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INNOTRACK

Integrated Project (IP)
Thematic Priority 6: Sustainable Development, Global Change and Ecosystems

Publishable Final Activity Report

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1. Project Execution

1.1 Introduction

INNOTRACK has been a unique opportunity bringing together rail infrastructure managers (IM) and industry suppliers, the two major players in the rail industry. The project concentrated on research issues that contribute to the reduction of rail infrastructure Life Cycle Cost (LCC). The main objective of INNOTRACK has been to reduce the LCC, while improving the RAMS characteristics (Reliability, Availability, Maintainability and Safety).

To reach this objective, INNOTRACK has analysed root causes (e.g. failure rates, failure causes) of the current too high cost of track maintenance and renewal. This was done on a European wide basis, with individual infrastructure managers (IMs) consulting at a national level and bringing identified problems together at a European Level. The consortium harmonised the nationally identified problems and identified those that are common across Europe. One important conclusion was that most of the identified significant cost drivers and related root causes where indeed problems on a European scale.

After drawing together a specification of common European cost drivers, these were integrated into an overall, coherent package of developing measures that together have had as an objective to achieve a 30% LCC reduction. In addition, these measures were aimed as a major progress in achieving the targets defined in the EC White paper on Sustainable Transport.

The main research activities of INNOTRACK have been carried out in sub-projects (SPs) 1 to 6. Initially, SP1 and SP6 worked to develop formal technical and economic specifications for the project. SP2 to SP4 have developed innovative solutions to solve these issues in three different technical areas (switches & crossings, rails & welding, and in substructure assessment and improvements). Finally SP1 and SP6 have verified that the solutions provided were appropriate in terms of overall technical feasibility and LCC gains (see Figure 1).

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**Figure 1: Project Flow**

![Diagram showing project flow](image-url)
Figure 1 shows the project flow. In addition, Figure 2 shows the project organisation it. These two figures indicate quite clearly why it is difficult to describe and understand the effects of INNOTRACK in a work-package centered presentation: The derived solutions interact. They are based on input from other work-packages. They influence the work in other work-packages and they are verified in yet other work-packages.

Figure 1 is slightly different for SP5. Here the input comes from interviews and questionnaires. Then some questions have been handled within INNOTRACK while some long-term questions have been dealt with in other organisations (see D5.2.1).

In addition, the documentation of INNOTRACK constitutes roughly 10,000 pages. For most persons, it is not feasible to study all this documentation. To this end, INNOTRACK has published 15 guidelines. These contain detailed implementation recommendations in selected areas. However, the guidelines constitute in the order of 1000 pages and are not intended to give a conclusive overview of INNOTRACK.

Therefore, UIC decided to produce a Concluding Technical Report (CTR). The CTR is a publicly available document, which describes the project in a more easy-to-understand manner than the Description of Work. With the help of the CTR, a person with less detailed knowledge of the project can more easily understand, find and use the results produced in INNOTRACK. The CTR is the “key” to implement INNOTRACK results at infra-structure managers, in the industry and in research organizations. In the CTR it is clearly stated in which Deliverables (and if relevant in which sections and appendices of these) more information is available.

**Figure 2: Project Organisation in terms of SubProjects with responsible partners indicated.**

**Project partners**

**Infrastructure Managers**

- Union Internationale des Chemins de fer (UIC), France
- Banverket (BV), Sweden
- Administrador de Infraestructuras Ferroviarias (ADIF), Spain
- Ceske drahly, a.s. (CD), Czech Republic
- DB Netz AG (DB), Germany
• Network Rail Infrastructure Limited (NR), United Kingdom
• Österreichische Bundesbahnen – Infrastruktur Bau AG (OBB), Austria
• Réseau Ferre De France (RFF), France
• PRORAIL BV (PRORAIL), Netherlands
• Railways safety and Standards Board (RSSB), United Kingdom
• Société Nationale des Chemins de Fer Français (SNCF), France
• Sprava zelezní dopravni cesty, statni organizace (SZDC), Czech Republic

Industry

• Association of the European Railway Industries (UNIFE), Belgium
• European Federation of Railway Track Work Contractors (EFRTC), Luxemburg
• Carillion Construction Ltd (Carillion), United Kingdom
• Voestalpine Schienen GmbH (VAS), Austria
• ALSTOM Transport SA (ALSTOM), France
• Balfour Beatty Rail Projects Limited (BBRP), United Kingdom
• Goldschmidt Thermit GmbH (Goldschmidt), Germany
• VOSSLOH COGIFER (VCSA), France
• SPENO INTERNATIONAL SA (SPENO), Switzerland
• Corus (Corus), United Kingdom
• VAE (VAE) Gmbh Austria

Academia

• Chalmers University of Technology (Chalmers), Sweden
• Laboratoire Central des Ponts et Chaussées (LCPC), France
• Delft University of Technology (TUDelft), Netherlands
• Czech Technical University in Prague (CTU), Czech Republik
• University of Newcastle (NCL), United Kingdom
• University of Southampton (ISVR), United Kingdom
• University of Birmingham (UNI BHAM), United Kingdom
• Manchester Metropolitan University (MMU), United Kingdom
• Universitaet Karlsruhe (UniKarl), Germany

SMEs

• Damill AB (Damill), Sweden
• G-Impuls (G-Impuls), Czech Republic
• Contraffic GMBH (Contraffic), Germany
• ARTTIC SAS (ARTTIC), France
• TenCate Geosynthetics Austria GmbH (TenCate), Austria

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1.2 The Concluding Technical Report (CTR)

In this section, each chapter of the CTR is presented in order to facilitate the understanding about how this report is linked with the CTR and how the CTR is structured.

The CTR is a printed book of close to 300 pages. It has 11 chapters and 6 appendices.

The CTR sets out from a summary of the book (chapter 1). This chapter also explains how statements made in the INNOTRACK project Description of Work have been met.

Chapter 2 deals with the questions of “why” INNOTRACK was started and “how” the work in INNOTRACK has been carried out. It contains four parts: background, current regulations, objectives and management.

Chapter 3 gives an accurate description on current cost drivers as identified by national workshops and evaluated at a European level. The cost drivers are tackled in INNOTRACK by identifying root causes and then deriving innovative solutions for how to reduce costs related to these identified cost drivers. Chapter 3 is divided into two parts: The first part includes the technical cost drivers dealt with in subprojects SP2, SP3 and SP4. The second part includes organisational cost drivers tackled in SP5 and SP6.

