International Innovation

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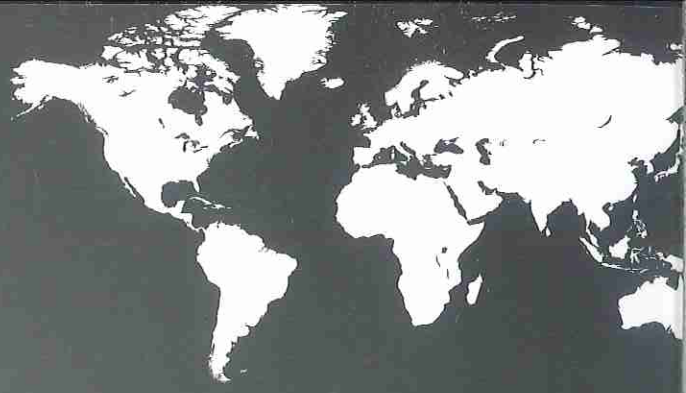

ENTERPRISE IN ENERGY

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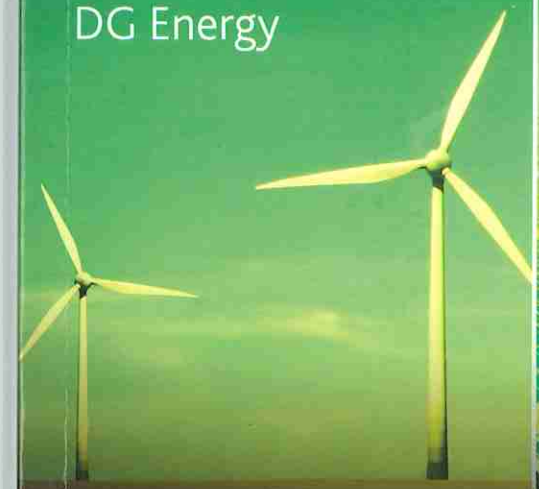

RESEARCH SPOTLIGHT

JRC Renewable Energies Unit • Covenant of Mayors • European Renewable Energy Council
Fuel Cells and Hydrogen Joint Undertaking • European Renewable Energy Centres Agency
DG Transport and Mobility • Digital Agenda for Europe • European Research Council

Reading the right **signals**

The daily journeys of rail users across Europe are underpinned by signalling systems. Here, **George Barbu** describes how his project is working to harmonise train control systems

Firstly, can you discuss the background to your research as the EU coordinator of the 'Integrated European Signalling System for Railways' (INESS) project?

European signalling systems have continuously progressed. The European Rail Traffic Management System (ERTMS)/European Train Control System (ETCS) itself is a synthesis of the technical and industrial know-how from the period 1990-98, when 'performing signalling' was already a reality in Germany (LZB), France (TVM), Sweden and other countries. Under the 'technical interoperability' commitment, ETCS has selected the best experience and matched it with unique train-control features, interrelation and communication regarding infrastructure.

The track-side functions and equipment which are essential for train detection, train routing, protection of routes and signalling as a whole, have progressed significantly, independent from ETCS. The challenge – and the main objective of INESS – is to harmonise the functionality dedicated to ETCS and interfacing in a win-win process for railways and suppliers.

Are there any particular regions that need significant investment and upgrading of their interlocking capabilities?

The ETCS deployment is now envisaged as a 'corridor' conception. It should be a railway strategy to fit its 'national' portion of corridor whilst implementing ETCS and providing track-side equipment (eg. interlocking, electric power for traction, train detection systems, etc.). There is no 'one' condition, but a complex conception of performance functionalities.

How have you approached the development of business models and cooperation models to support migration strategies for ERTMS?

A 'universal' business model is a fiction; only company business objectives are important. Nevertheless, commonality of business objectives exists and the cooperation of rail companies is based on this. It is obvious that compatibility on a performance level and technical interoperability are important for the key activity: transport. The approach of INESS is to analyse and apply life-cycle cost reduction factors of supply, implementation and migration. It seems that a pure win-win process needs to be redefined: what is 'win' and what is 'lose' from the perspective of both rail companies and suppliers?

With increasing competition from Asia and Russia, can you describe the impact that INESS has had on the competitiveness of European signalling infrastructure and systems?

The International Union of Railways (UIC) is running two international projects where signalling and the INESS topics are the main focus: 'International Train Control and Control-Command and Signalling' and the 'Global Signalling Project'. Both projects are making a large impact at the international level. The first is federating knowledge and enabling the exchange of information and experience. The second has the objective to provide convergence on a functional level between different signalling systems in a globalised context.

