INNOTRACK
Innovative Track Systems

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www.innotrack.eu

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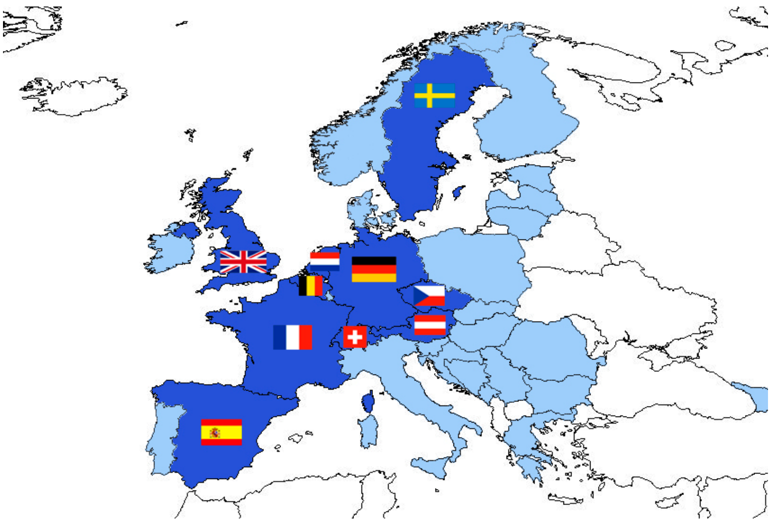
INNOTRACK – overview



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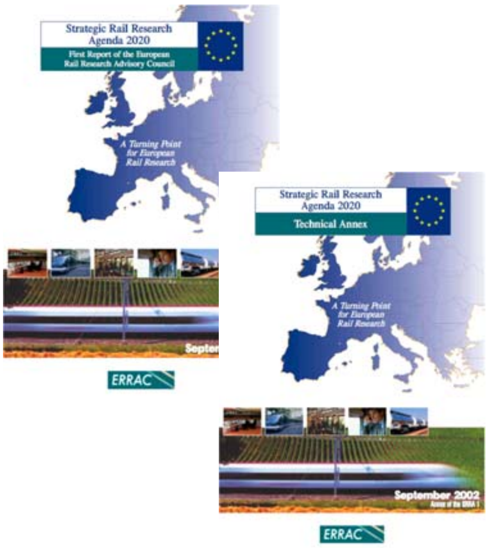
INNOTRACK overview

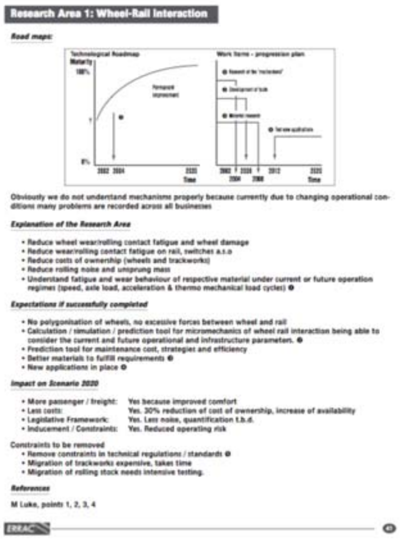
- Innovative Track Systems
- 3 year IP project in the Sixth Framework Progr
- 35 partners
- Around 20 MEURO budget (around 10 MEURO from the European commission)
- Detailed plan for first 18 months, overview of last 18 months in the Description of Work
- Important documents
  - Description of Work (task + deliverables)
  - Contract + Consortium agreement
  - Pre-Existing Know-How
  - Possible bilateral agreements

Targets

- First European project with comprehensive cooperation between **Infrastructure Managers** and **Industry** regarding the complete track construction
- A very innovative project to deliver new **products**, **processes** and **methodologies** in order to achieve the ERRAC objectives
- Significant **LCC reductions** and **RAMS improvements** in order to strengthen the competitiveness of railway sector in a persistent manner