In chapters 4, 5 and 6, the three technical sub-projects are described. The description of the research topics presented in these three chapters has the following basic structure:

**Background**
- Describe the component/phenomenon/process etc that has been studied. Motivation as to why it is a cost driver.
- What has been done in INNOTRACK?
- Increased knowledge, implementable results and related cost reductions are described.

**Key findings from the research in INNOTRACK**
- What can be implemented in terms of innovative products, processes and methodologies? How can it be implemented?
- How will cost savings be obtained? Is a future implementation planned to verify this? If so, where?

**Open questions**
- What has not been targeted?
- Which further studies should be carried out?

In these chapters, you can also find related input from the three supporting sub-projects SP1, SP5 and SP6. The chapters also include sections where LCC savings and logistic improvements related to the innovative solutions are described.

In chapter 7 deals with logistic improvements related to INNOTRACK solutions and the issue on how to obtain improved relations between IMs and contractors. These correspond to the parts of SP5 that are of a more general character.

Chapter 8 describes the general outcome from SP6. It starts with answering why and when to use LCC and RAMS and specific for track and structures.

It also explains the importance of the discount rate and gives example on the effect. To compare different boundary conditions is essential. This is also well described.
Also the importance of future feedback and requirements to supply industry is well described. This important question shows the need of projects like INNOTRACK.

Finally different uncertainty of parameters are analysed.

In chapter 9, the overall cost reduction that INNOTRACK generates is described. This analysis was carried out in SP1 with input from all SPs.

Chapter 10 details the work on dissemination and implementation that has been and is carried out in INNOTRACK. These activities are presented in much detail as INNOTRACK has taken a unique initiative to really get results implemented.

Finally in chapter 11 successes and challenges experienced during the course of the INNOTRACK project are. In this chapter, other questions are also described such as:

- R&D in INNOTRACK as an example on how to create a sustainable innovation process.
- The importance of and means to obtain cooperation between industry and IMs.
- Open questions from INNOTRACK and how they have been passed on.

The appendix consists of six parts.

1. List of partners
2. List of deliverables
3. Databases
4. Guidelines
5. Publications and presentations
6. Implementable results

Appendixes 1-5 are important compilations of administration and result. Appendix 6 represents a new way of thinking. Here the INNOTRACK consortium has taken the initiative to identify implementable results for different target audiences from the project. The philosophy behind this work is that such an identification is best done by the researchers that know the results best. On the other hand, the evaluations of whether the implementable results fits in a certain organisation and how they should be implemented is best done by the implementing organisations. With the aid of the list in Appendix 6, such an evaluation is significantly more manageable than from a full evaluation of the roughly 10,000 pages of INNOTRACK documentation.

A copy of the CTR is available on the INNOTRACK website (www.innotrack.eu), as well as on the homepages of UIC (www.uic.org) and UNIFE (www.unife.org).

1.3 Specific objectives of INNOTRACK and how they were met

One of the biggest challenges for railways in Europe is that track costs, the major cost component for infrastructure managers (IMs), have not significantly decreased in the last 30 years. Therefore, the main objective for INNOTRACK is to reduce costs, decrease disturbances and increase availability. In addition to the issues of cost and availability, also noise pollution has become a crucial issue for railway operations.

These issues can only be tackled by increasing R&D and standardisation at a European level. The EC White Paper on Transport addressed this (September 2002) and set ambitious targets for railway operations. These targets include:

- Doubling passenger traffic and tripling freight traffic by 2020
- Improving travel time by 25% – 50%
- Reducing life cycle cost by 30%
- Reducing noise to 69 dB for freight and 83 dB for high speed
- Increasing safety – reduce fatalities by 75%

The Railway Business Scenario 2020 also requires that:
• Railways capture 15% of freight and 12% of passenger market

This expected railway market share growth requires improvement of the current levels of reliability and availability of products and services framed by a more market-oriented railway system approach.

The railway vehicle industry has responded to the new challenges set before it, and will continue to respond by implementing:
  • Increased speed and acceleration
  • Increased axle loads and traction power
  • More rigid vehicles with greater stiffness

These innovations however have a downside: they place greater demands on the track, causing more damage and higher maintenance costs. INNOTRACK’s main objective was to reduce the LCC, while improving the RAMS characteristics (Reliability, Availability, Maintainability and Safety) of a conventional line with a mixed traffic duty.

Railways also endure various other problems: they have suffered for too long from innovative technologies that turn out to be too ambitious and expensive to maintain. At one of the latest World Congress of Rail Research, it was claimed that two-thirds of all railway research is undertaken by the supply industry and this leads to significant innovation in products (components) and services offered by the industry. However, the time to market and acceptance by IMs needs to be significantly reduced to justify the continued investment in R&D by the supply industry. To decrease time to market while reducing LCC, a European approach is required to support economy of scales and standardisation of railway infrastructures.

INNOTRACK has implemented appropriate changes to specifications and standards to achieve reduced LCC, time to market and cost of safety.

As an overall measurable objective, through the innovations and changes provided by INNOTRACK, the IMs are expecting from INNOTRACK a 30% LCC reduction of track-related costs.

INNOTRACK has shown, through LCC evaluations, that the developed innovative solutions provide cost savings of this scale. Further validations are in progress as the innovative solutions are gradually being implemented on a European scale.

INNOTRACK had the objective to provide railway infrastructure managers with crucial information and technologies to facilitate the understanding and implementation of leading edge track system technologies, which can effectively contribute to LCC optimisation in the following areas:
  • Track support structure
  • Switches and crossings
  • Rails
  • Logistics for track maintenance and renewal

These objectives have been met as detailed in the CTR and in the INNOTRACK Guidelines and Deliverables.

Furthermore, decision-making algorithms have been developed in order to harmonise the LCC calculation and provide comparison points on a European wide basis.

The INNOTRACK project was a joint response of the major stakeholders in the rail sector – IMs and the railway supply industry – for the development of a cost effective high performance track infrastructure. INNOTRACK has provided innovative solutions towards significant reduction of both investments and maintenance of infrastructure costs. This was needed:
  • To develop the necessary leading edge track system technologies in the shortest possible timescales and ensure full market acceptance by IMs
  • To speed up the realisation of the highly efficient Trans-European network so as to accommodate the increased passenger and freight traffic by 2020 as envisaged in EC White Paper

To achieve these objectives investment alone, even if achieved to the desired level by EC (220 billion for 30 TEN projects and 600 billion for all TEN projects), is not sufficient. A radical step change of the efficiency of rail systems including significant innovation and technology transfer is essential.
This objective has been met by INNOTRACK: Through the intimate collaboration between IMs, industry and research bodies, the technical solutions were validated already in the design stage. Further, the LCC evaluation provided economical arguments to support implementation. The result is that already three year after the start of the project; several innovative solutions have been implemented. Further, several INNOTRACK deliverables are in the process of being adopted as European and worldwide standards.