The rail sector is moving in the same direction of convergent functionality and performance. Differences will exist on the use of technology (eg. in the U.S., satellite positioning instead of balises) and on migration strategies, which are strongly dependent on cultural and technically inherited conditions. INESS and European know-how have an important role to play.

Can you summarise the tangible progress made by the project in the past year?

During the last year INESS has clarified its objectives and has pragmatically defined the expected achievements. We have worked to maximise the probability that, in a complex research process, all expected objectives will be achieved.

What have you learned from coordinating the INESS project?

INESS is, after ETCS, the most important project in the domain of signalling and train control in Europe. The very large scale of this integrated project was challenging with respect to clarity of objectives and the pragmatic, realistic definition of detailed achievements. Making all these clarifications and concretisations once the project had begun was advantageous, and offers a good lesson: think and measure twice and cut once.

Are there aspects of ERTMS that could benefit from your approach, and will you be looking to develop a new project or extend the lifespan of INESS?

The need to demonstrate what has been conceived in INESS will be essential to increase confidence and provide the proof-of-concept on various aspects within the technical, economic and operational domains. At the same time, INESS shall be integrated in the general context of the ERTMS/ETCS evolution and deployment, whereas integrated testing methodologies shall be conceived to accelerate the rollout of the technology.

The use of new technologies such as IT and satellite navigation for rail may also be integrated in the railways of tomorrow. All of these ideas provide objectives for future work within the European context.

Hassle-free train travel

INESS is contributing to efforts to update and standardise rail systems across Europe, which will lead to safer, faster and cheaper travel for all

ACROSS EUROPE, TRAIN speed and signalling are controlled in more than 20 different ways. This makes trans-European train travel complicated and potentially dangerous. For example, Thalys trains have to carry seven different signalling and speed control and radio communication systems just to travel the 200 miles from Paris to Brussels.

These technical barriers are hampering the development of rail transport throughout Europe with respect to both business and safety. In order to address these incompatibilities, the European Rail Traffic Management System (ERTMS) project was conceived to create a unique signalling and communication standard throughout Europe.

BETTER RAIL TRAFFIC MANAGEMENT

ERTMS is a major European industrial project with two main focuses: Global System for Mobile Communications-Railway (GSM-R) and European Train Control Systems (ETCS). GSM-R is a radio system for voice and data communication between train and railway control centres and is being developed as part of ETCS. The main aim of ETCS is to remedy the lack of standardisation in signalling and train control systems. These two elements of ERTMS also constitute one of the major obstacles to the development of international rail traffic.

Together, GSM-R and ETCS form the technical platform of ERTMS, the new train signalling and traffic management system for Europe, which already (to a certain extent) enables interoperability throughout the European rail network.

SIGNALLING SYSTEMS

Signalling systems come in all shapes and guises because they are generally derived from developments carried out within the borders of individual countries, meaning there is little overlap in terms of operational rules or the signals that train drivers are required to observe. Often, the signalling and control systems themselves have also been designed 'in-house' within individual countries.

In addition to these barriers to Europe-wide standardisation, there are new problems being caused by the implementation of ETCS. For example, the individual manufacturers' solutions to ETCS can vary considerably and many of the implementations of ETCS reflect particular national railways or manufacturers' preferences, instead of representing a single set of interoperable products, sub-systems and systems.

There are various different implementations of ETCS ranging from the most basic, level 0 (an ETCS vehicle being used on a non-ETCS route) to full implementation, level 3 (beyond pure train protection functionality to full radio-based train spacing). George Barbu, from the International Union of Railways, explains some of the challenges inherent to these levels: "ETCS level 1 can be overlaid on any existing interlocking; there is no 'hindrance' to applying ETCS level 1". He continues: "In the level 2 implementations, the use of track-side signals might be cancelled and this may simplify the interlocking architecture but shall add an 'intimate' integration of interlocking information with the radio block centre (RBC). Therefore there is a priority to standardise the interface between interlock equipment (IXL) and RBC".

At ETCS level 2, the essential functions of the new IXL will remain the same as they are now: train routing, protection of routes and utilisation of information on train space-speed relationships. The only change is the 'quality' of the IXL architecture which will move from 'physical' signalling to 'information' signalling.

