INNOTRACK

Innovative Track Systems

**Funding:** European (6th RTD Framework Programme)

**Duration:** Sep 2006 - Aug 2010

**Status:** Complete with results

**Total project cost:** €18,466,192

**EU contribution:** €9,999,999

**Call for proposal:** FP6-2005-TRANSPORT-4

**CORDIS RCN:** 81513

**Background & policy context:**

Infrastructure accounts for about 70% of railway systems' total costs. Rail infrastructure managers spend millions of euros each year on maintaining network infrastructures throughout Europe while the supply industry is investing hundreds of millions in research and development on rail technologies to deliver cost-effective products for rail infrastructure.

Any reduction of production and maintenance costs would, therefore, have a significant impact on the overall cost of the provision of rail infrastructure for operators. However, a reduction in the production cost itself at the site of the supply industry has to go hand in hand with a reduction in maintenance and renewal costs for infrastructure managers (IMs).

There is a strong need to bring together those responsible for the delivery of railway transportation with those responsible for providing products, services and technologies to this industry, in order to reduce life-cycle costs (LCC), improve reliability, availability, maintainability and safety (RAMS) of infrastructure, while still increasing the service life of infrastructure and overall performance of the rail system.

The INNOTRACK project was a joint response of the major stakeholders in the rail sector – infrastructure managers, railway supply industry and research bodies – to further develop a cost effective high performance track infrastructure by providing innovative solutions towards significant reduction of both investments and maintenance related infrastructure costs.

INNOTRACK has been a unique opportunity to bring together rail IMs and industry suppliers and to concentrate on the re-search issues that has a strong influence on the reduction of rail infrastructure LCC.

**Objectives:**

The main objective of INNOTRACK was to reduce the LCC, while improving the RAMS characteristics (Reliability, Availability, Maintainability and Safety) of a conventional line with a mixed traffic duty.

The second major objective of INNOTRACK was to streamline the introduction of innovative solutions. Railways have suffered for too long from innovative technologies that turn out to be too ambitious and expensive to maintain. This led to significant innovation in products and services offered by the industry. However, to ensure that the innovative solutions do indeed bring benefit to both industry and IMs two issues needed to be tackled:

- The IMs needs to be significantly reduced to justify the continued investment in R&D by the supply industry.
- Innovative to be verified from a railway system perspective.

The third important objective was to harmonise LCC calculations to provide comparison points on a Europe-wide basis.
As an overall measurable objective, INNOTRACK aimed at a 30% LCC reduction of track-related costs.

**Methodology:**

INNOTRACK was organised in seven sub projects (SP). To achieve a wider approach, a matrix organisation was formed. The three vertical technical projects were developed to meet the technical demands. The three horizontal where created to verify and to give other aspects on technical solutions based on the above mentioned new demands.

The three technical (vertical) sub-projects were:

- **Track support structure (SP2)**
  The sub-project has studied track subgrade monitoring and assessment. Furthermore, evaluation and test of superstructure innovations were carried out.

- **Switches and crossings (SP3)**
  The sub-project has studied optimised switch designs where predictive modelling played a key role. Further standardisation of driving and locking devices, and also the development of switch monitoring equipment were key elements.

- **Rails and welding (SP4)**
  The sub-project dealt with methodologies to establish rail deterioration under varying operational conditions. It established maintenance criteria and methodologies. It further studied improved methods for test of rail materials, for rail inspection and for welding.

These sub-projects could be described as traditional technical projects. They were supported by three cross-disciplinary (horizontal) sub-projects:

- **Duty and requirements (SP1)**
  The aim of this sub-project was first to identify current problems and cost drivers for the existing infrastructure. After the root causes had been identified, the project proposed innovative solutions in order to mitigate the problems. At the end of the project a technical verification of technical solutions that had not been validated in the technical sub-projects was carried out. The aim was to deliver innovative solutions that were both technically and economically verified. Finally, this sub-project also assessed the overall potential cost reduction derived from the INNOTRACK solutions.

- **Life cycle cost assessment (SP6)**
  There were two ideas with this sub-project. The first was to economically verify the innovative solutions to the technical problems. This was carried out with LCC and RAMS analyses. The second was to evaluate/develop a Europe-wide accepted process.

- **Logistics (SP5)**
  Here the potential for logistic improvements were identified and proposals for promising areas of improvement brought forward. Furthermore, the sub-project was responsible for a logistics a
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The result from innotrack is like a toolbox with many innovative solutions, the most important of which are presented as 'highlights':

1. **Insulated joints**
   - **Cost driver**
     Insulated joints impose a discontinuity in the rail. As such they will be subjected to high operational loads that may cause joint dips (leading to even higher loads) and material rollout (causing short-circuiting of the signalling system). The remedial actions, unless detected at early stages of deterioration, often result in replacement and hence add significantly to maintenance costs and causes traffic disturbance.
   - **Solution**
     INNOTRACK carried out an extensive simulation campaign on the mechanical deterioration of insulated joints. In addition, field measurements were made in order to verify simulations. The result is a significantly improved understanding of the influence of various operational parameters and the associated deterioration mechanisms.
   - **Benefits**
     The work in INNOTRACK lays the foundation for prescribing joint geometry and allowable tolerances for different operational conditions. Furthermore, the improved understanding of
deterioration mechanisms are also expected to contribute to improved designs of insulated joints.

- **Next steps**
  The derived knowledge needs to be established in operational codes, 'minimum action' handbooks and practices. Further increased knowledge is needed, e.g. regarding the influence of traffic situation, support conditions, material characteristics etc.

2. **Corrugation**

- **Cost driver**
  Corrugation increases noise emission levels and wheel-rail contact forces. The standard mitigating action is grinding, which is costly and causes traffic disturbances. There is also some evidence for increased susceptibility of corrugated track to squat defects.

- **Solution**
  INNOTRACK developed a method to determine allowable corrugation magnitudes with respect to noise pollution and risks for the formation of wheel and rail cracks.

- **Benefits**
  The numerical toolbox that has been developed can be employed to determine grinding intervals etc.

- **Next steps**
  The derived knowledge needs to be established in operational codes, 'minimum action' handbooks and practices. To further optimise maintenance actions, deeper knowledge on corrugation growth and the relationship between operational loading conditions.

**Technical Implications**

The INNOTRACK project was unique in many aspects: it was the first research project of this scale (with a budget of roughly € 20 M) concerning track structure that involved infrastructure managers, industry, research institutes, and universities. Since development of innovative technical solutions involved not only the industry, but also infrastructure managers and research bodies, the technical validation became an integrated part of the development process. This work has now commenced with solutions being adopted by the industrial partners and testing in field by the involved infrastructure managers. The tight integration between numerical simulations, experiments, and field tests is typical for much development in INNOTRACK.

**Policy implications**

INNOTRACK has provided a unique opportunity to bring together all major stakeholders – manufacturing and contractors; supply industry; infrastructure managers; railway undertakings; system integrators, and the elite of the European railway research community.

During the course of INNOTRACK it has been possible to have a concentrated focus by all these parties on identified common European cost drivers. The outcome of these concentrated efforts, as manifested in INNOTRACK’s over 140 R&D reports, will shape the development of the railway track sector of Europe for a long time.