REDUCING THE OCCURRENCES AND IMPACT OF FREIGHT TRAIN DERAILMENTS

D-RAIL

17th Nordic Seminar on Railway Technology
Tammsviks Herrgård, Sweden
3-4 October 2012

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SEVENTH FRAMEWORK PROGRAMME

Funded by the European Commission

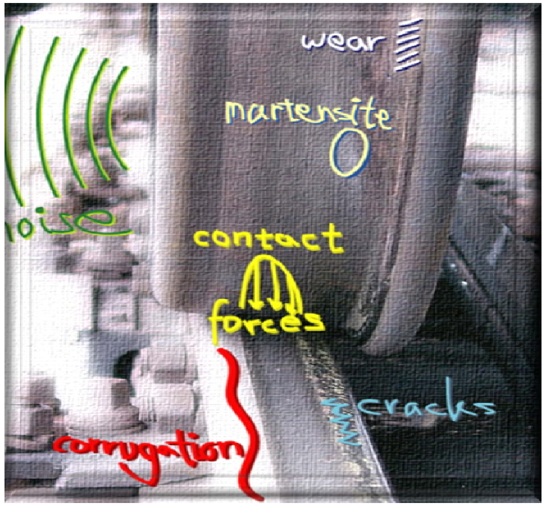
(Seventh Framework Programme)

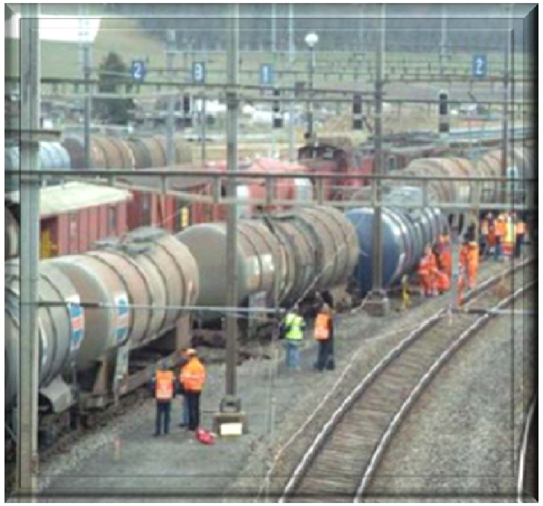
3 Year Project Commencing October 2011

(Total Budget €4,800,000)

BACKGROUND

- European rail freight is of strategic and economic importance
- Derailments cause major network disruption and societal impact
- Large number (low cost) - Small number (high cost)
- ERA initiative to reduce freight train derailments supported by EC
- Emerging research indicates potential for major step forward



OBJECTIVES

- Reduce the occurrences of freight train derailments within Europe by between 8 - 12%

- Through understanding and mitigation provide derailment related cost reductions of 10 – 20%

- Improve the competitiveness of freight operation against other transport modes

PARTNERS

D-RAIL

Newcastle University

TelSys

SBB

TRAFIKVERKET

Faiveley TRANSPORT

mermec

IEW

VUZ

CHALMERS

POLITECNICO DI MILANO

NEA a member of Panteia

ÖBB Infrastruktur

UIC INTERNATIONAL UNION OF RAILWAYS

DB Mobility Networks Logistics

?

Manchester Metropolitan University

rtu railtechnologyunit

HARSCO RAIL

RSSB

SNCF

LUCCHINI RS

oltis group

CONSORTIUM

- Twenty partners from across Europe with a wide geographical representation
- Partners include Infrastructure providers, operators, industry and academia

- Global project which includes International Railways (UIC), Russia (RZD) and USA (Harsco)
- Many of our partners also have significant International rail experience outside the EU

Project is jointly co-ordinated by UIC and Newcastle University

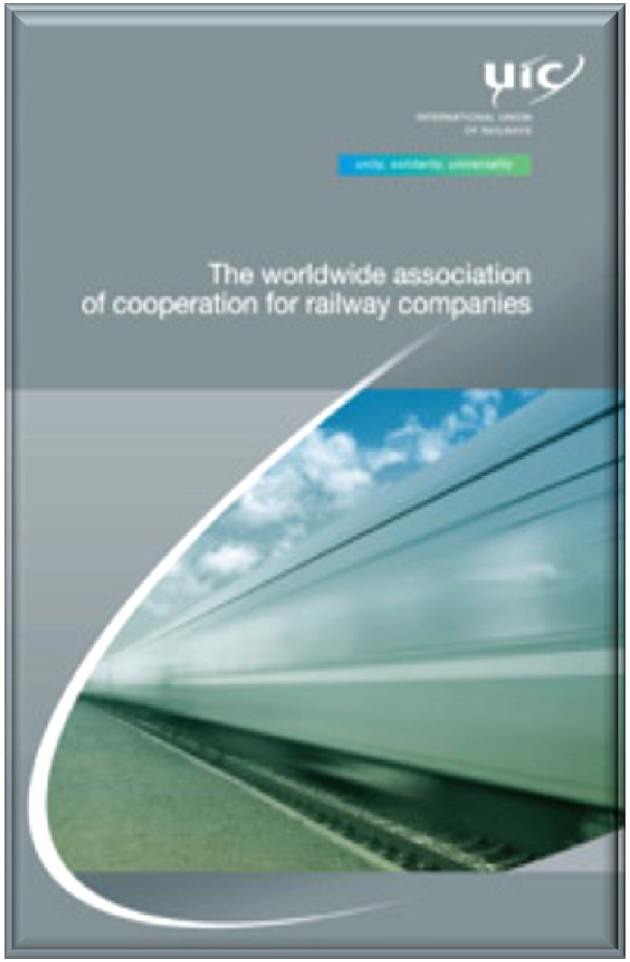
EU- RESEARCH RELATED PROJECTS

- SPECTRUM
- MARATHON
- REORIENT
- SUSTRAIL
- TREND
- EUROSABOT
- EURAXLES
- RETRACK
- DYNOTRAIN
- FREIGHTVISION
- ICON
- CREAM
- HIPERWHEEL
- INNOTRACK

