Smart Maintenance, Analysis and Remediation of Transport Infrastructure

Deliverable 5.4 User Platform

Project funded by the EU 7th Framework Programme under call SST.2011.5.2-6 Cost-effective improvement of rail transport infrastructure. Grant agreement no: 285683

Project Information

Project Duration:

01/09/2011 – 31/08/2014

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Document information

Version	Date	Action	Partner
01	22/12/2012	1st draft	EURNEX
02	16/01/2013	2nd draft	UCD

Title: SMARTRAIL – DEL 5.4 User platform

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Interim Report for Convergence Actions: SMARTRAIL Matching process of User/Customer

Preparation of Workshops in

- Ljublijana November 15-16; WP1, WP3 and WP4 Workshop incl Demonstration on Testsite

- Moscow, Russia, 5 – 6 December 2012: Europe Neighbourhood Cooperation Countries, (incl. Russia, CIS, Black Sea, Balkan States), 3rd Regional Workshop with SMARTRAIL, EU Project with Russian participation mid-term results and demonstration at Moscow Test Range of RZD (Sherbinka)

1 Objective of the interim report

SMARTRAIL project supports the rail sector, to become the sustainable backbone of the Single European Transport Area. The sector has to increase its competitiveness and overcome limitations on existing infrastructure by:

- reducing cost of maintenance
- increasing capacity & efficiency
- simultaneously improving resilience to climate change & extreme weather conditions

Tackling these challenges for continuous productivity improvements as traffic levels continue to grow is a demanding but powerful incentive therefore the SMARTRAIL project needs to provide and to prove:

- innovative & practical solutions
- technological integration & adaptation of lessons learned
- in an economic dimension

The aim of the interim report to summarize and to present the special stakeholder requirement, needs, constraints & priorities in the area of the project which has been identified together with experts in the areas of highway and railway infrastructure research, SME's and railway authorities who are responsible for national infrastructure. Means for identification have been

- questionnaires
- interviews
- workshops,
- bilateral meetings,
- feedback on priorities and first results of WP1, WP2 and WP3

The identified requirement, needs, constraints & priorities have been categorized according to their relevance for:

- Safety and performance
- Capacity
- Environment
- Cost

WP leaders have been requested to provide comments and additions to the spreadsheet developed according to the IM answers on the questionnaire incl. Potential solutions to the needs may even be subject of further analysis and R&I or require adaptive measures (initial progress and experienced R&I).

2 Identification of User Requirements

The identification of the user requirements are the basis for the streamlining of the work in the WP`S. In order to disseminate project information later on there is a strong need for information from the work package leaders.

EURNEX as part of the SMARTRAIL FP7 project is responsible for disseminating the results of the SMARTRAIL project and also validating with Infrastructure Managers (IMs) that;

- the research is useful and relevant
- it could be implemented
- it would be of use in reducing costs ,improving performance, improving safety
- it would provide tools to deliver a sustainable railway for the future.

These tasks would be achieved through:

- the design by EURNEX of a questionnaire and it's completion by a selection of IMs chosen by EURNEX
- reviewing the results to ensure that the project research was focussed on the right topics
- face to face interviews with IMs
- workshops in strategic locations
- site visits to pilot sites
- regular discussions with the Work Package leaders

The formation of the Advisory Board under the responsibility of the coordinator is still pending. In order to enable the Board to fulfil its functions we suggest the coordinator to start immediate actions with the proposed Advisory Board chairman.

2.1 Questionnaire

The results of the questionnaire have been and will continue to be used as a means of checking that the proposed research objectives are in line with those of your company, thus ensuring the maximum benefit is obtained for Infrastructure Managers.

2.1.1 Design of questionnaire

The questionnaire was designed by the EURNEX team and validated by the Work Package leaders before being sent to a number of IM recipients. An example of a completed questionnaire is shown as Annex I.

The aim of the questionnaire has been to identify the real topics of interest, needs and constraints in the area of the project Smart Maintenance and Analysis of Transport Infrastructure. The questionnaires were distributed by EURNEX amongst selected Infrastructure Manager in Europe during February 2012. By mid September 2012, 12 questionnaires had been returned. Interviews have also been performed with High Level Partners from dedicated institutions.