1.4 Main achievements and approaches taken in INNOTRACK

As explained above, the main achievements of the project are described in chapter 1 and 11 in the CTR.

The description below, which is an extract from the CTR, aims instead of providing a short escription of the different subprojects, as well as an insight in some of the successes and challenges related to the approaches taken in the subprojects.

1.4.1 Duty (SP1)

Since INNOTRACK is a “matrix” project where SP1 has acted as an identifier of cost drivers, a collector of input data, and an overall assessor of the innovative solutions, it is not easy to extract which parts of the INNOTRACK results that can be directly credited SP1. One significant result from SP1 is the basis for chapter 3 of the CTR “Cost drivers and how they are addressed in INNOTRACK”.

The main usable results from SP1 are the populated databases, the identification of common European problems and their root causes and the assessment of the overall cost reduction.

In SP1 the Overall Cost Reduction has been done. This deliverable gives figures of possible cost reduction that can bee achieved from INNOTRACK result. It is also a possibility for the IM to prioritise between the results.

As mentioned above, SP1 has been very active to support the three vertical projects. For this reason a lot of the work carried out in SP1 is described in relation to SP2, SP3 and SP4.

Pros of the approach taken in SP1

The national workshops were successful and very useful. For the first time national workshops was carried out with an international perspective. The conclusions of the workshops were also important in that they identified the cost drivers and clarified that the most important cost drivers where international. In fact, the differences between national important cost drivers in different countries where less than expected. This is an important fact and shows that international R&D cooperation is advantageous.

In addition, the developed tools and populated databases have been a success.

Cons of the approach taken in SP1

Collecting accurate and useful data has been a problem. The reason for this was the lack of comparable data of good quality. The idea of using general track segmentation partly failed. The main reason was also here a lack of high-quality, comparable data. In addition, it turned out the review process to technically verify innovative solutions partly was too complex for the number of deliverables produced in INNOTRACK and partly was not needed since the close collaboration between IMs, industry and research bodies in SPs2, 3 and 4 led to innovative solutions that were technically verified already in the design stage (which of course is not negative). It however turned out that the technical verification process developed in SP1 proved to be a very powerful tool to technically verify selected products.

1.4.2 Track Support Structure (SP2)

Previous research on track support structures has mainly been carried out on a national level. One important consequence of INNOTRACK is that a significant part of these national results have now been expanded, coordinated and placed in a European context. In chapter 4 in the CTR the R&D and
subsequent results from SP2 are described.

Pros of the approach taken in SP2

This was the first time a European-wide project in this research area was set up. INNOTRACK has opened the view in this previously very “national” research area. Different measuring and strengthening methods have for the first time been compared and evaluated. This will provide valuable knowledge for the future.

Several results were implemented, evaluated and validated within INNOTRACK such as: Reinforcement of a soft embankment area with inclined lime cement columns, improvement of a transition zone using geosynthetics, improvement of a bad drainage zone and test section of Corus two layer steel slab track.

Cons of the approach taken in SP2

The test section of the BBEST slab track was not possible to carry out within the project. This was due to circumstances outside of INNOTRACK’s influence.

1.4.3 Switches and Crossings (SP3)

In SP3, more basic R&D was needed, since this is an area with a less established tradition of R&D than e.g. SP4. Even if the sub-project for this reason started from a more basic level, implementable results have been provided. Some of these have already been validated in field tests, while others are in on-going validation. In chapter 6 in the CTR the results from SP3 are described in detail.

Pros of the approach taken in SP3

A real step forward has been taken on how to reduce dynamic forces in switches both for lateral and vertical forces. This has been done by identifying and optimising track gauge and stiffness.

A new optimized geometry of crossings has been produced. This geometry has also been verified by simulations and in demonstrations.

A new generation of hydraulic actuators were developed and demonstrated in the project. Both solutions are mounted in hollow sleepers, which are standardised and being developed to an EC-norm by the CEN.

An open standard for Ethernet-based communication between signalling plant and switch has been developed.

New algorithms for switch monitoring have been developed and tested.

Cons of the approach taken in SP3

A 3–4 year project is too short to finalise demonstrations and have a proper follow-up of result within the project. Therefore, some of the reports will only be ready after the official ending of the project.

1.4.4 Rails and Welding (SP4)

In the area of rails and welding, a lot of R&D has been carried out during the last ten years. By facilitating this knowledge, it was possible to produce several directly useful guidelines in SP4. In chapter 5 in the CTR the results from SP4 are described.

Pros of the approach taken in SP4

Several guidelines that represent a significant step forward have been brought forward. Example of such are:
- Rail grade selection criteria based on a significant amount of high-quality field measurements and a knowledge about the dominant damage mechanisms
- Better understanding and predictive models for the degradation of joints and key defects such as squats
- A first step towards the harmonization and of laboratory tests for rail steel grades and a significant step forward in being able to compare these with in-track behaviour
- Comparative evaluation of grinding strategies & target profiles with concluding recommendations that also consider logistics and strategic planning aspects.

Also, evaluation of innovative technologies has been carried out. As an example three new welding technologies have been assessed.

Cons of the approach taken in SP4

Track trials to study weld degradation that were planned in Germany, UK and the Netherlands were not possible to carry out within the INNOTRACK project mainly due to lack of track availability. They have partly been replaced by on-going track tests at other locations.

1.4.5 Logserv (SP5)

In chapter 7 in the CTR, the results from SP5 are described from an overall point-of-view. In chapter 4, 5 and 6 logistics aspects related to specific technical innovations are described.

Pros of the approach taken in SP5

INNOTRACK has made an important step forward in the broad field logistics. This is especially important since the “Directive 2004/17/EC” of the European Parliament and the Council of 31 March 2004 “Coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors” have to be met. Not the least, INNOTRACK has identified several areas of potential improvement on a European scale through in-depth interviews with both IMs and suppliers/contractors.

Many questions have been brought up in SP5. Some of these are brought up for the first time in a structured way in a detailed cooperation between the IMs and the rail contractors.

Several of the findings from SP5 have been taken over by other bodies like EIM, CER and EFRTC that can continue the development of these questions in a sustainable manner.