Research

D- RAIL Partners active in many important EU related projects

UIC RESEARCH RELATED PROJECTS



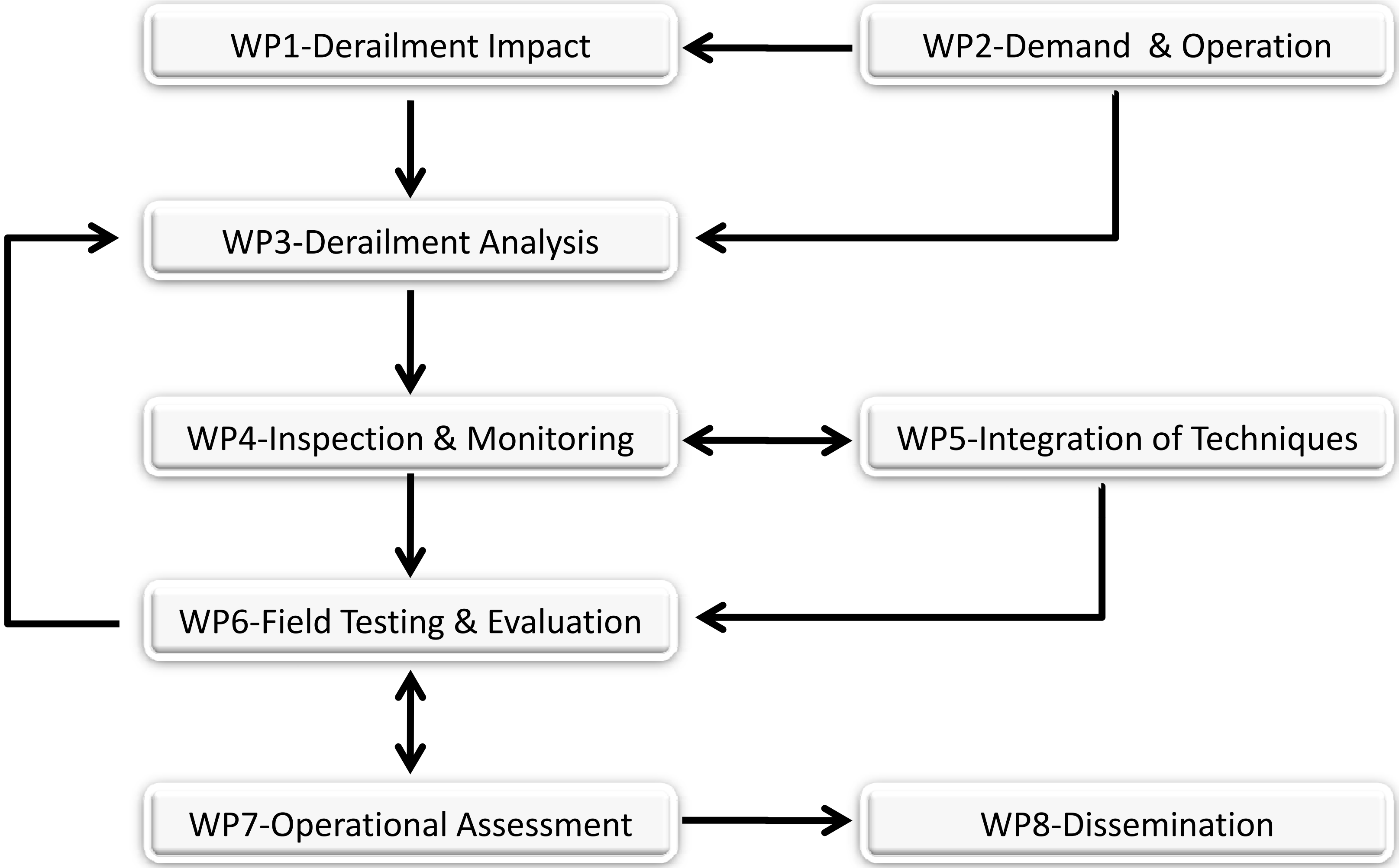
- R & D from ERRI/ORE still the base for today’s limit values
- Harmonisation Running behaviour and noise on Measurement Sites (HRMS)
- Equivalent conicity shows complexity of the current European situation

D- RAIL Partners active in many important UIC related projects

PROJECT BREAKDOWN

WP1	Impact of Freight Derailment
WP2	Freight Demand & Operation
WP3	Freight Derailment Analysis
WP4	Inspection & Monitoring Techniques
WP5	Integration of Monitoring Techniques
WP6	Field Testing & Evaluation
WP7	Operational Assessment & Recommendations
WP8	Dissemination & Exploitation