2.1.2 Compilation of results

Once the completed questionnaires were received the results we entered into a spread sheet, see Annex 2, and grouped into various categories as shown below;

Safety and Performance: This covered a reduction in risks associated with catastrophic failure i.e. bridge collapse, reduction in failures, reduction in temporary speed restrictions due to the condition of the infrastructure leading to improved performance and higher customer satisfaction.

Capacity Improvement: Including improved maintenance techniques leading to less downtime on the network with the consequential improvement in availability and capacity. Fewer temporary speed restrictions leading to improved end to end section running times generating more capacity for the same amount of infrastructure.

Environmental benefit: By moving from find and fix to predict and prevent and using different techniques the total amount of materials used will be reduced with a consequent improvement in environmental pollution. The elimination of catastrophic bridge collapse and the consequent oil pollution from such an event will also bring environmental benefits.

Cost reduction: As stated above by moving from find and fix to predict and prevent through the application of measurement techniques, better planning and utilisation of the workforce will be achieved leading to improved levels of productivity, better quality of work and Lower Life Cycle Costs.

The results were also prioritised and risk assessed using a simple 3x3 matrix of High, Medium, Low probability x High, Medium, Low cost. In addition by compiling the spread sheet it was also possible to easily identify any areas of research in the work packages which were important and not included and similarly those which were not important and were included.

2.1.3 Analysis of results

The table of results is shown in Annex II. All of the work packages were seen as relevant to the IMs

2.2 Interviews and bilateral meetings

EURNEX organised the first set of interviews and bilateral meetings with high level Infrastructure Managers for identification of needs and topics of interest. EURNEX developed a “roadmap” for these meetings. Results of the Interviews and bi-lateral meetings also included the provision of contact data of the responsible technical experts which shall be contacted by the SMARTRAIL WP responsible. During the first round of interviews a lack of information available has been identified on both sides;

- Information on the contents and outcomes of the WP
- Information on IM needs

In order to prepare for discussions with IM’s and to provde a clear explanation of the project, WP leaders are requested to clearly define

- the objectives,
- priorities,
- deliverables and results

of the individual WP which will be incorporated into promotional materials (outcome to be put into simple slides).

2.2.1 Selection of IMs for direct discussions

In order to ensure that the project was researching the correct issues prior to and following the issue of the questionnaire interviews were held with a representative sample of IMs. The IMs for interview were selected by EURNEX expert Michael Robson based on his experiences as General Manager EIM (European Infrastructure Managers) and included;

- Club Feroviar, Romania, 04.10.2011
- PLK Polish IM, 03.11.2011
- HZ Croatian IM, 11.11.2011
- MAV Hungarian IM 19.06.2012
- SZDC Czech IM, 18.06.2012
- REFER Portuguese IM, 15.05.2012
- LD Riga, Lithuania 12.07.2012

These interviews and meetings were conducted to an agreed script and involved one or two members from the EURNEX team discussing with senior members of the respective IM team their input to the questionnaire or their responses to the questionnaire.
These meetings were also important in terms of raising the profile of the project.

2.3 Workshops and conferences

In workshops and conferences the SMARTRAIL project brings together experts in the areas of highway and railway infrastructure research, SME's and railway authorities who are responsible for national infrastructure.

The aim of the first workshops running until December 2012 will be to identify together with IM experts and SMARTRAIL partners the special requirements, needs, constraints & priorities in the area of the project. Common topics / projects, according to infrastructure manager priorities, will be defined and further developed in the frame of the project. These priorities may form an input for future projects.

The workshops will be based on the evaluation of the results of the questionnaire (which is ongoing), the feedback on priorities and first results of WP1, WP2 and WP3 e.g. on embedded sensors, inspection technologies where we request WP leader input.

TRA 2012 Athens
TRA 2012 Athens (workshop together with Mainline)
In the course of the workshop the project and the interim results have been presented to the broad audience of the TRA2012.

1st regional conference Dubrovnik
The aim of the Dubrovnik workshop with 15-20 external participants mainly from the region was to identify together with IM experts and SMARTRAIL partners the special requirements, needs, constraints & priorities in the area of the project. Common topics / projects, according to infrastructure manager priorities, have been defined and further developed in the frame of the project or may be included in future projects.