Cons of the approach taken in SP5

It was difficult to conclude the results in a good way since the initial ambitions regarding the level of changes turned out to be unrealistic considering the three-year scope of INNOTRACK. Another reason for the complications was that the views on logistics varied a lot between different IMs. For this reason, it was not possible to verify the result in such a good way as would be desirable.

1.4.6 LCC (SP6)

Regarding LCC and RAMS it was observed that the use of these techniques was in its infancy on a European scale in the area where INNOTRACK has been focusing. The reason was not so much lack of knowledge of the techniques as a lack of useful input data. For this reason, the work in INNOTRACK was partly different from what was initially planned. In chapter 8 in the CTR the results from SP6 are described. In chapter 4, 5 and 6 LCC effects of specific technical innovations are described. SP6 has also influenced chapters 3 and 9 in the CTR.

Pros of the approach taken in SP6

SP6 has constituted a significant step forward in developing Europe-wide accepted LCC and RAMS evaluations. It has further promoted a much better common understanding of RAMS and LCC for both supply industry and IM’s.
INNOTRACK has developed a common understanding of RAMS and LCC between supplier and IM’s. A common approach to LCC evaluations for European track-related costs has been derived. A guideline for LCC and RAMS evaluations using this common approach has been developed. LCC and RAMS in procurement documents have been defined.

Cons of the approach taken in SP6

The use of LCC and RAMS in the track sector was not as advanced as expected for this reason the final results of INNOTRACK did not fully reach the intended objectives.

1.4.7 Management and Coordination (SP0)

Management and coordination is described in chapter 2 of the CTR.

Pros of the approach taken for the management organisation

The management structure used in INNOTRACK has been a success in the way INNOTRACK could be steered. It has been easy to take decisions and to make necessary changes immediately.

The chosen management structure has also made an efficient coordination possible. This has been especially important since INNOTRACK has been organised as a “matrix” project.

It has also been an advantage to have professional management support in INNOTRACK.

Cons of the approach taken for management organisation

Smaller participants have had less influence in the steering of the project. To compensate this negative effect, the project manager and the SP-leaders have spent extra time to inform these participants.

1.4.8 Dissemination and Training (SP7)

Dissemination and training is thoroughly described in chapter 10 of the CTR.

Pros of the approach taken for the dissemination and training

The positive engagement from railways and industry also from outside the INNOTRACK consortium has made dissemination and training easier.

A new step has been taken in INNOTRACK in the sense that the implementation step has been planned in detail during the whole of the project and the plans been fully established well before the ending of the project.

Open questions have also been handled. This is described more in detail in the chapter “Open questions and how they are passed on” below.

INNOTRACK dissemination and implementation activities are now carrying on after the project end.

One example is the “ERIKSGATA” where the individual railways get information of the total INNOTRACK and how to find important result. Today 9 railways, voestalpine and ERA have given this opportunity.

Another example is that an Implementation Group has been established. Today this group consists of four IMs, four industries, UIC, and UNIFE. This group has a clear agenda to promote implementation in cooperation between the IMs and the industry. This initiative from UIC is unique.
Cons of the approach taken for the dissemination and training

The railway industry structure as a whole is complex. Therefore, most activities here have to be tailor-made according to the target. It is also not always straightforward to identify the proper person/department to whom a certain dissemination/implementation action should be addressed.

1.5 INNOTRACK in the light of the state-of-the-art

1.5.1 Logserv (SP1)

In WP1.1 and in WP1.2, Europe-wide data regarding operational vehicles and track have been gathered. This is the first time it has been done in a European perspective. Especially WP1.1 is interesting since several railways outside of INNOTRACK also provided vehicle data. This European database is unique. WP1.1 has also compiled a database of European generic vehicle characteristics.

WP1.3 was also a first of its kind: organising workshops to identify and define cost drivers from a European perspective is something new. Previously massive amount of data have been collected. However, they have not been analysed in detail in a European perspective. Through the work in WP1.3 it was possible to conclude that the most important cost drivers are indeed international. This had not been done before. Also in WP1.3 the root causes for the cost-drivers have been identified and innovative solutions proposed in a systematic way. Also this has never been carried out before. Finally, the work had a very fruitful side effect: the compilation on a European-wide scale indicated the complications in comparing data between countries and regions. It thereby indicated specific needs for harmonisations and, through the work on actually harmonizing the data carried out in INNOTRACK, how such a harmonization can be obtained.

In WP1.4 there are three reports that are interesting from this aspect. A report is providing detailed analysis of the key railway infrastructure problems and recommendation as to how appropriate existing cost categories for future data collection could be designed from a European perspective. Overall, cost reduction and cost data collection have been addressed in two reports that show two ways forward to verify cost reductions. The first shows the impact of INNOTRACK and the second how to obtain accurate data. This is currently the most difficult question.

SP1 has also outlined and demonstrated a systematic method for technical approval of innovative products where current homologation processes are insufficient or inadequate.

1.5.2 Track Support Structure (SP2)

In SP2 there are several Guidelines that constitute significant enhancements of the current state-of-the-art.

In WP2.1, a guideline regarding methodologies of geophysical investigation of railway track defects shows the latest improvements in this area. Geophysical methods have been used for a long time, but have been questioned due to difficulties in drawing precise conclusions. This report is a significant improvement in this context. A guideline on methods for track stiffness measurements has been derived. The results from INNOTRACK are a key factor in the increasing use of track stiffness for track substructure assessment. The work in INNOTRACK also paves the way for future standardisation and inclusion in TSIs. Measuring techniques for assessing track stiffness have been compared for the first time. Furthermore, results from all in-situ measurements of subgrade quality covering a very wide range of investigative methods have been compiled in a database. This is the first time it has been done in a European perspective and on such a scale. The user-friendly interface of the database provides geotechnical engineers with an unprecedented innovative tool for reference data and for evaluating future investigations.

WP2.2 dealing with subgrade improvements has been concluded in four reports. Different traditional and innovative strengthening methods have been adopted and the results evaluated in a stringent and scientific manner. The guidelines have given clear directions on how to employ the methods better and what the advantages are with the different reinforcement methods. Until today, it has not been easy for the IMs to optimise and compare different solutions. The work in INNOTRACK on subgrade reinforcement not only facilitates this, but also gives the engineer access to innovative methods that can be adopted with less (or no) traffic disturbance.
In WP2.3 two new innovative slabtrack solutions have been demonstrated. These solutions target different operational scenarios. Both of these represent significant improvements toward the previous state-of-the-art. The scopes of application, benefits and LCC gains of the solutions have been established in cooperation between industry and IMs.