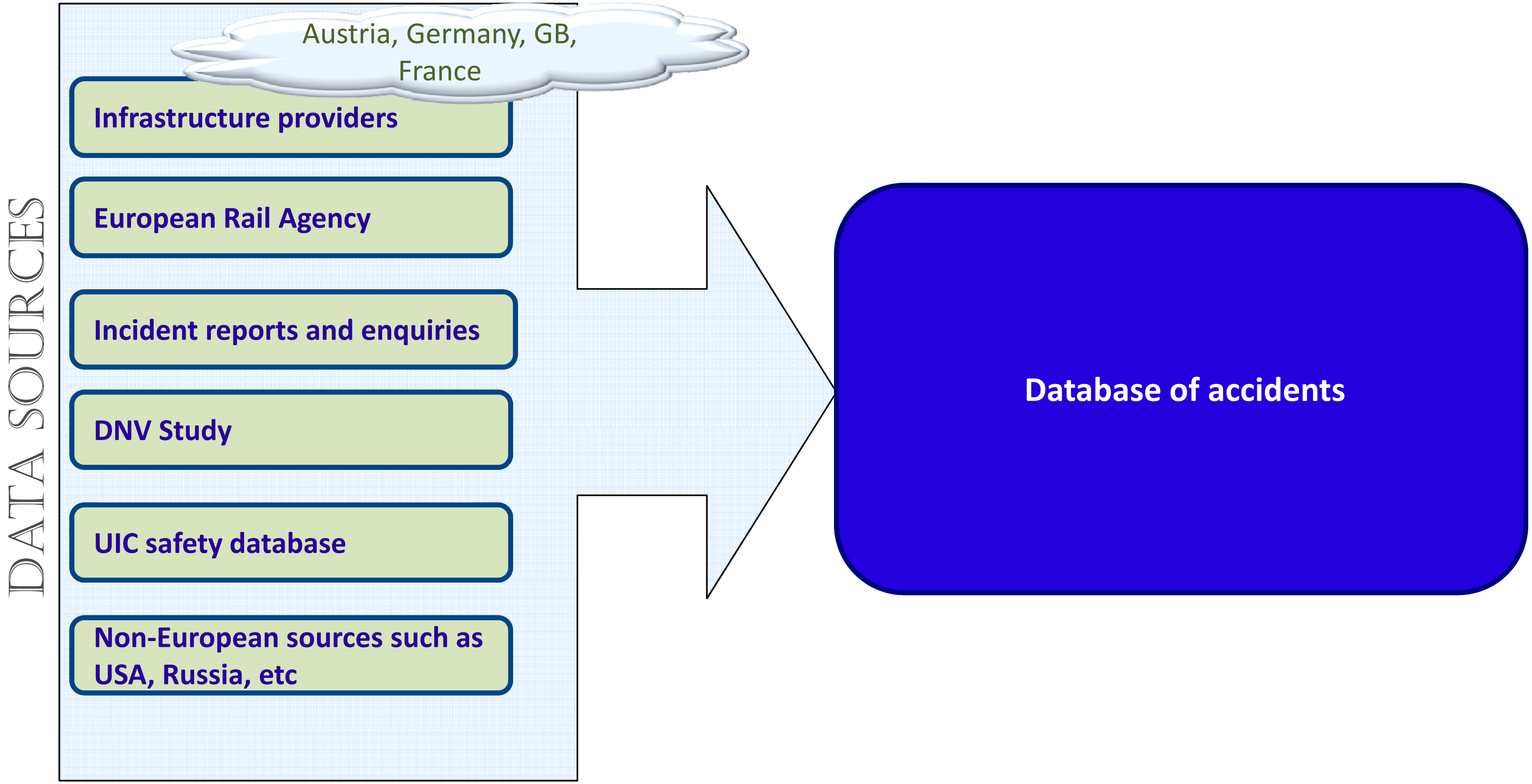
PROJECT ARCHITECTURE



DERAILMENT IMPACT (WP1)

- Review of existing freight train derailments including causal effects (wide ranging)
- Effectiveness of current technologies and ability to detect and prevent derailment
- Build upon ‘Assessment of Freight Train Derailment Risk Reduction Measures’ (ERA)
- Social and financial impact of freight derailments for all stakeholders
- WP-1 will form a key platform for the entire project

Derailment accident data collection



WP 1 has gathered information on numbers of derailments and their causes from countries in Europe (GB, France, Germany, Austria, some European databases) and some countries outside Europe, direct data from USA and Russia on the six-year period 2005-2011.

OCCORED DIFFICULTIES

Databases are structured in a different way with different cause classification.

In each database are used individual approach for assessment consequences and cost of derailments. In many databases such assessment is not clear.

Information in available data sources do not cover all issue required for comprehensive analysis.

There are no full access to data of all IMs participating in the project.

CAUSES RANKING

Different alternative approaches to comparing and ranking causes were used

•**Ranking by number of derailments** *(Ranking of causes with third-level causes merged, according to the average number of derailments per billion tonne-km across Austria, France and GB).*

•**Number of Derailments per billion tonne-km**

•**Cost of Derailments**

•**Ranking of causes according to cost as share of total***, averaged across Russia, the USA and Austria*

•***Frequency ranking of derailment cause categories by Pareto function***

•***Cost ranking of derailment cause categories by Pareto function***

•***Final ranking of derailment causes***

FINAL RANKING OF DERAILMENT CAUSES, WHICH WILL BE USED IN D-RAIL FURTHER

Each method of cause ranking gives slightly different results. Considering all methods it could be noted that the following causes appear in the most categorisations.