In order to gain customer involvement preliminary solutions and proposed wyas to meet the requirements have been presented by WP leaders and formed the focus of the discussions. The workshop was based on the evaluation of the results of the questionnaire (which was ongoing that time), the feedback on priorities and first results of WP1, WP2 and WP3 e.g. on embedded sensors, inspection technologies where we requested WP leader input.
For dissemination purposes the presentation of first results by WP leader did incl.

- objectives of the WP
- priorities and requirements definition
- way ahead / envisaged outcome
- identification of customer requirements in dialogues

InnoTrans Workshop, InnoTrans 2012, September 19, 2012
The event has been dedicated to inform stakeholders on the project progress and updating information of ongoing activities in a relaxed atmosphere. Participating project partner will give an abstract of their work in bi-lateral discussions.

Ljublijana November 15-16; WP1, WP2 & WP3 Workshop incl. Demonstration on Test Site
Following a very straight forward project meeting in Ljubljana at ZAG premises November 15/16 a updated “Interim Report for Convergence Actions” which summarizes the matching process of special stakeholder requirement, needs, constraints & priorities in the area of the project will have been distributed among the WP leader for streamlining.

Moscow, Russia, 5 – 6 December 2012:
Europe Neighbourhood Cooperation Countries, (incl. Russia, CIS, Black Sea, Balkan States), 3rd Regional Workshop with SMARTRAIL, EU Project with Russian participation mid-term results and demonstration at Moscow Test Range of RZD (Sherbinka), with Decision making participants from Ministries of CIS and black sea countries to introduce the SMARTRAIL project and the ongoing activities and results.

Further on the event will be embedded on high-level in the frame of the Moscow Transport Research Forum of the Russian Academy of Transport Science and hosted by MIIT the Moscow State University of Railway Engineering.

2.4 Midterm results

The results of the identification of special stakeholder requirement, needs, constraints & priorities in the area of the project have been structured in a requirements matrix (Annex II) according to the identified relevance of the topics for:

- Safety and performance
- Capacity
- Environment
- Cost

Project structure	Substructure	existing practice	Customer needs / requirements / topics / comments	Safety and performance	Capacity	Environment	cost
Technology							
WP1 embedded sensor				x	x	x	x
WP3 New rehabilitation technologies to extend service life of existing railway infrastructure				x	x	x	x
Asset Improvment							
WP2 Assessment and Models				x	x	x	x
LCC, cost							
WP4 Whole Life-Cycle Cost Calculation Tools				x	x	x	x

Figure 1 Requirements matrix

Project structure	Summary of Customer needs / requirements / topics / comments
General remarks on SHM	proactive approach to emerging issues predict and prevent rather than find and fix
	planned interventions known to customers rather than unplanned and unpredictable interventions
	SHM to access the changes of climatic conditions, in particular the scour of water
SHM, techniques used	move from manual inspection to automated inspection - not automated rather intelligent - use of experienced people on site with real data from non-intrusive broad spectrum followed by intrusive focused investigations
	move towards non-intrusive techniques e.g. Geophysics for soils, accelerometers on bridges
	real-time monitoring is becoming a reality as sensors are becoming cheaper and remote logging is available
Bridges	specification to provide remote/active monitoring of high risk structures
	improvement of existing system to deliver the safety, capacity and environmental benefit in a cost effective way
	Monitoring water flow and changes in water content? How could it be possible?
	Fatigue examination of steel, reinforced concrete, stressed concrete, composite structures.
	Dynamic monitoring of steel bridges
	Scour detaction on river bed height changes
	Improved scour detection to predict failures in a better way
	Continuous monitoring of the conditions of critical structure/super structure/structural elements (e.g. structural safety)
	Reduction of safety limits in planning of structure/super structure/structural elements
	Increase of impact due to changed term of use
Embankments	Improve the existing system to deliver the safety, capacity and environmental benefit in a cost effective way
	Means of optimizing the monitoring of the linearity of earth structures while keeping costs low
	Optimizing the monitoring of the linearity of earth structures while keeping costs low
	New monitoring systems at existing big bridges
	Tracking system for the continuously welded track stressing
	Interaction between the continuously welded track and the steel bridges
	As there are no comments I have proposed to delete them
What are the real topics needs?	New rehabilitation methods
	Benchmarking to determine economical methods
	Transition from ballasted track to slap track