1.5.3 Switches & Crossings (SP3)

WP3.1 has been a real breakthrough in reducing impact of lateral and vertical dynamic forces in the switch and the crossing when trains are passing. The work has also presented, for the first time, a full chain of computer-aided optimisation of switches: simulations of train–track interaction have been connected to numerical simulations of plastic deformation and wear. The results have been validated by full-scale field measurements of forces, wear and plastic deformation. The results from INNOTRACK are so interesting that the next step of building full-blown INNOTRACK switches have been decided in Germany and Sweden. The result is described in two guidelines “Recommendation of, and scientific basis for, optimization of switches & crossings part 1 and 2”.

In WP3.2, functional requirements have been defined for hollow sleepers and driving and locking devices. Also technical and RAMS requirements/recommendations for the actuation system have been defined for locking and the detection devices for a UIC 60-300/1200 switch. This is important to promote future European standardisation. Contacts have been taken with the CEN and a group has been established to work with the question.

In WP3.3, no guideline has been produced but several important documents specify requirements for IMs regarding switch monitoring. A report that quantifies the benefits that is available from switch and crossing monitoring has been produced.

1.5.4 Rails & Welding (SP4)

In WP4.1, a guideline for rail grade selection has been produced. This guideline constitute a major leverage from the current state-of-the-art in two aspects: Firstly, the current guideline for rail grade selection is modified based on results from extensive monitoring of rail degradation across Europe. Secondly, an innovative procedure of rail grade selection based on the degradation characteristics of existing rails is put forward.

WP4.2 constitutes a massive increase in the current body of knowledge. Some examples are an improved understanding on how squats develop and grow from field observations and numerical simulations. A second example is a better understanding of crack propagation and how this can be predicted from measured and/or estimated operational conditions. Another example of significantly increased knowledge concerns insulated joints where the influence of geometrical and load parameters are established. The results have been compiled in a guideline with implementable recommendations and procedures.

WP4.3 includes, for the first time, comparisons between results from different rigs for rail tests. Innovative damage classifications and numerical simulations have supported this comparison. The results pave the way for standardisation and better comparisons towards field conditions. This question will also be discussed with the TC256.

In WP4.4, a major step forward has been taken in establishing the capabilities and accuracy of different measuring techniques to identify rail cracks. The result shows that different methods have different advantages.

WP4.5 has delivered a clear recommendation on grinding practices and strategies. This is the first time such a recommendation has been compiled on a European level. This sets the foundation for future standardisations and improvements in efficiency. A next step with a TecRec is today decided and is planned to be delivered in 2011.

In WP4.6, it is showed that new welding technique can be used with a quality better than expected. E.g. the benefits of welds with narrow heat affected zones have been quantified. Further, the feasibility of gas-pressure welding has been established. The work has highlighted needed revisions of current weld regulations to not discriminate innovative welding procedures.

1.5.5 Logserv (SP5)

INNOTRACK has made an important step forward in assessing logistic issues from a broad
perspective. This is especially important since there are existing directives in Europe to be met. Several issues, e.g. on sourcing and safety practices have been thoroughly charted for the first time in a detailed and structured way in cooperation between IMs and rail contractors. Several of the identified success critical areas have been taken over by bodies like EIM, CER and EFRTC to assure the long-term development.

SP5 has furthermore contributed to the logistics evaluation of derived INNOTRACK solutions. An example is the analysis and quantification of gains from innovative logistics solutions for S&C. This is the first time such an evaluation has been carried out in such detail on a European scale.

1.5.6 LCC (SP6)

The main contributions towards the current state-of-the-art have been produced in WP6.4 and WP6.5. In WP6.4 key values regarding LCC in contracts are defined. The report also assesses how these values can be monitored. This is new in a European perspective.

In WP6.5 an excellent guideline regarding LCC and RAMS analysis has been produced. This provides a hands-on assistance in structured LCC analysis, which has major implications for standardisation, Europe-wide comparisons and evaluations. As an example, the crucial role of the selected discount rate has been highlighted and it is demonstrated how innovations will be killed by employing a high discount rate in LCC evaluations.

1.5.7 Dissemination and Training (SP7)

INNOTRACK is exceptional in focusing on implementation during the entire project. Already before the project started, a very clear goal was to fulfil the needs in the area. During the project, INNOTRACK has reviewed results at an effort estimated to 100 k€. Very small part of this has been funded by the EC. In the end of the project, support has been given to the end-user to implement the results. This has been carried out e.g. by physical meetings with IMs and industry, in compiling results in guidelines and in the current authoring of a Concluding Technical Report.

1.6 Impact of the project on its industry or research sector

In chapter 9 of the CTR, the effect quantified in terms of overall cot reductions is presented. In that chapter, the impact of e.g. more correct choice of rail grades, improvement of embankments with lime/cement columns and the economical outcome of enhancement of S&C are described.

Appendix 6 of the CTR gives a detailed description of implementable result for different target audiences. These are also appended to this report as an annex to section 2.

There are also effects of INNOTRACK that are hard to quantify in LCC terms. Chapter 9 gives examples of three categories of innovative solutions for which is the case. In addition, INNOTRACK has also established a unique approach for R&D in cooperation between IMs and industry. This is likely to have long-reaching effects regarding e.g. onfuture R&D, implementation, homologation and standardization processes. As one example of this is that INNOTRACK will provide the material for some of the first TecRecs (i.e. common guidelines drafted by the UIC and UNIFE).
2. Dissemination and Use

In INNOTRACK, it has been an objective to make as much of the results as possible publicly available. Public deliverables have been posted on the INNOTRACK public website (www.innotrack.eu) under the heading “Results”. The efforts towards dissemination and implementation are described in detail in chapter 10 of the concluding technical report. Two activities can be mentioned here: The INNOTRACK top management has travelled to different IMs and industries to present the main results of INNOTRACK in person. This work continues during 2010. Further, the Coordination Group and the Steering Committee of INNOTRACK has formed an Implementation Group, which is continuing to operate and aid in coordinating implementation among the INNOTRACK partners.
3. Annex 1 – Table of implementable results in INNOTRACK

Below can be found a list of implementable results in INNOTRACK.
IMPLEMENTABLE RESULTS FROM INNOTRACK

D1.1.1 Database of representative vehicle types and characteristics from participant countries.
Database of vehicle data.

D1.1.2 Database of European Generic Vehicle Characteristics
Database of European vehicles.
Generic model for Multiple Unit vehicle.

D1.2.1 Standardised method for converting measured track data into segments for “virtual tracks”.
Numerical generation of representative track segments.