For further work it was defined 16 major causes which will be basic for other WP

1. [I] rail failures

2. [RS] failure of bogie structure and supports

3. [I] excessive track width

4. [RS] hot axle box and axle journal rupture

5. [I] excessive track twist

6. [I] switch component structural failure

7. [O] wrong setting in relation to movement authority (points and turnouts)

8. [I] track height / cant failure

9. [O] wagon wrongly loaded

10.[O] brake shoe or other object left under train or fall down during movement

11.[O] human or organizational factor

12. [I] failure of rail support and fastening

13.[RS] failure or rupture of wheels or axels

14.[RS] twisted or broken wagon structure/frame

15.[RS] spring and suspension failure

16.[O] speeding

Elaborate methodology and classification for assessment causes of derailments which will be common for all EU countries.

CONCLUSIONS

Mainline derailments were categorized into the following groups:

- 1. Derailments caused by *Infrastructure failures* *40%*
- 2. Derailments caused by *Rolling Stock failures* *33%*
- 3. Derailments caused by *Operation failures* *25%*
- 4. Derailments caused by *Weather, Environment and 3rd Party*
- 5. *Unspecified*

88% of derailments were successfully categorized into one of these four groups. The spread between countries is sometimes huge due to differences in operation, track, rolling stock, etc.

The ranking of major causes in **DNV** study

1. hot axle box and axle journal rupture
2. excessive track width
3.excessive track twist
4.failure of composite wheel with rim and tyre
5. spring & suspension failure
6.track height/cant failure
7. rail failures
8. wagon wrongly loaded
9. point switched to new position while point is occupied by train
10. axle shaft rupture
11. rupture of monoblock wheel
12. other mishandling of train including driver caused SPAD
13. brake shoe or other object left under train
14. wrong wheel profile
15. switch component structural failure
16. failure of rail support and fastening

The ranking of major causes in **Europe**

1. hot axle box and axle journal rupture
2. Excessive track width
3. Wheel failure
4. Skew loading
5. Excessive track twist
6. Track height/cant failure
7. Rail failures
8. Spring & suspension failure

The ranking of major causes in **D-Rail project**

1. [I] rail failures
2. [RS] failure of bogie structure and supports
3. [I] excessive track width
4. [RS] hot axle box and axle journal rupture
5. [I] excessive track twist
6. [I] switch component structural failure
7. [O] wrong setting in relation to movement authority (turnouts)
8. [I] track height / cant failure
9. [O] wagon wrongly loaded
10.[O] other object under the train
11.[O] human and operational factor
12. [I] failure of rail support and fastening
13.[RS] failure or rupture of wheel & axles
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FREIGHT DEMAND & OPERATION (WP2)

- To evaluate trends towards for the railway freight system of the future (2050) including European rail policy and the impact on freight operation and forward technologies.
- Impact on forward operation and emerging technologies to support the freight sector
- Evaluate future trends for movement, loading, logistics and sector economics
- Cost/benefit analysis based upon the expected future rail freight market