	Transition from ballasted track to structures Study of the possibilities and conditions, for use of old (over 80 years) steel bridges for performance of train movement with speed 160-200 km/h Reinforcement of the slopes at abutments and foundations of the railway bridges pillars against hydraulic impacts in case of high waters; Recalculation and reinforcement of drainage structures (ditches, culverts, siphons etc.), mitigation of changing climate conditions and environment impacts. Retrofitting and rehabilitation whenever possible, instead of replacement by new structures (following the general Europe tendencies concerning rail networks) Combined response of railway track and super structure to avoid rail expansion joints, temperature behavior of the superstructure to avoid track changeover constructions
	Bridge scour modeling and measurement Lack of data cause model uncertainty inclusion in the analyses. SHM to minimise this problem.
Means of sensor used ?	Certainly the future and something which WP2 can contribute towards. Network Risk not considered specifically but developed techniques in WP2 could certainly be incorporated into a system analysis.
What are the real topics needs?	Novel strengthening techniques and verifying their long-term efficiency. The techniques should focus also on serviceability problems and not only on load carrying capacity increase. Fully agree. Modeling of LCA/WLC (e.g. LCA/WLC -of open track with and without geogrid reinforcement) - WP4 Probability assessment versus risk assessment - The focus of WP2 is on probabilistic assessment in quantitative terms. Qualitative risk assessment if not considered in WP2. Prediction of life span for models of structures. (WP2) Collection of Data. Collection of SHM data forms an integral part of WP2. Attempts for implementation of the remaining resource of the railway bridges. Prognosticates of changes in the loading capacity level within the time and the repairs could be planned. Method for definition of the railway structures remaining resource. Fully agree and this is indeed included in the scope of WP2. IMPORTANT: in cases where you are near to the collapse of a structure/super structure/structural element, there you have a lower level of reliability? Online monitoring (SHM) important to increase the level of security, but you must also have the time to react.
What tools have been used?	Acceptance and implementation of a LCA/WLC system Need for confidence in the LCA/ WLC tool Request for EC wide accepted LCA/WLC tool

3 Matching requirements / R&I Work package activities

3.1 Adopted output by work packages

In preparation for the discussions with Infrastructure Managers the Work Package leaders were requested to define the objectives, priorities, deliverables and results of the individual Work Packages to incorporate into promotional materials (outcome to be put into simple slides).

3.2 Adaptive Actions of WP 1

To be completed

3.3 Adaptive Actions of WP 2

To be completed

3.4 Adaptive Actions of WP 3 New rehabilitation technologies to extend service life of existing railway infrastructure

Task 3.1 European Existing Railway Tracks: A Survey Report

The WP3 action is based upon the questionnaire sent out to the railway authorities and on the literature survey.

A survey of European existing railway tracks was carried out to identify challenges related to current infrastructure.

a) There is a strong demand for rail transport and continuous research and development is being carried on to make railways faster, heavier, longer and greener.
b) Most of the existing railway tracks in Europe have reached their designed service life; the main challenge is how to enhance these existing ballasted tracks.
c) Most countries have their own standards in railway engineering and maintenance. Some typically technical data have been obtained from five countries which may be useful for engineering design or evaluation.
d) The effects of climate on track services are critically significant.
e) There are a number of projects on R&D of railways worldwide.
f) There is a great deal of information on railways in various sources, e.g., journals and magazines, societies conferences, internet, etc. it would be helpful to obtain sufficient literature search and review before starting a new R&D.

3.5 Adaptive Actions of WP 4 LCC (status Nov , 2012) to match user requirements

WP 4 compiled a set of questions and it was sent to the project partners. Results of the questionnaire are used for the LCA model and for some detailed information the different producers for railway maintenance were contacted.
The Smart Rail environmental calculation tool is based on PCR (Product Category Rules) for Railways UN CPC 53212 and is in compliance with standards EN ISO 14040 and EN ISO 14025. It has been created in order to meet the following purposes:

- comparisons of the Indicators describing environmental impacts (GWP, ODP, AP, EP, POCP) for different composition of rail structures and maintenance techniques,
- comparisons of the Indicators describing resource input (renewable, non renewable energy resources) for different maintenance techniques,
- comparisons of the costs for different composition of rail structures and maintenance techniques.

