Depot Tool;
- The Operational Decision Support System;
- The Traffic Re-Scheduler.

**Technical Implications**

Some of the main InteGRail results, specifically those related to the Technology Reference Platform, are well suited to become standardisation proposals:

1. A standard Railway KPI structure
2. Ontology based standard Railway Data Model
3. Standard Railway Service Grid Architecture
4. Standard Railway Intelligent Communication Framework: ICOM

Not only will such standards be very useful for the railway community, filling in existing gaps, but they are needed in order to achieve a real interoperability between railway information systems, in order to fulfil legal obligations (like those required by the TSIs) or to enhance the performance of railway systems (e.g. for Corridors operation, maintenance, etc).

The InteGRail final report also identifies each of the project's outputs in terms of market-readiness (on a scale from 1 to 9).

**Policy implications**

Although Infrastructure Managers and Railway Undertakings have their own systems in place, they have the intention of exploiting the InteGRail results in order to enable collaboration and information exchange between and within the different companies.

Such companies focus on the improvement of performance they can gain from the application and deployment of InteGRail results. Improvement of performance can be translated into:

- Improvement of Railway Network Capacity
- Improvement of Punctuality
- Improvement of Availability
- Improvement of Reactivity to changes/ Reduction of time to recover from failures
• Reduction of Costs, within a system vision.

Concrete benefits that can be realised from integrating InteGRail results into railway equipment or organisations are:

• Cost reduction in railway operation: early information about train and infrastructure faults will help operators to adjust their schedules to the actual situation, choose a cost-effective solution and minimise delays.
• Cost reduction in maintenance: early warning through condition trend monitoring and predictive maintenance improves the effectiveness of maintenance activities. Providers of infrastructure and fleet owners can adapt their efforts and manpower according to actual situation and urgency.
• Minimise delays and disruption through more reliable infrastructure and rolling stock as a result of predictive maintenance procedures.
• Increase of transport volume. The easy exchange of information will reduce problems through prediction of future events; will lead to faster recovery from problems; and so allow greater use of the available trains and infrastructure.
• Better feedback to customers as a result of easier exchange of information.
• Manage the railway as a single system – integrating information about infrastructure, rolling stock, operations and traffic management; and integrating information from different countries to create a view of the railway as a single system.
• Cost reduction in information technology: information systems using a common ‘language’ can be connected easily. There is no need for special interfacing, extra programming or dedicated connections between systems. This will reduce both the investments and the costs of maintenance and modifications.
• The implementation of TAF TSI and TAP: TSI requires a common information backbone. The reference platform provided by InteGR

Documents:
- InteGRail - Vision Paper (Other project deliverable)
- Final Report Summary - INTEGRAIL (INTElligent inteGration of RAILway systems)

STRIA Roadmaps: Network and traffic management systems
Transport mode: Rail transport
Transport sectors: Passenger transport, Freight transport
Transport policies: Societal/Economic issues, Safety/Security,
Geo-spatial type: Infrastructure Node