One important point is that ETCS level 3 is not yet clearly specified. ETCS project members have still not fully analysed train integrity, train spacing on 'virtual' blocks, 'moving block' strategies related to braking and train dynamic behaviours, reveals Barbu: "The rail and industry community is working on these specifications".

INTEGRATED SIGNALLING

From the background of ETCS and ETRMS was born the 'Integrated European Signalling System for Railways' (INESS), an ambitious project attempting to solve these various differences and challenges in a way that will benefit both railways and manufacturers.

Some of the potential outcomes of INESS include specifications for a new generation of interlocking systems which will extend and enhance the standardisation process in line

with ETCS; more cost-effective procurements of signalling systems, particularly where ETCS is concerned; better ways for railways and suppliers to communicate their needs and requirements in a cost-effective and acceptably safe manner; and greater portability of signalling products between different market places.

The INESS project began in October 2008 and is near the end of its three-and-a-half year lifespan. In total, 30 partners including railway infrastructure managers, industrial companies and universities have taken part in the project.

The European Commission has invested approximately €10 million in INESS and seeks a return on their investment: the results of INESS have to be demonstrated and applicable to European countries. The EC investors will be pleased to know then that many of INESS's initial objectives have been met. There is now:

- An extended kernel of common interlocking requirements
- An INESS reference architecture and specification of interfaces to the RBC, to the other IXL, to the traffic control layer and to the track ETCS devices – this forms the 'INESS concept'
- A series of tools and utilities which may reduce the cost and accelerate INESS applications and commissioning

The project team are now in one of the last phases: implementation.

DATA HARMONISATION

One of the perhaps less-heralded successes of the INESS project has been in data file and flow harmonisation, reveals Barbu: "INESS applies a unique data format and flow specified by the user, addressable to any supplier who has adopted the INESS concept". This unique 'tendering specification' shall mean that rail companies avoid addressing each supplier differently.

Barbu clarifies the INESS data harmonisation concept in more detail: "INESS is, at this stage, only a concept: to define a commonly endorsed functional, technical, workable and implementable complex framework". Its success will be gauged by the applicability of the INESS concept within business constraints. So INESS must represent a strong but flexible architecture which may be adapted to changing business objectives and strategies.

> INESS is a unique chance for railways and industry to conceive together the future of interlocking technology

TESTING AND SAFETY

Another important area of the INESS project is safety: "How safe is safe enough is an old question – it has had no response and will have no response," says Barbu. But by testing, verification, validation and certification of INESS systems, the team should ensure their products' safety.

Whilst this process is normally very expensive, Barbu explains how they are cutting costs whilst maintaining safety: "I can say that tools and techniques to verify *in vitro*, so to speak, as much as possible from the intended application, are important to reduce costs and accelerate the time to exploitation. But I would like to compare the process with the certification of medicaments, and the proof of evidence in real life cannot be skipped, but only made simpler and more targeted".

BETTER TRANSPORT IN EUROPE

Barbu envisages INESS as a unique chance for railways and industry to conceive together the future of interlocking technology. It is intended to be beneficial in terms of both business and safety; a win-win process. Moreover, INESS will serve in the capacity of a cooperation framework through which normal rail business will work.

The idea is that corporate competition will be based on the project's understandings and 'rules' established during the project lifespan. "We hope that these considerations shall be followed and INESS will win through," says Barbu. "Only those who believe in the victory can win!"

INTELLIGENCE

INESS

INTEGRATED EUROPEAN SIGNALLING SYSTEM FOR RAILWAYS

OBJECTIVES

To define and develop specifications for a new generation of interlocking systems, and apply methods and tools capable of reducing LCC and enhancing the standardisation process. In the context of current European policies, it is expected to foster migrations of signalling equipment and support the rollout of ERTMS. This has afforded the opportunity to harmonise the functions, architectures, interfaces and connections of the interlocking as a constituent of signalling involved in ERTMS.

PARTNERS

BBR; DB Netz AG; Funkwerk IT; RWTH Aachen; Scheidt & Bachmann; Siemens AG; DLR; Thales; TUBS, Germany

Bombardier Transportation RCS; Invensys; Network Rail; Railsafe Consulting Ltd; University of Southampton; University of York, UK

Ansaldo STS; Mermec; RFI, Italy

UIC; Alma Consulting Group, France

ADIF; Nucleo; TIFSA; UPM, Spain

Eindhoven University of Technology; ProRail B.V, The Netherlands

Alstom; UNIFE, Belgium

AZD, Czech Republic

Trafikverket, Sweden

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INtegrated European Signalling System