D1.2.2 Identification of critical track segments.
Correlation analysis between failures, maintenance and costs and line routing data, track design and operational conditions.
Structured catalogue of track faults.
Identification of cost drivers.

D1.2.4 Definition of track irregularities.
Database of track section characteristics for typical sections with faults.
Related data of operating vehicles.

D1.2.5 Track segmentation.
Guidelines for track segmentation.
Analysis of track recording coach data.
Numerical tools for track segmentation and data analysis.
Data on track conditions.

D1.3.1 Report on the state of the art of the simulation of vehicle track interaction as track degradation rates.
Overview of six numerical toolboxes for strategic decision making.

D1.3.3 The root causes of problem conditions and priorities for innovation.
State-of-the-art of track deterioration mechanisms.
Background deterioration data for prioritizing research/development.

D1.3.4 Report on the most appropriate tools for method already exists.
Framework for technical assessment and FMECA analysis of innovative solutions with case study.
Technical approval of BBEST slab track solution.

D1.3.6 Report on the state of the art of the simulation of vehicle track interaction as a method for determining track degradation rates.
Overview and classification of numerical models for vehicle–track interaction and pertinent track degradation.

D1.4.1 Detailed Framework for Information and Data Collection
Track problem related data.

D1.4.2 Database of models and list of potential model gaps.
Database of numerical toolboxes for simulation of different aspects of track loading and deterioration.

D1.4.3 Process for the linking of modelling tools.
Transfer format for simulation data and models.
Data export/import/transfer programs and/or routines for simulation programs.
D1.4.4 Completed knowledge repository available online and data mining routines for system wide analysis. Measurement train data. Track information data. Wheel impact load data.

D1.4.5 Prototype linking of multiple tools to aid with an appropriate case study. Outline of XML scheme for link in data and output of different numerical tools.

D1.4.6 A report providing detailed analysis of the key railway infrastructure problems and recommendations as to how appropriate cost categories for future data collection. Common European cost and maintenance structures. Compilation of cost drivers. Mitigation of cost drivers. Better (more clear) reporting routines.

D1.4.7 Data mining of data sets. Exemplification of how to mine data collected in INNOTRACK to draw practical conclusions (e.g. On maintenance needs).

D1.4.8 Overall Cost Reduction. Evaluation of cost savings as basis for prioritizations. Method of deriving overall cost savings of innovative solutions. Exemplification of detailed LCC evaluations.

D1.4.9 Cost data collection. Proposed breakdown structure of track maintenance cost categories as basis for future standardization.

D1.4.10 Demonstrator: vehicle classification based on wayside monitoring station. Wayside monitoring station to evaluate track forces and steering behaviour on a vehicle basis. Comparison of wayside monitoring systems. Innovative approach to vehicle classification based on monitoring data.

D2.1.1 In-situ measurement preliminary database, based on information management framework. Database for track and subgrade/subsoil data. Structure for defining data sets in the database of track and subgrade/subsoil data.

D2.1.2 Prototype of adapted Portancemeter for track substructure stiffness measurement on existing tracks. Evaluation of needed characteristics for a portancemeter for railway use. First version of a portancemeter for railway use.

D2.1.3 First phase report on the modelling of poor quality sites. Test box to measure sleeper deflection. Measured deflections under different ballast/sub-ballast/foundation conditions. Numerical (FE) models validated towards experiments. Design graphs to obtain a specified deformation modulus.

D2.1.4 Report on test results and sampling. Results from field tests, comparison of methods of sounding. Lab tests. Application of the concept onset of settlements: requirements and results.

D2.1.5 GL Methodology of geophysical investigation of railway track defects. Geophysical measurement.
D2.1.6 RSMV stiffness measurements
Results from field tests.  
Comparison with other methods.

D2.1.7 Investigation with geo-endoscopy and penetrometer.
Results from field tests.  
Comparison with other methods.

D2.1.8 Update of D211 – Database.
Database for track and subgrade/subsoil data.  
Structure for defining data sets in the database of track and subgrade/subsoil data.  
Applications  

D2.1.9 Report on measurements campaign with railway portancemeter.
Results from field tests.  
Comparison with other methods.  
Portancemeter tool.

D2.1.10 Study of variation of the vertical stiffness in transition zone.
Data base of track stiffness variation for operating vehicles.  
Data of track condition.  
Measurement train – track data.  
Influence of the traveling condition in the track stiffness values.  
Variation of the vertical stiffness in transition zones.

D2.1.11 GL Methods of track stiffness measurement.
Test of different tools for track stiffness measurement.  
Comparison with other methods.  
Development of portancemeter.

D2.1.12 GL Modelling of the track subgrade.
Part 2: final report on numerical modelling.  
Test box to measure sleeper deflection.  
Measured deflections under different ballast/sub-ballast/foundation conditions.  
Numerical (FE) models validated towards experiments.  
Design graphs to obtain a specified deformation modulus.  
Stochastic approach for variability accounting.

D2.1.13 Stiffness data processing and evaluation.
Method to deriving track quality information from measured data on track stiffness, track geometry and ground penetration radar.

D2.1.14 Concluding update of D218.
Database for track and subgrade/subsoil data.  
Structure for defining data sets in the database of track and subgrade/subsoil data.  
Applications  
Overview and selected examples.

D2.1.15 Non-destructive geophysical methods.
Review of geophysical measurement methods.