ERRAC objectives





Research Area 1: Wheel-Rail Interaction

Road maps:

Obviously we do not understand mechanisms properly because currently due to changing operational conditions many problems are recorded across all businesses

Explanation of the Research Area

- Reduce wheel wear/rolling contact fatigue and wheel damage
- Reduce wear/rolling contact fatigue on rail, switches a.s.o
- Reduce costs of ownership (wheels and trackworks)
- Reduce rolling noise and unsprung mass
- Understand fatigue and wear behaviour of respective material under current or future operation regimes (speed, axle load, acceleration & thermo mechanical load cycles)

Expectations if successfully completed

- No polygonisation of wheels, no excessive forces between wheel and rail
- Calculation / simulation / prediction tool for micromechanics of wheel rail interaction being able to consider the current and future operational and infrastructure parameters.
- Prediction tool for maintenance cost, strategies and efficiency
- Better materials to fulfill requirements
- New applications in place

Impact on Scenario 2020

- More passenger / freight: Yes because improved comfort
- Less costs: Yes. 30% reduction of cost of ownership, increase of availability
- Legislative Framework: Yes. Less noise, quantification t.b.d.
- Inducement / Constraints: Yes. Reduced operating risk

Constraints to be removed
- Remove constraints in technical regulations / standards
- Migration of trackworks expensive, takes time
- Migration of rolling stock needs intensive testing.

References

M Luke, points 1, 2, 3, 4

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35 PARTNERS
(3 branch organisations, 10 industrial companies, 10 railway administrations, 9 Universities / institutes, 3 consultancies

CO	1	Union Internationale des Chemins de fer	UIC	FR	M1	M36
CR	2	Association of the European Railway Industries	UNIFE	BE	M1	M36
CR	3	European Federation of Railway Track Work Contractors	EFRTC	LU	M1	M36
CR	4	Carillion Construction Ltd	Carillion	UK	M1	M36
CR	5	voestalpine Schienen GmbH	VAS	AT	M1	M36
CR	6	Banverket	BV	SE	M1	M36
CR	7	Administrador de Infraestructuras Ferroviarias	ADIF	ES	M1	M36
CR	8	ALSTOM Transport SA	ALSTOM	FR	M1	M36
CR	9	Balfour Beatty Rail Projects Limited	BBRP	UK	M1	M36
CR	10	Česk˘ dr‡hy, a.s.	CD	CZ	M1	M36
CR	11	Chalmers University of Technology	Chalmers	SE	M1	M36
CR	12	Laboratoire Central des Ponts et Chauss˘e s	LCPC	FR	M1	M36
CR	13	Goldschmidt Thermit GmbH	Goldschmidt	DE	M1	M36
CR	14	Network Rail Infrastructure Limited	NR	UK	M1	M36
CR	15	…sterreichische Bundesbahnen Š Infrastruktur Bau AG	OBB	AT	M1	M36
CR	16	Reseau Ferre De France	RFF	FR	M1	M36
CR	17	VAE GmbH	VAE	AT	M1	M36
CR	18	VOSSLOH COGIFER	VCSA	FR	M1	M36
CR	19	DB Netz AG	DB	DE	M1	M36
CR	20	SPENO INTERNATIONAL SA	SPENO	CH	M1	M36
CR	21	Railways Safety and Standards Board	RSSB	UK	M1	M36
CR	22	Delft University of Technology (Technische Universiteit Delft)	TUDelft	NL	M1	M36
CR	23	PRORAIL BV	PRORAIL	NL	M1	M36
CR	24	University of Birmingham	UNI BHAM	UK	M1	M36
CR	25	Czech Technical University in Prague	CTU	CZ	M1	M36
CR	26	Corus	Corus	UK	M1	M36
CR	27	Soci˘t˘ Nationale des Chemins de Fer Fran¨ais	SNCF	FR	M1	M36
CR	28	Damill AB	Damill	SE	M1	M36
CR	29	Universitaet Karlsruhe (TH)	UniKarl	DE	M1	M36
CR	30	University of Newcastle	NCL	UK	M1	M36
CR	31	Contraffic GMBH	Contraffic	DE	M1	M36
CR	32	ARTTIC SA	ARTTIC	FR	M1	M36
CR	33	University of Southampton	ISVR	UK	M1	M36
CR	34	Manchester Metropolitan University	MMU	UK	M1	M36
CR	35	G-Impuls	GI	CZ	M1	M36

