Foreword

NeTIRail-INFRA is a 5.4 million € H2020 project funded through INEA part of the European Commission. After 35 months of hard work and good cooperation, NeTIRail-INFRA will come to an end in a few weeks. This project has been an exciting experience with many partners coming from many different areas and working on a large range of activities.

We will present in this newsletter some of the dissemination activities that have been conducted in the last months of the project as well as the project results achieved.

In the coming month we are particularly excited to present all of the technologies developed within the project (among others technologies for track, overhead lines and also monitoring and signalling technologies) and to discuss the research and development in detail in the final conference, as well as in the training workshops that will be organised in May for WP4 and WP6.

We will also present the assessment of the financial benefits of all of these technologies, as well as the societal impacts for the railways.

Finally, we will show the decision support tool that has been developed within the project to be used by infrastructure managers across Europe to assess which is the most appropriate technologies developed within the project to suit their particular railway lines.

Our website is frequently updated with the presentations delivered by the partners during all public events, as well as with all of the deliverables produced by the project partners once they are validated by the EU. Please visit us regularly at http://netirail.eu/.

Jon Paragreen – NeTIRail-INFRA Project Manager

FORTHCOMING PUBLIC EVENTS

Final conference

NeTIRail-INFRA will hold its final conference on 23-24 May in Slovenske Železnice premises in Ljubljana (Slovenia).

On the first day, a visit of the Slovenia railway museum will be organised, followed by a dinner.

The second day will give the opportunity to present all of the technologies developed within the NeTIRail-INFRA project and to hold demonstrations of sensor technologies and of the decision support tools.

More information, detailed programme and online registration at: http://netirail.eu/-News-and-Events-3-.

WP4 Training workshop

A training workshop will be organised at UIC in Paris on 31 May 2018 to present all of the technologies developed within WP4 (Track monitoring innovations and results). This training workshop will end with a one and a half hour interactive session between the speakers and the participants to discuss further steps to be taken towards implementation and new challenges to be taken up.

More information, detailed programme and online registration at: https://events.uic.org/netirail-infra-wp4-training-workshop.

WP6 Training webinar

The Web-based application developed under WP6 aims at informing the user about the opportunities to use the NeTIRail innovations. Users would typically be decision-makers as well as technology-aware staff of infrastructure managers. To learn more about the application, you may attend our training webinar at 3.30 pm on Thursday 31 May 2018 at: http://uic.adobeconnect.com/netirail-gis-web-application/
NEWS OF THE CONSORTIUM

TRACON 2018

The Transport Research Arena (TRA) 2018 - Europe’s largest transport research conference - broke all records with more than 3,500 visitors from science, industry and politics, over 100 sessions with more than 8,500 minutes of scientific discussion and more than 90 exhibitors. The results of NeTIRail-INFRA were well represented with several posters displayed in the Market place area. The posters presented some of the technologies developed for low cost railway infra measurement and signalling during the three years’ duration of the project, i.e.:

- Instrumentation for real time monitoring of the overhead contact line acceleration
- NeTIRail-INFRA – Needs Tailored Interoperable Railway Infrastructure - technology demonstrations
- Smart technology solutions for the NeTIRail-INFRA case study lines: Axle box acceleration and ultra-low cost smartphones

TEN-T Days

NeTIRail-INFRA presented at TEN-T Days 2018 in Ljubljana, 25-27 April

TEN-T Days 2018 was held in Ljubljana from 25 to 27 April. With over 2,000 registered participants and 26 Ministers of Transport in attendance and with around 100 exhibition booths, TEN-T Days offered an excellent opportunity for transport industry stakeholders to meet and exchange innovative ideas.

Ms. Christine Hassoun, UIC Senior Advisor, Project Dissemination and Ms. Violeta Bulc, EU Commissioner for Transport
European Commissioner for Transport Violeta Bulc invited Ministers, members of the European Parliament and key stakeholders to Ljubljana to discuss ways of contributing to smart, sustainable and safe mobility, relying on the trans-European transport network and investment in transport connectivity.

TEN-T Days also hosted an idea accelerator and futuristic lab, allowing young European entrepreneurs and companies to showcase innovative mobility solutions. A high-level interinstitutional meeting was held to discuss further synergies between transport, energy and digital connectivity and investment with the greatest added value for the EU in the post-2020 framework. This culminated in a Ljubljana declaration by all relevant stakeholders on key principles for investment in smart, sustainable and safe mobility. High-level events included ministerial sessions with the western Balkans and Turkey, and with southern Mediterranean countries. This year’s TEN-T Days indoor and outdoor exhibition showcased innovative projects and ideas that contribute to European transport infrastructure development.

NeTIRail-INFRA was one of the indoor exhibitors, and TEN-T days provided an excellent opportunity to announce the final project conference which will take place on May 24, once again in Ljubljana. Ms. Violeta Bulc, EU Commissioner for Transport, visited our stand and declared that she fully supports the project. Mr. Alan Haigh, Head of H2020 Department, INEA (Innovation and Networks Executive Agency) showed a keen interest and stated that cooperation on EU-funded projects must continue.