D2.1.16 Final report on the modelling of poor quality site.
Test box to measure sleeper deflection.  
Measured deflections under different ballast/sub-ballast/foundation conditions.  
Numerical (FE) models validated towards experiments.  
Design graphs to obtain a specified deformation modulus.  
Stochastic approach for variability accounting.
<p>| D2.2.1 | State of the art report on soil improvement methods and experiences. Overview of soil improvement methods with indication of: purpose, area of application, standards, specifications and implementation status among INNOTRACK partners. |
| D2.2.4 | Description of measurement sites + LCC reference sites. Characteristics of measurement sites to be used together with measurement database. |
| D2.2.9 | Subgrade reinforcement with geosynthetics: Enhancement of track using under-ballast geosynthetics. Test box to measure sleeper deflection. Measured deflections by using different geosynthetics. Numerical (FE) models validated towards experiments. Design graphs to obtain a specified deformation modulus. Field measurements and evaluation. |
| D2.3.1 | Validation methodology and criteria for evaluations of superstructure innovations. Evaluation criteria for innovative superstructure solutions. |
| D2.3.2 | Optimised design of a steel-concrete-steel track form to provide consistent support for low maintenance operation based on modelling and laboratory testing. Innovative steel-concrete-steel track form. Evaluation of deflection, stresses, fatigue, noise emission etc of steel-concrete-steel track form as basis for maintenance and operational limits. |
| D2.3.3 | Design and Manufacture of BBEST slab track components. Innovative embedded slab-track solution. Evaluation of deflection, stresses, fatigue, noise emission etc of steel-concrete-steel track form as basis for maintenance and operational limits. |</p>
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<td>Optimization of track gauge variation, and quantification of benefits in terms of decreased track forces, wear and risk of RCF.</td>
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<td>Optimization of crossing geometry and quantification of benefits in terms of decreased contact forces.</td>
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<td>Optimization of crossing support stiffness and quantification of benefits in terms of decreased track forces, wear and risk of RCF.</td>
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<td>Methodology for validated prediction of contact forces and resulting plastic deformation, wear and RCF.</td>
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<td>Quantification of the influence of increased axle load on switch deterioration through numerical simulations.</td>
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<td>Overview of DLDs used in different countries.</td>
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<td>Acceptable (and realistic) RAMS and LCC targets for purchasing etc.</td>
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<td>D3.2.2</td>
<td>GL Functional requirements for hollow sleepers for UIC 60 switches.</td>
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<td>Functional requirements for hollow sleepers as basis for codes and standardisation.</td>
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</tr>
</tbody>
</table>
### D3.3.1 List of key parameters for switch and crossing monitoring.
Structured decomposition of the components of a generic switch as basis for e.g. improved fault reports.
- Failure mode effects and criticality analysis as basis for design optimisations.
- Analysis of the occurrence of different failure types as basis for design optimisation.

### D3.3.2 Available Sensors for railway environments for condition monitoring.
Compilation of types of faults of switch actuators and the number of occurrences as a basis for design development.
- Categorisation of faults as a basis for refined detection.
- Testing of the influence of the faults on measurable parameters as a foundation for detection equipment.
- Quantification of which measurable parameters that can indicate which fault.

### D3.3.3 Requirements and functional description for S&C monitoring.
A structured list of requirements for S&C monitoring.

### D3.3.4 Algorithms for detection and diagnosis of faults on S&C.
Survey of fault detection and diagnosis algorithms and their applicability for switches.

### D3.3.5 Draft specification of the monitoring demonstrator.
A structured list of requirements for a DLD and monitoring demonstrator.

### D3.3.6 Quantification of benefits available from switch and crossing monitoring.
Definition of five levels of S&C monitoring including description of how to upgrade to a higher level and pertinent benefits.
- Two LCC evaluation schemes for calculating financial benefits of S&C monitoring.

### D4.1.1 A database for actual and new, innovative rail/joints.
Database with long-term degradation data from rail manufacturers and infra-managers.

### D4.1.2 Interim rail degradation algorithms.
Empirical predictive formulas for wear as function of operational conditions and rail grade.
- Correlation between track based circumstances, operational situation and crack growth rates.

### D4.1.3 Interim guidelines on the selection of rail grades.
Compilation of rail grade selections throughout Europe as basis for standardisations.
- A first recommendation for updating guidelines w.r.t. rail grade selection (UIC 721).

### D4.1.4 Rail Degradation.
Empirical predictive formulas for wear as function of operational conditions and rail grade.
- Correlation between track based circumstances, operational situation and crack growth rates.
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<th>D4.1.5 GL</th>
<th>Definitive guidelines on the use of different rail grades according to duty conditions and based on RAMS and LCC principles. A recommendation for updating guidelines w.r.t. rail grade selection (UIC 721).</th>
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| D4.2.1    | Estimations of the influence of rail/joint degradation on operational loads and subsequent deterioration. Tentative report.  
Knowledge on frequency content in contact loads from operations on corrugated track / with out-of-round wheels as basis for standards of wheel–rail contact force measurements.  
Influence of parameters such as axle load, speed, corrugation magnitude etc on wheel–rail contact forces on operations on corrugated tracks as basis for regulations on allowed load and maintenance practices.  
Numerical tools to predict rolling contact fatigue impact for operations on corrugated track / with out-of-round wheels.  
Influence of insulated joint dip on vertical contact forces as input to allowed magnitudes and maintenance practices.  
Numerical tools to predict loading of and stresses/strains at an insulated joint.  
Numerical tools to calculate the influence of squats on contact stresses.  
Influence of parameters such as traction/braking, unsprung mass, welds etc. on squat loading as basis for maintenance practices. |
| D4.2.2    | Interim report on “Minimum Action” rules for selected defect types. Outlining of a statistical approach to minimum action rules. |
| D4.2.3    | Improved model for loading and subsequent deterioration due to point-like rail defects (e.g. insulated joints).  
Influence of parameters such as width of insulating layer, loading etc on predicted deterioration of joints as basis for regulations on design, placement and maintenance.  
Numerical models to simulate the deterioration of an insulated joint.  
Field monitoring over half a year of the deterioration of an operational insulated joint and relation to pertinent traffic load. |
| D4.2.4    | Improved model for loading and subsequent deterioration due to distributed rail defects (e.g. squats and rail corrugation).  
Correlation between the occurrence of squats with the locations of welds as a basis for regulations on welds and maintenance practices.  
Numerical toolbox to predict squat initiation.  
Identification of critical size for a surface defect to grow into a squat as basis for allowed surface irregularities and maintenance practices.  
Knowledge on squat growth from in-field monitoring for refining maintenance practices.  
Knowledge of the variation in corrugation spectra between lines as basis for measurement, detection and maintenance practices.  
Influence of speed and roughness levels on rolling contact fatigue impact and rolling noise as basis for regulations and maintenance practices.  
Numerical toolbox for prediction of noise emission and rolling contact fatigue impact at operations on corrugated rails and/or with out-of-round wheels.  
Knowledge of wavelength characteristics of squats as basis for detection. |
| D4.2.5    | Improved model for the influence of vehicle conditions (wheel flats, speed, axle load etc) on the loading and subsequent deterioration of rails.  
Quantification of the influence of wheel–rail hardness correlation, applied traction and wheel out-of-roundness on wear rates as basis for regulations and design practices.  
Hardness evolution under conditions of varying hardness of wheel and rail.  
Numerical toolbox for wear prediction.  
Numerical toolbox for growth of short railhead cracks.  
Numerical toolbox for prediction of operationally induced bending of rails and subsequent long crack growth. |
### D4.2.5 continued

- Prediction of wheel impact load corresponding to rail breaks under varying operational conditions (speeds, axle loads, vehicle type, track stiffness, temperature) as basis for regulations and maintenance practices.
- Prediction of growth rates of long rail cracks under varying operational conditions as a basis for maintenance regulations, practices and planning.