The objectives
Main objective of the WP 4 is to develop a methodology and consequently a simple tool to assess life cycle of the interventions, both form the financial point of view and form the environmental impact point of view. This assessments will be as accurate as possible, taking into account also predicted life time of the intervention (where we are relying on common effort of the project).

Second objective is to define as far as possible a »typical« unit process. This means to find common things and to identify differences in different interventions. Consequently one would be able to define a fixed (unchangeable) part of the process and variable part of the process of the interventions. This should be useful for the construction of the simplified tool.

Priorities
First priority is to establish LCA and WLC models for the pilot selected interventions. Second priority is to integrate these models (or results) into a tool. Third priority is to get as realistic as possible the predicted life time of the intervention (this is crucial for the tool reliability)

Deliverables and results
Both LCA and WLC models are to be reported in written reports. An internet based tool will be set-up at the end of the project including aging rail networks (i.e. the tool should be able to provide results for different life span and different aging (and small intervention) scenarios for the same selected intervention)

4 Way ahead

The exploitation of the project results depend very much on the degree of response to the customer requirements.

In line with the results of these research activities on customer needs, requirements & priorities specific activities will be undertaken to start the actual exploitation. In order to exploit the project results successfully, it is essential that the results meet needs and requirements of the clearly identified since the beginning of the project.

This report clearly indicates a number of exploitation opportunities.. During the course of the project, the WP leaders will actively evaluate project outcomes and make recommendations on their further usage.

Discussion with stakeholder will be proceeded with Europe Neighbourhood Cooperation Countries, (incl. Russia, CIS, Black Sea, Balkan States), 3rd Regional Workshop with SMARTRAIL, EU Project with Russian participation mid-term results and demonstration at Moscow Test Range of RZD (Sherbinka), with Decision making participants from Ministries of CIS and black sea countries to introduce the SMARTRAIL project and the ongoing activities and results in Moscow, Russia, 5 – 6 December 2012.

Needs for discussion with the WP leaders

- Embankment stability is a key issue and progress on the best ways of achieving it are important. What have we learnt so far?
- The progress being made with the bridge strengthening work could be incorporated with the work of the MAINLINE/MAV work so as to present a package which could be easily implemented.
- The work on bridge scour needs to be publicised, where have we got to, do we have any early views emerging from the research?
- How is the work on transitions zones progressing and track stability, what lessons are available to incorporate in new works?

These issues are important to enable quick wins by incorporating the recommendations into contracts being let in both Romania and Bulgaria for rehabilitation works on major parts of the networks. Serbia and Croatia are also about to tender contracts using EU funds.

5 Annex I Example of the questionnaire (MAV Hungary)

Discussions on the work packages

WP1 embedded sensor
aims to bring about a step change in the traditional methods of visual inspection and ad-hoc monitoring with integrated monitoring systems which utilize the latest embedded sensor technology and optimized in-situ testing methods.

- Structural Health Monitoring (SHM), what techniques are used:
  - Manual inspection Yes (visual inspection or with measuring equipment/instruments
  - Sensors Yes E.g. in turnouts installation of Roadmaster 2000 light, Embedded sensors in concrete frame bridges, sinking measuring instrument installed in embankment, monitoring of the movements of damaged steel structural element
  - Other, NDT technique: Infrared thermography measurements on masonry arch bridges /only pilot application/
- Bridges
  - What work has been carried out for using sensors (measurements of stresses by strain gauges for the comparison of calculated and actual loads) Monitoring of deflections on a damaged structural element in a steel bridge
  - What means of sensor have been used (strain gauge, fibre optics, etc.) Extensometers
- What are the real topics needs (Monitoring/examination of wall-movements (methods, limit values, etc.) . Automated monitoring system on bridges with on-line data processing
  - What work has been carried out for using sensors

Embedded sensors in concrete frame bridges for deflection and stress monitoring

  - What means of sensor have been used: sinking measuring tube under the embankment , inclinometer, press-meters (ground penetration radar (georadar) but this is not a sensor) Optical sensors
  - What are the real topics needs How could it be possible t monitor the water flow and changes in water content? Fatigue examination of steel, reinforced concrete, stressed concrete, composite structures. Dynamic monitoring of steel bridges
  - What means could be used:

    Controlling Speed of trains? This is realized by tachographs and GPS mounted on the engine drivers' cab, and their regular evaluation

    Axle load checking equipment

WP2 Assessment and Models
Aims to develop models which will greatly improve the ability of the track owners to predict the future condition of the infrastructure and hence to greatly improve the efficiency of maintenance programmes.