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Organisation

SP0 **InnoTrack Coordination**
UIC

SP 2
Track support structure
SNCF
Track subgrade monitoring & assessment
Evaluation and tests of superstructure innovations

SP 3
Switches and Crossings
DB
Predictive models for S&C
Switch designs
Standards & LCC analysis

SP 4
Rails
VAS/ CORUS
Methodology for duty conditions
Supported track form
Rail steel material
Grinding methodology

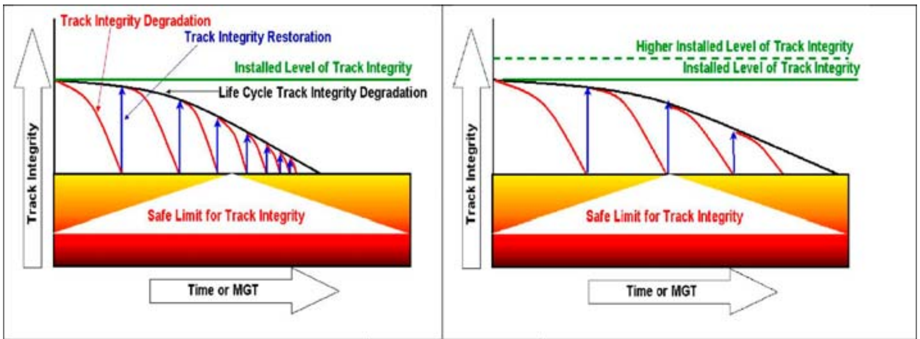
SP 5
Logserv
ALSTOM
Best logistics practices
New logistics processes
Cost effective methodologies

SP 1
Duty
NR
Vehicle & track characteristics
Generic model of failure/ degradation

SP 6
LCC
DB
LCC methodology
RAMS technology
LCC models

SP7 **Dissemination and Training**
UIC

The degradation process



Current Situation	⇒	*InnoTrack objective: reduce rate of track degradation & maintenance intervention*

“Innovation”

PRODUCTS

new subgrade treatments
optimised track components and construction
innovative component designs
improved track materials

PROCESSES

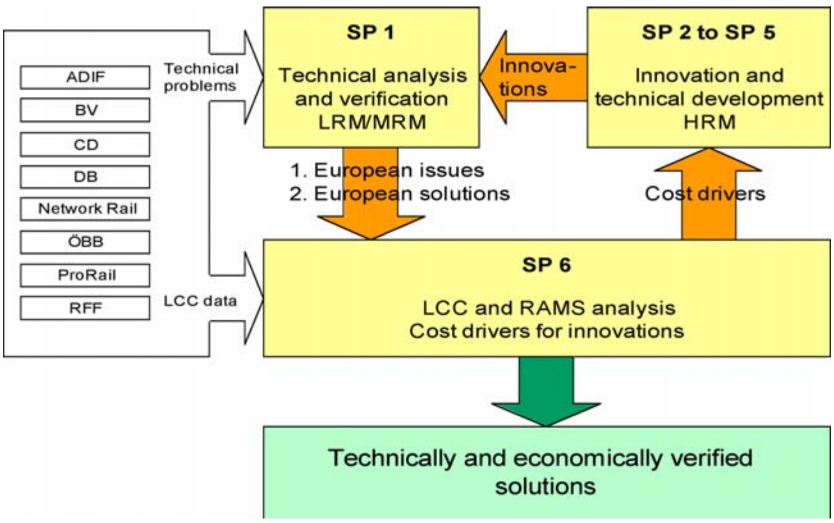
logistics processes
construction techniques
inspection methods
maintenance processes
evaluation process for economical optimisation of technical solutions (as a closed loop)