INTRODUCTION

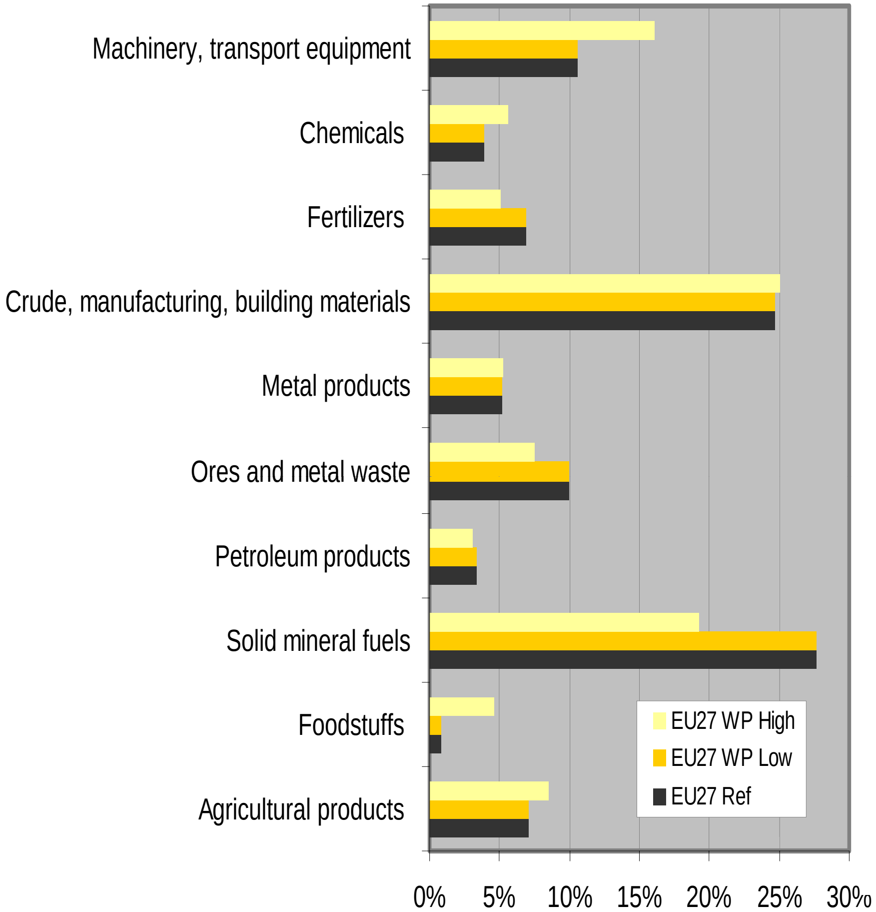
- **Tasks**

- Task 2.1 Synthesis of Freight Forecast to 2050

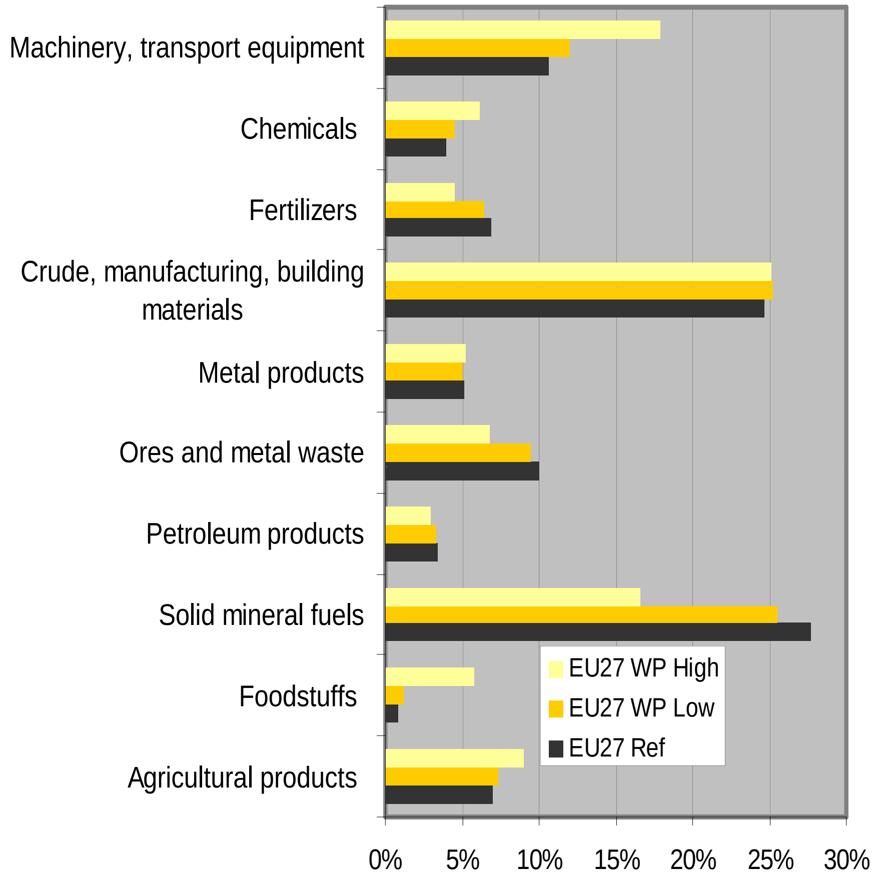
- Task 2.2 Rolling Stock Breakdown to 2050 of Rail Freight Forecast

- Task 2.3 – Cost/Benefit Analysis

Commodity Split for 2030



Commodity Split for 2050



Top Three Wagons in 2050

		Ave Forecast Growth Pa			Highest Absolute Forecast Value			Net Increase 2010-2050		
Commodity	**Typical Wagon Type (UIC)**	**REF 2050**	**WPL 2050**	**WPH 2050**	**REF 2050**	**WPL 2050**	**WPH 2050**	**REF 2050**	**WPL 2050**	**WPH 2050**
Agricultural products	Covered Hopper Wagons		x	x						x
Foodstuffs	Covered Wagon		x	x						
Solid mineral fuels (Coal)	Open Top Wagons	x			x	x	x	x	x	
Petroleum products	Tank Wagon	x								
Ores and metal waste	Open Top Wagons									
Metal products	Flat Wagons									
Crude, manufacturing, building materials	Flat Wagons or Covered Wagon				x	x	x	x	x	x
Fertilizers	Covered Hopper Wagons	x								
Chemicals	Tank Wagon									
Machinery, transport equipment	Flat Wagon		x	x	x	x	x	x	x	x

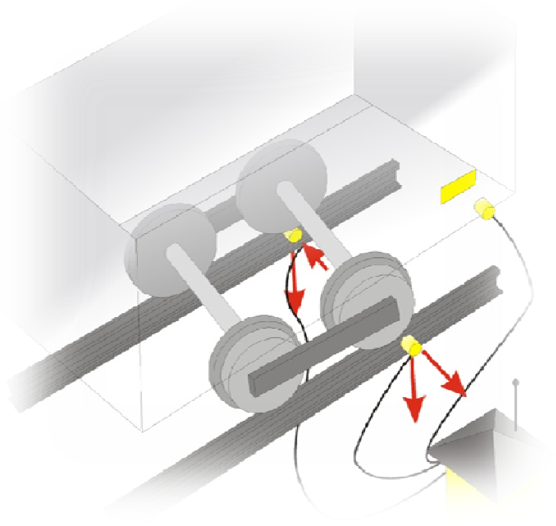
FREIGHT DERAILMENT ANALYSIS (WP3)

- Identification, simulation and analysis of the key contributory derailment factors
- Improved methods, techniques and understanding of derailments causes
- Provide cost effective solutions to reduce or eliminate the propensity for derailment
- Quantative assessment of derailment reductions against current benchmark

INSPECTION & MONITORING (WP4)