- What kinds of models have been used On the base of track geometrical measurement from the qualification numbers belonging to different dates the rate of deterioration /improvement the necessity of track tamping can be predicted (PÁTER program)

We have got calculation model for steel bridges, which supplies data for the expectable life-time on the base of the cumulated loading. Simplified model exists for masonry arch bridges /more sophisticated models and calculation is under development in the UIC Assessment of Masonry Arch Bridge project

- What means of sensor have been used (Barhhausen noise measurement)
- What are the real topics needs: Working out a model for other structures than steel bridges (e.g. stone, concrete, reinforced concrete, composite) which enables the prediction of life-time
- versus risk assessment which will need to be discussed in the project to ensure that we are clear what we are proposing

WP3 New rehabilitation technologies to extend service life of existing railway infrastructure
The WP aims to develop, and verify by on-site application, sustainable (cost-effective, durable, rapid) technologies for effective rehabilitation and strengthening of "older" existing railway infrastructure (built in 19th and 20th century).

- What work has been carried out Reconstruction by earth-work technology or by reconstruction train. In case of bridges: replacement, partial renewal, partial replacement of elements, strengthening, Temporary strengthening measures using Fibre Reinforced Plastics /case study on pilot application exists at MAV/
- What means of sensor have been used Sensors of check measurements after rehabilitation: strain gauge, deflection meters, strain meters, etc..)
- What are the real topics needs. Novel strengthening techniques and verifying their long-term efficiency. The techniques should focus also on serviceability problems and not only on load carrying capacity increase.

- Examples: transition from ballasted track to structures was of great interest to PLK

Lot of methods for the forming of transition zones:

- Floating plate, ribbed plate, substructure strengthening (mechanical- chemical stabilization), geo-synthetics, and their combined application
- Ballast gluing in different depths: in 3 rates above the back-filling section

WP4 Whole Life-Cycle Cost Calculation Tools

The overall objective of WP4 is to create a model by which the rail industry will be able to assess railway infrastructure rehabilitation techniques economically and environmentally

- What tools have been used. We haven't done Life cycle cost calculation yet, but we have already done for bridge renewal
- What level of confidence does the company/member state have in LCC tools Currently low confidence.

MÁV hasn't got one

- Do you think that will be possible to have an EC wide accepted LCC tool Yes
- What means of sensor have been used
- What are the real topics needs

Hungary_MAV_SMARTRAIL filled in questionnaire 2012.03.01

WP4

For LCA calculation GABI sftware is used. GASi software supports databases for generic data to be used for Europe:

- IISI (International Iron and Steel Institute)
- Ecoinvent
- ICA (International Copper Association)
- European Copper Institute
  (Deutsches Kupferinstitut – Life Cycle Center)
- EAA (European Aluminum Association)
- PE Plastics Europe
  (former APME Association of Plastics Manufacturers in Europe)
- EIME (Environmental Information and Management Explorer) EcoBilan
- NTM
- CORINAIR

There is a problem to get specific data for some machines, but we are in a contact with their producers. LCA tools can optimize the new construction or maintenance of the railway in a sense of lower GWP (Global worming potential) emissions which is a politic of EUROPE and UN by the Copenhagen Accord (CP.15). In the future, the application of LCA into railway infrastructure can achieve a fundamental technology for sustainable development.

New technologies which will be used in Smartrail for open track not contribute only to the lower GWP emissions but reducing the cost of the railway maintenance too.

LCA tools need to be used very carefully and for every models data, procedure and boundaries has to be explained into detail. Under these conditions LCA tool could contribute to using green materials and technologies where they could have the highest effect on the lower GWP emissions. In that sense more and more products which are used for railway construction and transport have EPD (environmental product declaration) which provide valuable and relevant information on the environmental impact of all life cycle phases.

The main goal in WP4 is to support the use of new technologies which have low GWP emissions and lower cost of construction and maintenance of the railway.

The topic of the WP4 is to develop the tool which will be used for open track and for technologoes developed in the project SmartRail.

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- What means of sensor have been used Sensors of check measurements after rehabilitation: strain gauge, deflection meters, strain meters, etc..)
- What are the real topics needs. Novel strengthening techniques and verifying their long-term efficiency. The techniques should focus also on serviceability problems and not only on load carrying capacity increase.