INNOVATION

METHODOLOGIES

classification methods for track and vehicle characteristics and methodology for assessment of technical and economical problems
Europe-wide accepted LCC methodology and RAMS technology for practical application

Workflow



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SP4 Rail & Weld

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Sixth Framework Programme

Sub-Project Partners

SP4 - Rail & Weld: Sub-Project Partners		
Railways	**Supply Industry**	**Academia**
Banverket, Sweden	Corus Rail	Chalmers, Sweden
Deutsche Bahn, German	Goldschmidt	University of Newcastle, UK
Network Rail, UK	SPENO	TUDelft, Netherlands
Prorail, Netherlands	Voest Alpine	
SNCF, France		

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Sixth Framework Programme

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Innovative Track Systems

SP4 Work Packages

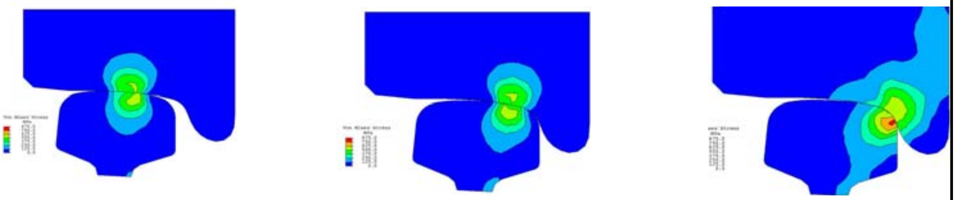
Work Package No.	Work Package Title
4.1	Study of degradation of actual and new rail steels and joints:
4.2	Validation of tolerances and limits for rails and joints
4.3	Innovative laboratory tests of rail steel grades and joints:
4.4	Innovative inspection techniques
4.5	Validation of new maintenance processes:
4.6	Innovative welding processes:

The "Drivers" for the need for Improvement

- The participating IMs account for >185,000 km of track
- An annual rail requirement of over 733,000t or >6000 km of track renewal is predicted based on using 60kg/m rail and a 3.3% renewal rate
- Cost of rail is a small proportion of the total track renewal costs and use of premium grade rails offers significant savings on maintenance to IMs

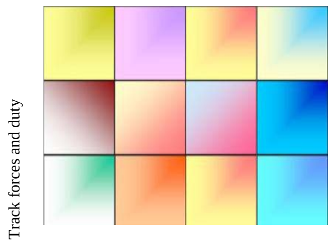
Participating IMs	Approximate Total Track Length, km
ADIF	16800
OBB	7700
SNCF	45500
DB	53750
PRORAIL	4700
BV	11800
NR	33500
CD	11400
Total of 8 Participating IMs	**185,150**

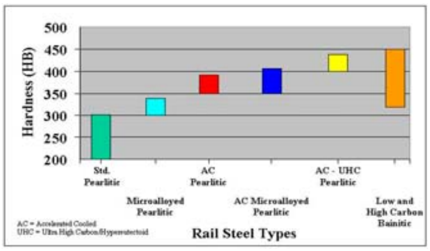
The Complex Rail System



- Rail is the HUB as it forms the interface between the Vehicle & Track Systems
- Rail condition affects the integrity & life span of other components of system
- Optimisation of system requires a range of disciplines
  - Vehicle dynamics, contact mechanics, civil/P'way engineering & **Metallurgy**
- **The Key DELIVERABLES from this SP are:**