### D4.2.6 GL Recommendation of, and scientific basis for minimum action rules and maintenance limits.

- Overview of current minimum action rules in Europe.
- Determination of critical size for squat growth.
- Guidelines for squat detection.
- Guidelines for squat countermeasures.
- Definition of corrugation characteristics in terms of wavelength spectrum.
- Operational acceptance criterion for allowed corrugation accounting for noise emission and risk for RCF.
- Guidelines for wear limitation.
- Recommendation of documentation practices in relation to rail wear documentation.
- Quantification of the influence of insulated joint dip, insulating layer width and load magnitudes on joint deterioration.
- Quantification of mitigating effects of modifications such as rail edge bevelling, insulation material stiffness, laterally inclined joints.
- Recommendations for insulated joint design under different operational conditions.
- Definition of standardized wheel flat geometry and simplified contact force history related to wheel flat impact based on field measurements and numerical simulations.
- Approximate relations to relate wheel–rail contact loads from quasi-static and wheel flat impact to rail bending moments based on field measurements and numerical simulations.
- Approximate stress intensity factors for rail head and foot cracks.
- Derivation of fracture risks as function of rail crack size, wheel–rail impact load, ballast stiffness, temperature, vehicle type etc.
- Derivation of crack growth rates as function of rail crack size, wheel–rail impact load, ballast stiffness, temperature, vehicle type etc.
- Recommendation of practices to avoid rail breaks.
- Predictive model to evaluate the risk of rail breaks as function of distributions of load, defect size, temperature etc.
- Estimations of possible savings related to RCF, corrugation and squat management.

### D4.3.1 Initial definition of conditions for testing matrix of rail steels and welds.

- Information on available test benches.
- Structured definition of test parameters to build specifications from.

### D4.3.2 Characterisation of microstructural changes in surface and sub-surface layers with traffic.

- Development and validation of a method of defining damaged material based on misorientation of the material microstructure.
- Establishment of a relationship between surface crack length and crack depth as basis for estimations of needed grinding depths, classification of damage etc.
- Evaluation of depth of damaged rail surface layer for different rail grades under different conditions as background for e.g. needed grinding depths.

### D4.3.3 Test results of first test rig measurements.

- Times to crack initiation under different test bench conditions.
- Rail profile evolution under different test bench conditions.
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<td>Description of which data to collect and how to report it in connection to laboratory tests.</td>
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<td>D4.4.2 Operational evaluation of a multifunctional inspection equipment (phase 1: laboratory and static tests).</td>
<td>Structured samples of real and manufactured defects for testing of inspection equipment.</td>
<td>Evaluation of available inspection method's abilities to detect defects.</td>
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<td>Evaluation of innovative inspection techniques to detect defects.</td>
<td>Evaluation of further market qualities (maturity, cost etc) for innovative techniques.</td>
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<td>Toolbox for mapping inspection results to infrastructure assets (not developed in the frame of INNOTRACK).</td>
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<td>Compilation of grinding causes and practices for grinding at different infra-managers as basis for benchmark and standardisation.</td>
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<td>Definition of grinding approaches to avoid corrugation and RCF, respectively.</td>
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<td>Evaluation of use of LCC and RAMS at infra-managers, contractors, manufacturers, SMEs, branch organisations and academia as basis for benchmarks and optimisations.</td>
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<td>Identification of synergies between INNOTRACK and LICB.</td>
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<td>List of available standards, databases and software related to RAMS analysis.</td>
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<td><strong>D6.1.2</strong> Models and Tools.</td>
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<td><strong>D6.2.1</strong> Unique Boundary Conditions.</td>
<td>Evaluation and recommendation of capital budgeting techniques for track related LCC analysis.</td>
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<td>Motivation and recommendation for discount rates and time horizons to consider in track related LCC analysis.</td>
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<td>Definition of RAMS boundary conditions for railway infrastructures and impact on RAMS parameters.</td>
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<td><strong>D6.3.2</strong> Requirements for RAMS-analysis of railway infrastructure regarding deterioration rates, influence functions, statistical methods, monitoring method, etc.</td>
<td>Description of operational RAMS analysis at infra-managers and in industry as basis for adoption and improvements.</td>
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<td><strong>D6.3.3</strong> Necessary developments of RAMS technologies.</td>
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<td>Identification of necessary development for the different IMs as basis for knowledge transfer etc.</td>
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<td><strong>D6.4.1</strong> Key values for LCC and RAMS in contracts.</td>
<td>Review of the most commonly used key values to describe RAMS and LCC, and their relevance for INNOTRACK related items.</td>
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<td>Identification of needs for identifying measurable key values to develop or set objectives for.</td>
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<td>Comparison of different systems and delivery of necessary information for technical and economical decisions.</td>
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<td>Overview of analysed and compared systems/products with indication of: optimisation of maintenance for low LCC, technical performance (RAMS parameter), best point in time for maintenance, best practise.</td>
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<td><strong>D6.5.4</strong> Guidance for LCC and RAMS analysis.</td>
<td>LCC/RAMS guidance for technicians and controller among INNOTRACK partners.</td>
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D7.1.1 Set up project private and public web-site.  
Considerations in designing a graphical profile and setting up a 
website as basis for future projects.

D7.1.2 Set up the Dissemination Platform.  
Outline of dissemination platform as input for future projects.

D7.1.3 Planning Report: set up Network of Industries and Infrastructure Managers.  
Stand-alone report

D7.1.4 Report on the dissemination activities and proposal for further actions/update.  
Description of dissemination strategies as input for future projects.

D7.1.5 Identification of relevant codes and correlation to INNOTRACK results.  
Overview of the regulatory system in Europe.  
Overview of how INNOTRACK deliverables are influenced and influences the regulatory system and examples on how they can be merged into the system.

D7.1.6 Summary of dissemination and training – lessons learnt.  
Basis for continued implementation.

D7.2.1 Establishment of Training Platform.  
The work contains the mapping of current training practices, identification of gaps and needs and establishment of training platform.  
Training and education in the field of LCC and RAMS for IM and track staff based on required training/needs.

D7.2.2 Report on training needs and plan for training programme.  
Basis for training programme.

D7.3.1 Set up the Technical Review & Standardisation Platform.  
Stand-alone report

D7.3.2 Technical Review Platform.  
Description of the review processes in INNOTRACK as input for future projects.

D7.3.3 Experience from review work.  
Experience from INNOTRACK reviewing as input for future projects.