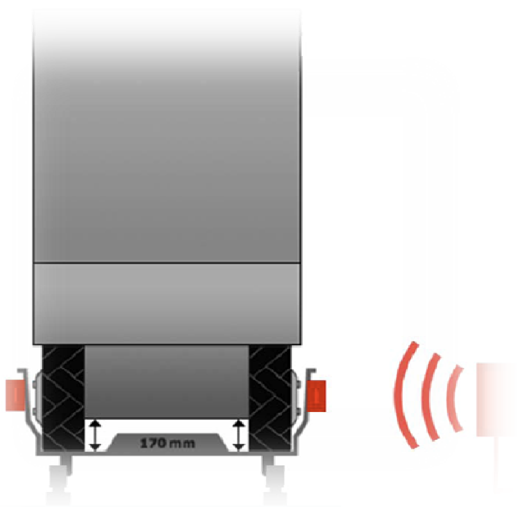
- Critical and detailed assessment of current inspection and monitoring techniques
- Examine prevention and mitigation for the 'total freight system' (vehicle and track)
- Develop from previous findings suitable cost effective technical improvements
- Provide forward functional and operational requirement specification(s)

INTEGRATION OF MONITORING (WP5)



- Development and integration of wayside and onboard monitoring concepts

- Examine how to integrate these various monitoring systems and techniques



- Concept development based on RAMS and LCC assessment and analysis

- Development of business case(s) to support wider industrial implementation

FIELD TESTING & EVALUATION (WP6)

- Field testing and evaluation of developed mitigation and monitoring concepts
- Instrumentation of vehicle/track and system interfaces and subsequent interactions

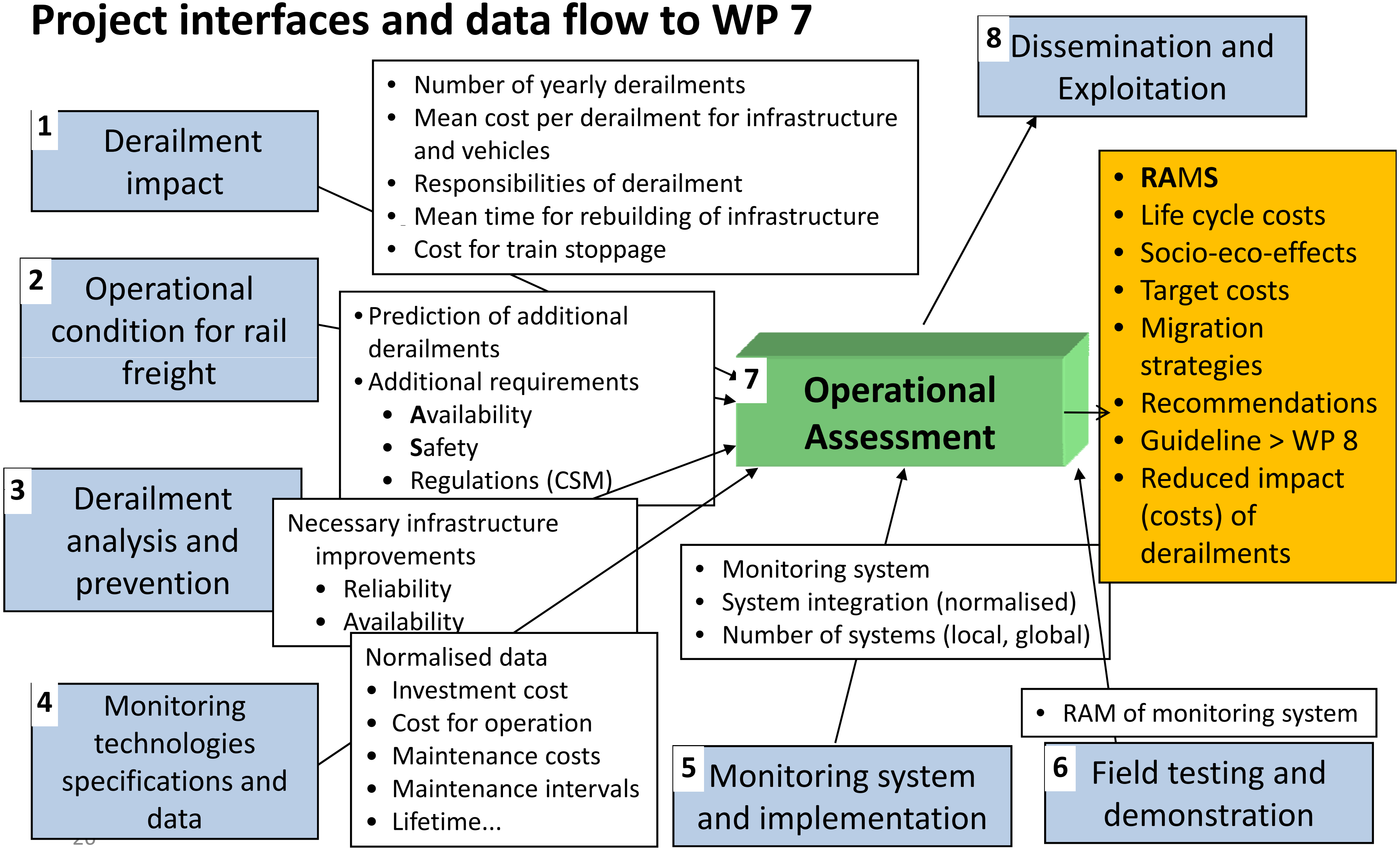
- Evaluation of the integrated systems (step change) including cross border operation
- Validation and verification of the initial modelling and analysis system