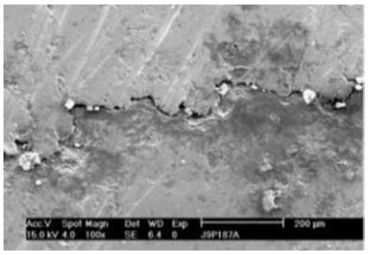
Employing Rail Metallurgy Developments to Improve LCC





- Wide range of duty conditions & Wide range of existing higher performance rail steels
- Selecting optimum rail metallurgy to match duty conditions will lower LCC and improve RAMS characteristics
- **SP4 will deliver a definitive guide to the selection of rail grades as a function of duty conditions based on a scientific understanding of rail degradation**

SP 4: RCF Control



- Grinding is key tool for the management of Rolling Contact Fatigue
- **SP4 aims to demonstrate that the use of Innovative Grinding techniques combined with optimised rail metallurgy & track quality will enhance Rail Life**

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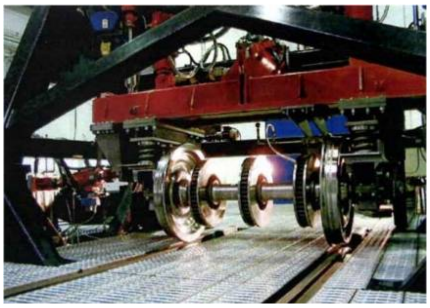
SP 4: Laboratory Tests for RCF

- Rolling Contact Fatigue is the major cause of rail degradation & replacement throughout the railway world
- None of the properties included in European or International Specifications for rails include a test for RCF resistance
- **SP4 will develop rail steel material property tests that more closely reflect the in-service performance**



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SP 4 – Minimum Action Rules

- A significant number of rail breaks & defectives occur in all networks
- Knowledge of criticality of defects is essential for effective planned maintenance
- **SP4 aims to develop "minimum action rules" based on problem oriented application of fracture mechanics principles for selected defects – Such rules will reduce unplanned maintenance costs**

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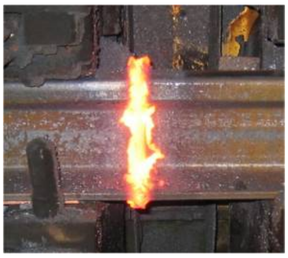
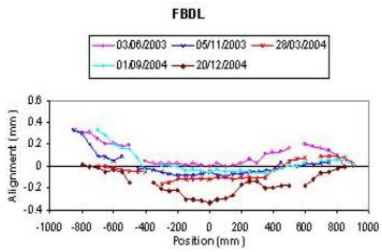
SP 4 Improved Integrity Welds





- Discrete track irregularities such as those at welds are a source of increased dynamic track forces and hence promote track degradation
- **SP4 aims to demonstrate the benefits of narrow HAZ and improved geometry welds in improving and maintaining high track integrity**

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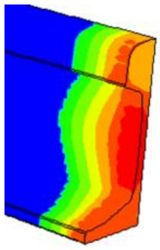
SP 4 Improved Integrity Track Welds



- Alumino-thermic weld breaks and defectives account for a large proportion of all breaks & defectives in any network
- Introduction of cost effective solid phase welding techniques will reduce weld failures in the future.
- **SP4 will build on the research already undertaken to develop a modified gas pressure welding unit suitable for European practices**

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WP 4.6 Innovative welding processes.