Project results and tests

The NeTIRail-INFRA project has successfully achieved the project aims and testing of the innovations has been completed. Test sites were selected on the operational railway in Turkey, Romania and Slovenia for the validation of measurement and monitoring devices, the application of lean to S&C renewal and for trialling of interlocking devices and corrugation reduction strategies.

WP1 – Contrasting market needs, and business case

Leading partner: University of Leeds – Institute of Transport Studies

Within WP1 the incentives and wider economic impacts relevant to the project case study lines and other examples have been studied. This forms the background of the assessment and quantification of benefits beyond just the financial life cycle costs. The individual innovations developed within the project have been assessed for their impacts on costs and user benefits which is brought together in the deliverable D1.4 and the final business case in deliverable D1.8.
Corrugation reduction strategies

Within the NeTIRail-INFRA project corrugation was investigated and 3D-FE coupled dynamic vehicle-track models created for identifying the root causes of corrugation and therefore to develop corrugation reduction strategies. These corrugation reduction strategies were trialled in the field in Turkey with the NeTIRail-INFRA project specifying the fastening and under rail pad systems for minimising corrugation at a known corrugation site. More information can be found in deliverable D2.6.

Modeled corrugation: (a) field measurement of corrugation (27–33 mm bandpass filtering); (b) schematic diagram of the corrugation and 4 positions (blue line: P1, red line: P2, green line: P3 and magenta line: P4); and (c) illustration of the applied corrugation (Corrugation 2 with P2 at 0.6 m) in the rail surface with 5× magnification (only 3 complete waves are plotted).

Contact pressure, shear stress, contact patch, adhesion-slip distributions and vector graphs of micro-slips when $A = 20 \text{ µm}$ along one corrugation wavelength (P1–P4) (projection onto the xOy plane; Border 1: contact patch border; Border 2: adhesion-slip distribution border).
Lubrication

The NeTIRail-INFRA project studied the lubrication techniques already in use across Europe, and completed a detailed literature review, a survey of suppliers and incorporated results from in operation trials in Slovenia and Turkey. This has resulted in a catalogue of lubrication products and NeTIRail-INFRA have developed recommendations for lubricant and applicator type based on line type (according to UIC leaflet 714) and climatic conditions (based on Köppen-Geiger climate classification), a decision making flow chart guides the end users through the decision making process to the optimum solutions to suit their lines and climate. Deliverable D2.8 contains the background information and the decision making flow chart.

Lean techniques to reduce S&C renewal costs

Two lean case studies were carried out, one in Celje, Slovenia and another in Kayseri, Turkey. Both of these case studies analysed the installation of new S&C. The processes used were mapped and individual steps analysed to produce recommendations for optimisation based on cost minimisation or minimisation of possession time for the particular case study lines and more generalised recommendations were also made. More detailed information can be found in deliverable D2.4.

Transition zones

NeTIRail-INFRA has investigated alternative, low cost, solutions to expensive transition zone designs through the modification of sleep mass. The deliverable D2.10 describes the modelling work carried out within the project to model the dynamic track deformation through transition zones between ballasted track and structures and presents low cost solutions to reducing track forces and deformation through these zones, leading to reduced maintenance and installation costs. The transition zone models were validated against measurements from a transition zone in Portugal.

Modal analysis of the two major frequencies (1185 and 1296 Hz): (a) rail vertical mode at 1185 Hz and (b) rail longitudinal mode at 1291 Hz, in comparison with the closest vertical pin-pin mode at 1100 Hz shown in (c).

Full extrude version of the whole transition zone
Work package 3 developed dynamic models of the overhead line catenary systems and from these models assessed low cost alternatives to the traditional catenary systems and the impact of controllable factors such as contact wire tension. WP3 also developed and tested a range of instrumentation for understanding the characteristics of overhead line systems including contact wire accelerometers, on-board voltage and current measurement, and high speed video capture of the catenary system and contact wire, from both on-board service vehicles and from the line side. The measurement and monitoring technologies were successfully trialled in Turkey, Slovenia and Romania and will help to develop predictive maintenance programmes and aid the understanding of the dynamic responses of the catenary system and further validation of the computational models.

More details can be found in deliverables D3.6 and D3.5.
**WP4 – Monitoring and Smart Technology**

**LEADING PARTNER: TU DELFT**

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**ABA (Axle Box Acceleration)**

The ABA system developed by TU Delft is a high precision monitoring system which is suitable for running on in-service vehicles and detecting even very small rail defects such as small squats. This system has the advantage of detecting defects at their earliest stages and allowing for better maintenance planning. The system was tested on a lesser used line operated by RC-CF in Romania and on the AFER test track, also in Romania. These tests allowed the ABA system to be validated at a greater range of speeds, and the detected faults were confirmed with visual inspections. The system validation is described in detail in deliverable D4.11.