- Examples: transition from ballasted track to structures was of great interest to PLK

Lot of methods for the forming of transition zones:

- Floating plate, ribbed plate, substructure strengthening (mechanical- chemical stabilization), geo-synthetics, and their combined application
- Ballast gluing in different depths: in 3 rates above the back-filling section

Annex II Results of questionnaire matrix

Project structure	existing practice	Customer needs / requirements / topics / comments as basis for the WP answers in the 1st Regional WS in Dubrovnik May 07, 2012	Safety and performance	Capacity	Environment	cost	customer priority 1=high; 5=low
Technology							
WP1 embedded sensor							
General remarks on SHM	SMH (Structural Health Monitoring)	proactive approach to emerging issues predict and prevent rather than find and fix	**relevant**				
		planned interventions known to customers rather than unplanned and unpredictable interventions		**relevant**			
		SHM to access the changes of climatic conditions, in particular the scour of water			**relevant**		
SHM, techniques used	manual inspection, remote monitoring	move from manual inspection to automated inspection - not automated rather intelligent - use of experienced people on site with real data from non-intrusive broad spectrum followed by intrusive focussed investigations	in a safe way	increasing capacity by better understanding the performance of the asset	in continuosly environmental conditions	in a cost effective way	
	Visual inspection in conjunction with DT and NDT techniques like penetrant liquids, carbonation test, chloride content, electromagnetic covermeters, etc	move towards non-intrusive techniques e.g. Geohysics for soils, accelerometers on bridges	x	x	x	x	
	general perception about sensor network	real-time monitoring is becoming a reality as sensors are becoming cheaper and remote logging is available					
		specification to provide remote/active monitoring of high risk structures	x				
Bridges	infrared themography, sensors for deflection and stress monitoring; Accelerometers bridge strike monitoring and bridge movement sensors	improvement of existing system to deliver the safety, capacity and enviromental benefit in a cost effective way	x	x	x	x	
	sonar equipemtne to measure the effect of water on bridge foundation	Monitoring water flow and changes in water content? How could it be possible?	x		x		
	contours measuring of tunenels, bridges, railway sections and embankments	Fatigue examination of steel, reinforced concrete, stressed concrete, composite structures.	x	x		x	
		Dynamic monitoring of steel bridges					
		Scour detaction on river bed height changes	x	x	x	x	
	sonar equipment to measure the effect of water on bridge foundations	improved scour detection to predict failures in a better way	x	x	x	x	
	External sensors, to measure displacement, strain, inclination, load, temperature, beam (to measure distance)						
		Continuous monitoring of the conditions of critical structure/super structure/structural elements (e.g. structural safety)	x				
		Reduction of safety limits in planning of structure/super structure/structural elements	x				
		increase of impact due to changed term of use		x			
embankments	track sensors (Roadmaster 2000)	Improve the existing system to deliver the safety, capacity and enviromental benefit in a cost effective way	x	x	x	x	
	detect movements of earth sturctures	Means of optimizing the monitoring of the linearity of earth structures while keeping costs low	x				
		Optimizing the monitoring of the linearity of earth structures while keeping costs low	x	x	x	x	
		New monitoring systems at existing big bridges	x	x		x	
		Tracking system for the continuously welded track stressing	x	x		x	
		Interaction between the continuously welded track and the steel bridges	x	x		x	
WP3 New rehabilitation technologies to extend service life of existing railway infrastructure							
work carried out?	calculation model for steel bridges						
	Simplified model exists for masonry arch bridges /more sophisticated models						
	calculation is under development in the UIC Assessment of Masonry Arch Bridge project						
	only in triggering events, e.g. sliding of slopes						
What means of sensor ?	track geometrical measurement , inclinometer						
What are the real topics needs?	Working out a model for other structures than steel bridges (e.g. stone, concrete, reinforced concrete, composite) which enables the prediction of life-time	New rehabiltation methods	to improve safety	to improve capacity	environmental friendly (e.g. noise / vibration reduction) adaption to new condition due to climate change	cost effective (e.g. reduction of work force need)	
		Benchmarking to determine economical methods	x	x	x	x	