OPERATIONAL ASSESSMENT (WP7)

- RAMS analysis for best and worst case scenarios to identify the impact of vehicle monitoring on the reliability, availability and safety of the railway system
- Economical assessment of monitoring systems including migration with regard to LCC and social economic effects
- Derivation of a guideline using monitoring systems for detection of derailment risks and to identify maintenance needs

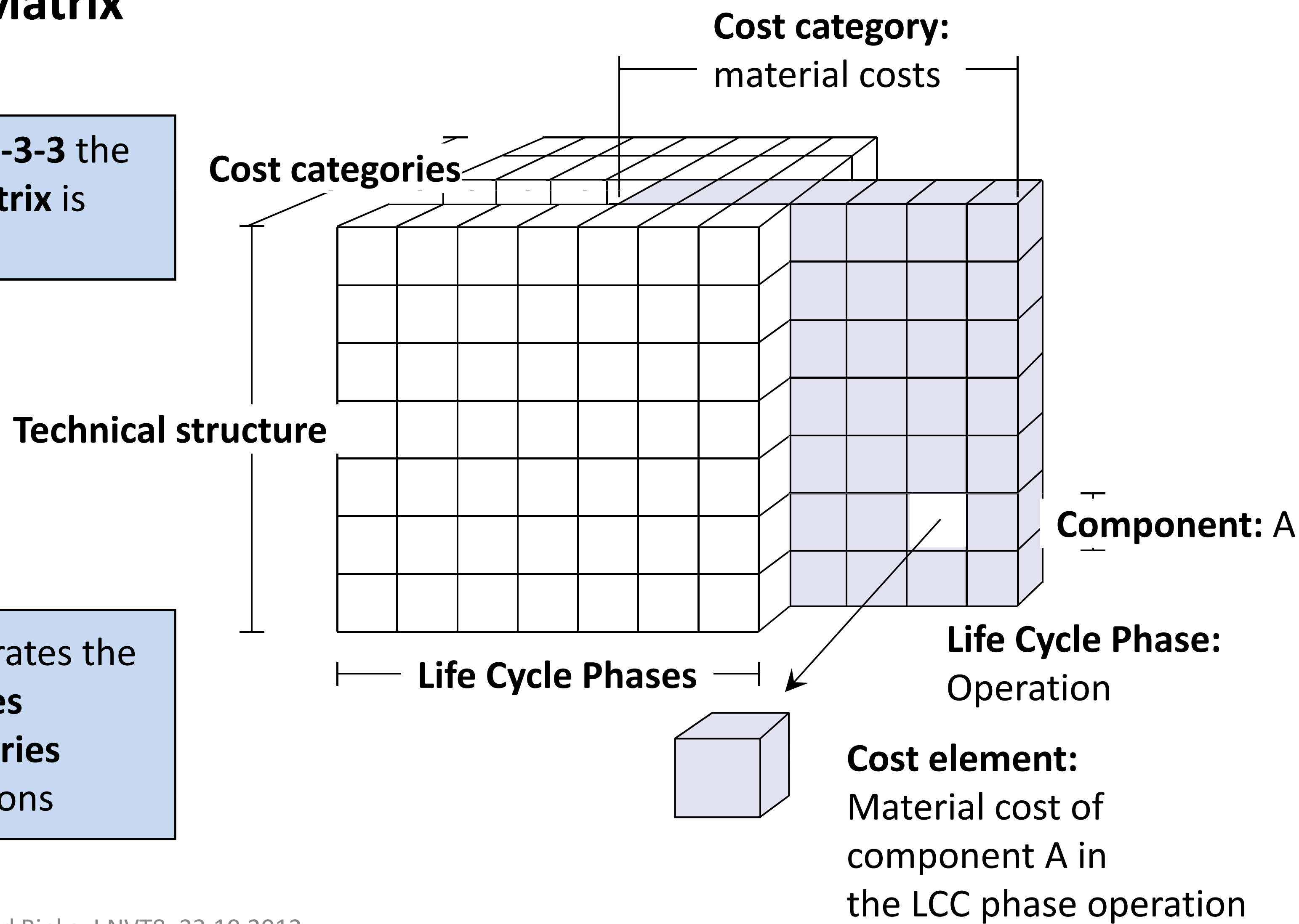
OVERVIEW

Project interfaces and data flow to WP 7



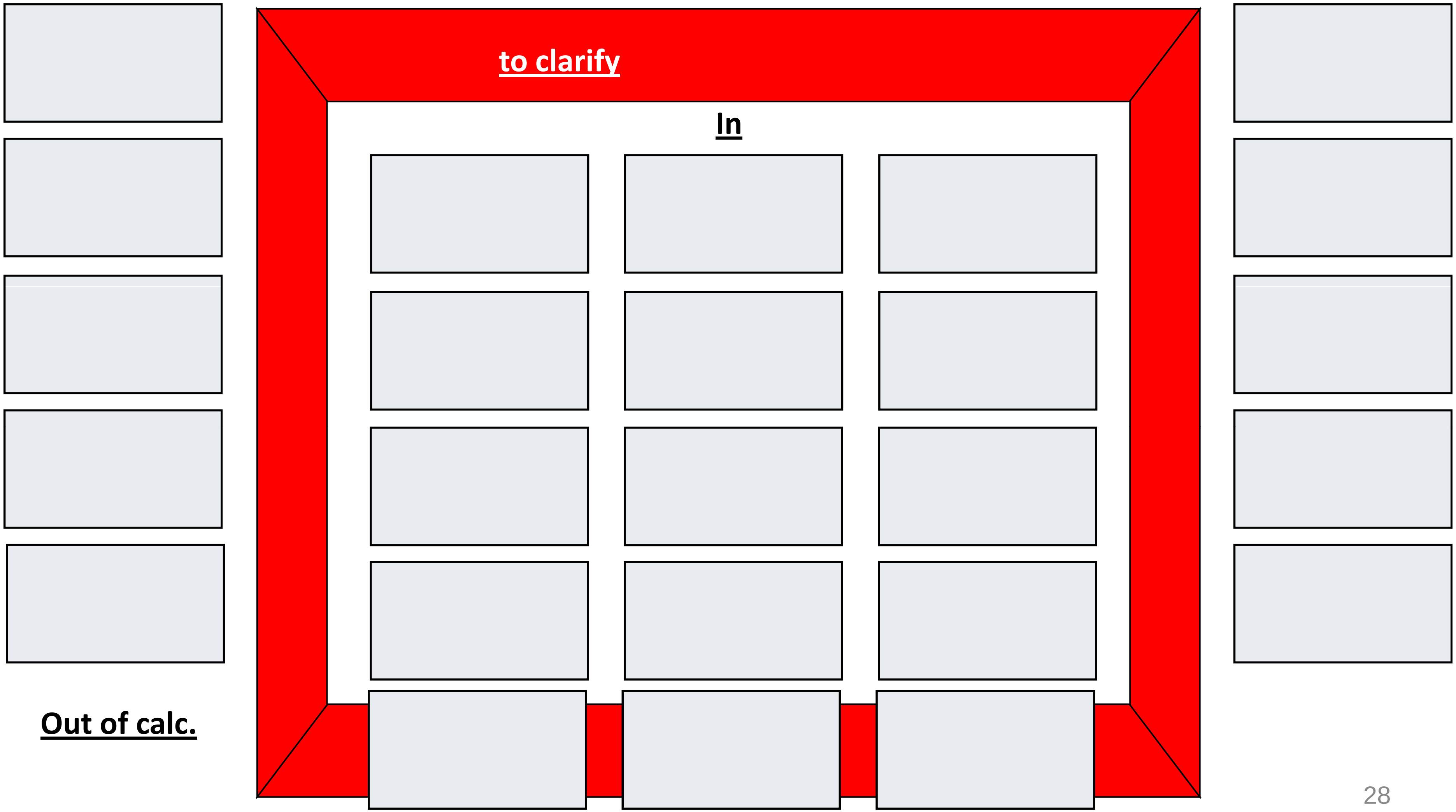
LCC - Cost Matrix

From **EN 60300-3-3** the shown **cost matrix** is known. .



This view separates the **life cycle phases** and the **categories** in two dimensions

Documentation - In/Out-frames for definition of boundary condition



RESEARCH OUTPUTS

- Quantified step change in the number of freight derailments and economic impact
- Recommendations for monitoring systems based on technical/economic grounds
- Reliable implementation scenario's and guidelines for national/international use