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**High precision monitoring in Slovenia**

High precision monitoring tests were carried out in Slovenia using a combination of axle mounted high frequency and low frequency accelerometers, again mounted on in service vehicles. The systems was also used for the detection of minor track defects and ride comfort, the results from these tests were validated against a track recording car. See deliverable D4.11.

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**Low cost smartphone sensors**

NeTIRail-INFRA has developed an android smartphone app for collecting data from the phone’s accelerometers for the recording and assessment of train ride comfort and the detection of large track defects. This smart phone app was tested along side the other the measurement devices on the AFER test ring and also the RC-CF track, and the defects detected by the app were correlated with those detected by the ABA system. The full results of the validation are described in deliverable D4.11.

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**Low cost track monitoring**

Solutions were developed for low cost accelerometer sensors for track, which are also self-powered. This solution developed has been tested on track in Romania, Slovenia and in Turkey. These low cost sensors are designed to be deployed to problematic sections of track and switches and crossings to better understand the damage mechanisms, lead to preventative maintenance strategies and also to detect damaging rolling stock. See deliverable D4.11 for further details of the validation of these sensors.
Interlocking detection devices

The NeTIRail-INFRA project has also developed low cost solutions for linking mechanical signalling systems and interlocking devices to centralised control systems. The sensors are also designed to be self powered for convenience and reduced installation costs. The system validation can be found in deliverable D4.11.

SATLOC positioning data and GSM communications for monitoring equipment on in-service vehicles

Solutions were developed for utilising the positioning data from the SATLOC system for the in-service vehicle monitoring systems, solutions were also developed for breaking up the data generated from the monitoring systems into packets for effective and reliable transmission over the GSM network.

WP5 – Societal perspective

Leading Partner: Albert-Ludwigs-Universität Freiburg

The societal impacts of the NeTIRail-INFRA innovations were assessed for the case study lines, surveys of passengers were carried out on the case study lines to identify the factors which were most important. A methodology has been developed for quantifying this societal impact, using the results of the survey to weight the relative impact of the different factors. This methodology is being integrated into the decision support tool developed within work package 6. More details on the societal impacts can be found in deliverables D5.2 and D5.3.
WP6 – Evaluation and decision support tools

LEADING PARTNER: UIC

A web based GIS tool has been developed for railway infrastructure managers, enabling them to easily assess the impacts of the NeTIRail-INFRA innovations and identify the most appropriate technologies for their different lines. The assessment methodologies and results from work package 1 and work package 5 will be integrated into this tool.

WP7 – Dissemination, training needs and influence on guidelines and standards

LEADING PARTNER: UIC

Future development

NeTIRail-INFRA project developed many technologies during these three past years and is providing a route for further research actions. Throughout the project, opportunities for further developing smart technologies arose.

However, research is not limited to technologies, but also includes their socio-economic evaluation. Among future development needs in this field, we have identified a deeper study on the interaction between employment effects and the rail investment, providing improved modelling of wider economic benefits. Another example of further need for development which would open many perspectives is the extension of the database used by the web application, so that maintenance policies and the state of the infrastructure are reflected therein. The upgrade of the web application would follow, so that such data can be input, displayed, and meaningful indicators can be derived.

The analysis of future development needs will be part of deliverable “Overview of project related recommended future development needs” which will be published shortly.
Background to NetIRail-INFRA

The principles behind the NetIRail-INFRA project were conceived in early 2014 in response to the topic MG2.1 “Intelligent Infrastructure” in the 2014-2015 Mobility for Growth Horizon 2020 call. The NetIRail-INFRA concept was based on designing railway infrastructure and monitoring tailored to the needs of specific lines to ensure the most cost effective and sustainable solution for different line types and geographical locations.

There is particular emphasis in the project on lesser used lines which are marginally economical and at risk of closure or require substantial public subsidies. As well as the lesser used lines the project also considers capacity constrained and freight dominated lines.

NetIRail-INFRA videos

Several videos have been made to present the project and its main achievements. These videos cover the following fields:

► Overview of the NetIRail-INFRA project
► NetIRail-INFRA WP4 demonstrations
► Overview of NetIRail-INFRA WP4 - Monitoring and Smart Technologies
► NetIRail-INFRA Track and Overhead line accelerations monitoring
► NetIRail-INFRA Smartphone monitoring of train accelerations and passenger comfort
► NetIRail-INFRA ABA Axle Box Acceleration System
► NetIRail-INFRA Interlocking devices
► NetIRail-INFRA High speed video camera analysis of overhead line dynamics
► NetIRail-INFRA Switch and Crossing monitoring

All these videos are available on the NetIRail-INFRA website at: http://netirail.eu/Documents-and-Downloads#Videos
Facts and figures

NeTIRail-INFRA is funded by the European Commission under the Horizon2020 programme

- Total budget: 5.4m€
- Duration: 36 months
- Partners: 13
- Countries: 8
- Grant agreement n°: 636237

Project start date: 1st June 2015
Project end date: 31st May 2018
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