		Transition from ballasted track to slap track	x	x	x	x	
		Transition from ballasted track to structures	x	x	x	x	
		Study of the possibilities and conditions, for use of old (over 80 years) steel bridges for performance of train movement with speed 160-200 km/h	x	x		x	
		Reinforcement of the slopes at abutments and foundations of the railway bridges pillars against hydraulic impacts in case of high waters;	x	x	x	x	
		Recalculation and reinforcement of drainage structures (ditches, culverts, siphons etc.), mitigation of changing climate conditions and environment impacts.	x	x	x	x	
		Retrofitting and rehabilitation whenever possible, instead of replacement by new structures (following the general Europe tendencies concerning rail networks)	x	x		x	
		Combined response of railway track and super structure to avoid rail expansion joints, temperature behavior of the superstructure to avoid track changeover constructions	x	x		x	
Asset Improvment							
WP2 Assessment and Models							
kinds of models used?	Reconstruction by earth-work technology or by reconstruction train. In case of bridges: replacement, partial renewal, partial replacement of elements, strengthening, Temporary strengthening measures using Fibre Reinforced Plastics /case study on pilot application exists at MAV	Developed probabilistic basis will facilitate evaluation of alternative rehabilitation strategies from a cost and performance perspective.					
	Lack of data	Lack of data couse model uncertainty inclusion in the analysys. SHM to minimise this problem.					
means of sensor used ?	regard to sensors and asset monitoring to route information on monitored assets into central traffic control where we can monitor asset performance on screens. Network Wide Risk Model	Certainly the future and something which WP2 can contribute towards. Network Risk not considered specifically but developed techniques in WP2 could certainly be incorporated into a system analysis.					
What are the real topics needs?	Novel strengthening techniques and verifying their long-term efficiency. The techniques should focus also on serviceability problems and not only on load carrying capacity increase.	Novel strengthening techniques and verifying their long-term efficiency. The techniques should focus also on serviceability problems and not only on load carrying capacity increase. Fully agree.	x	x	x	x	
		Modelling of LCC (e.g. LCC of track) - WP4	x	x	x	x	
		propability assessment versus risk assessment - The focus of WP2 is on probabilistic assessment in quantitative terms. Qulaitative risk assessment if not considered in WP2.	x				
		Prediction of life span for models of structures. (WP2)	x	x	x	x	
	lack of data	Collection of Data. Collection of SHM data forms an integral part of WP2.	x	x	x	x	
		Attempts for implementation of the remaining resource of the railway bridges. Prognosticats of changes in the loading capacity level within the time and the repairs could be planned.	x	x	x	x	
		Method for definition of the railway structures remaining resource. Fully agree and this is indeed included in the scope of WP2.	x	x	x	x	
		IMPORTANT: in cases where you are near to the collapse of a structure/super structure/structural element, there you have a lower level of reliability. Online monitoring (SHM) important to increase level of security, but you must also have the time to react.	x	x	x	x	
LCC, cost							
WP4 Whole Life-Cycle Cost Calculation Tools							
What tools have been used?	Some haven't done Life cycle cost calculation yet, but we have already done for bridge renewal	Acceptence and implementation of a LCC system				x	
	LCC tool of TU Graz, whole renewal is based on LCC	Need for conficence in the LCC/ LCA tool	x	x	x	x	
	OBB is living the LCC-philosophy since years, always look to other methods	Request for EC wide accepted LCC tool	x	x	x	x	
What level of confidence ?	a tool to sum and account for the maintenance and intervention costs of each structure during its life-cycle, but in early development phase	Understanding of the need of LCC	x	x	x	x	
Is a EC wide accepted LCC tool possible?		LCC: estimation of remaining service life				x	
means of sensor used?		need for demonstration of LCC versus initial cheapest price	x	x	x	x	
What are the real topics needs?		Evaluate the cost of delays, cancallations, lost opportunites and down time for maintainance	x	x	x	x	
		tool recognising that it will be difficult to gain EU wide acceptance	x	x	x	x	
		LCA tool with wide acceptance of both Infrastructure Managers/Rail Regulators/Governments to ensure it will be of value as many railways have LCA tools	x	x	x	x	
		Developement of a "cheap" LCC tool; containing necessary activities on maintenance, repair and rehabilitation	x	x	x	x	

x **Customer needs / requirements to be answerd by the SMARTRAIL project**