- Future technological developments and innovation for industrial applications

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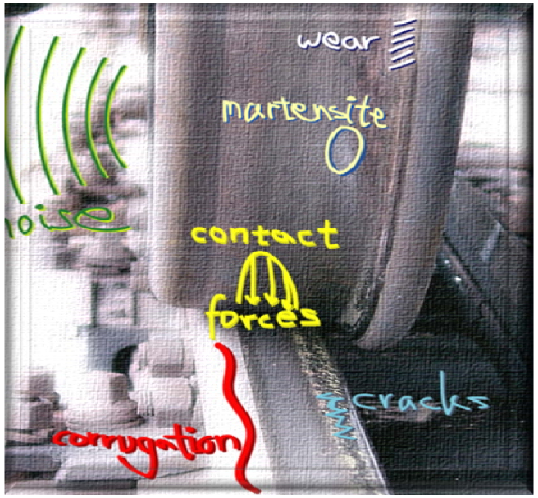

- Why EU-projects?

WHY EU-PROJECTS?

Railway Research and Development in Europe

- In 2009 UIC had UIC-projects for 8 million €
- The members paid 100%
- The same year 2009 UIC had a turnover in EU-projects of 60 million €. Here the members paid ~2 million €

VILKA RESURSER KRÄVS I FORM AV PERSONAL HOCH PENGAR? EXEMPEL FRÅN MAINLINE

Influencing phase	Launching phase	Evaluation phase	Negotiation phase	Realization phase	Implementation phase
1.5 years	4 months	3 .5 months	6 months	3 years	? years

Costs UIC and MAINLINE partners

	Influencing phace	Launching phace	Negotiation phase	Realization phase	Implementation phase
UIC	2-3 k€	15 k€	10 k€	50 k€	45 k€
Totalt	?	150 k€	20 k€	2000 k€	?

Totala kostnader UIC ~120 k€ för 5 år med en total forskningsvärde på ~5000 k€
Det innebär att för varje 1€ som medlemmarna investerar ges 42€ i forskning
Om dessutom 12 UIC-medlemmar delar denna kostnad så ger 1€ forskning för ca 500€