- Narrow Heat Affected Zone
- Invisible Weld – Controlled Profiled Weld
- Improved gas pressure welding
- One of the degradation mechanisms of welds is the differential wear between the bulk metal and the heat affected zone (HAZ) in flash butt welds arising from the difference in hardness and wear resistance in the two regions and leading to a vertical discontinuity at the weld. This degradation mechanism has been countered in the development of the narrow heat affected zone flash butt weld by reducing the thickness of the HAZ and particularly the thickness of the band of lower hardness so that it is not visible to the wheel.
- A second concern that is often raised against welds is the presence of minor changes in crown profile, and vertical and lateral alignment in the vicinity of the weld. This issue has been addressed by imparting an identical crown and foot profile to the weld as that in the adjacent rails. This improves the fatigue performance of the welds and ensures that the weld is invisible to the passing wheels and hence no increased dynamic loading is experience by the track.
- A separate programme of work is not essential for the evaluation of the above two products as they can been incorporated into selected trial sites for the evaluation of the rail steel grades.
- A further development of interest is the use of Gas Pressure Welding (GPW) to provide a solid phase weld in place of the current casting process of alumino-thermit welding. Although the technology of GPW is well established and widely used in Japan, it has not penetrated the European railways because of perceived inconsistent performance.

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WP4.2 Validation of tolerances and limits for rails and joints.

- Alumino-thermic weld failures account for ~25% of all rail fractures in most railways and a similar proportion is likely to exist within the much larger population of defectives taken out of track. Furthermore, there is sufficient empirical evidence to suggest that alumino-thermic welds that survive approximately the first year of service are likely to last for a long time and that defects such as porosity in the weld do not always lead to early failure. Since there are a very large number of existing alumino-thermic welds in most railways and more are continually added, it is essential to identify the critical defects, in relation to their location within the weld, and the loading and support conditions.
- As in the case of "minimum action" rules for rail defects, the knowledge of the critical defect size in welds as a function of the imposed duty will facilitate a move from reactive to planned maintenance and permit extension of the residual life of track.

SP3 Switches & Crossings

Sub-Project Partners

SP3 - Switches & Crossings: Sub-Project Partners		
Railways	**Supply Industry**	**Academia**
Banverket, Sweden	**VAE, Austria**	**Chalmers, Sweden**
Deutsche Bahn, Germany	**Contraffic, Germany**	**Rail Research UK, UK**
	VCSA, France	
	Corus Rail, UK	

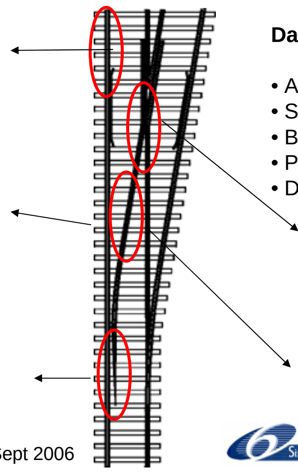
The Cost drivers in S&C´s are:

- Damage and wear

Wear

Rail breaks in the spring area

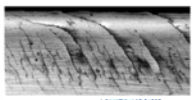
Severe head checks
Spalling



Damages due to severe duty conditions

- Axle loads
- Speed
- Boogies
- Power units with slip control
- Discontinuous track

Surface spalling
Severe wear



RCF, eg
head checks

The Cost drivers in S&C´s are:

- Malfunction and Non-availability of Driving & Locking devices

Which construction has the best LCC ?

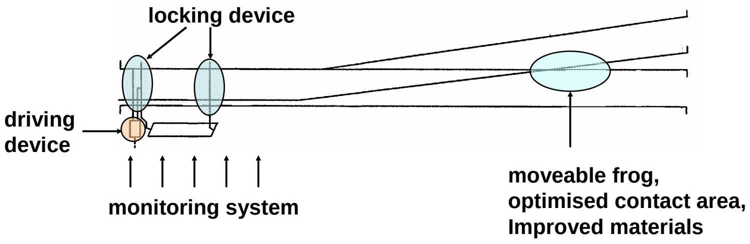
- Low investment
- High availability
- Low Maintenance

The Cost drivers in S&C´s are:

- Not optimised maintenance processes

-Wrong grinding of the rail in the area of tongue

SP 3 delivers Innovations in



- Definitive guide for selection of switch system depending on operational conditions by LCC Assessment
- Optimization of design and contact areas for low maintenance switch
- Innovative maintenance strategies and techniques
- High effective Monitoring Systems with Standard "Plug & Play"