A framework for testbed concept in railway

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Introduction

The Swedish deregulated railway is composed of several different stakeholders, with individual objectives and strategies to manage, operate, and maintain their assets. Simultaneously, the development of the railway system is highly dependent on collaborative processes and tools, which facilitate implementation of innovations in the overall asset management. When the OECD evaluates Sweden's politics regarding innovation, the conclusions from a SWOT-analysis states that one of nine threats to the Swedish competitiveness is difficulties in transferring technology between research and industry [1]. One major prerequisite for an effective implementation and innovation process is the enablement of a collaborative environment.

To achieve smooth implementation of new research and innovation, the railway stakeholders, need to develop means for testing of new technology and innovative solutions. To achieve this, Luleå Railway Research center (JVTC) at Luleå University of Technology (LTU) have developed a framework called 'Railway 4.0', with a corresponding testbed called 'Testbed Railway'. The framework and the testbed aim to facilitate establishment of a digitalised railway and enable enhanced decision-making through big data analytics. Testbed Railway is a platform aimed for transparent and replicable testing, validation and verification of of scientific theories, development of computing tools (hardware and software), and new technologies. Hence, this poster describes the constitution and materialization of the 'Testbed Railway'.

Experimental work

A project called ePilot (2013-present), aiming at facilitating development and innovation in railway, has established a generic concept for a testbed. During the project, various measurement equipment have been tested and information from operators, infrastructure managers and vehicles has been collected, to be analysed and tools for decision-making in operation and maintenance has been developed.

Examples of measuring equipment and data sources connected to Testbed Railway:

- The JVTC Research Station in Sävast measures forces exerted by vehicles on the track.
- The Wheel Profile Measurement Station in Sunderbyn fires laser-based units to measure the wheel profiles of trains at operational speed.
- Information is combined with RFID readings of the wagon identity to enable wheel maintenance optimization on an individual wheel level (figure 1).
- Track Logger is a portable logger that can be installed on any railway vehicle and that scans the rail for imperfections by using accelerometers on axle bearings (provided by Damill AB).
- Trafikverket's wayside detectors for monitoring of passing vehicles.

The Railway Cloud, provided by the eMaintenance LAB at LTU, is a platform that enables tools, data, and information aimed for Big Data Analytics related to railway system. This platform has connected the mentioned data sources (figure 2) and provide railway research projects with context-adapted services.

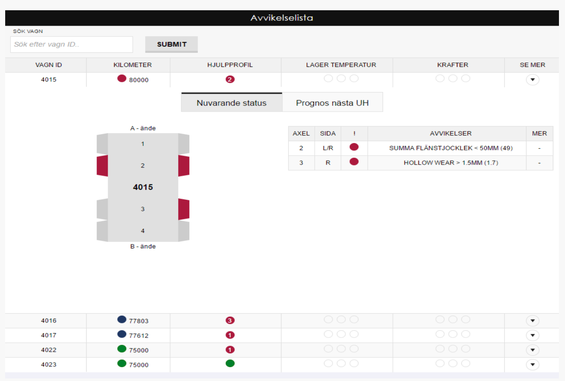

Figure 1: A tool for maintenance optimization on an individual wheel level.

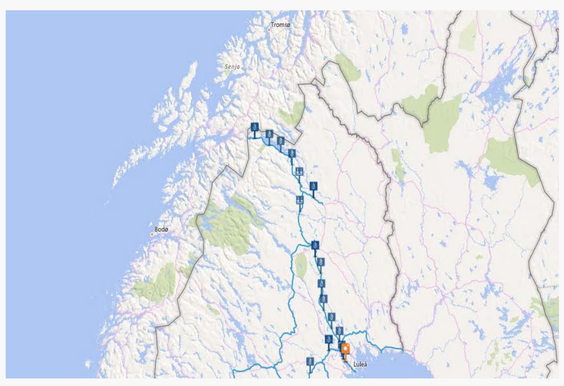

Figure 2: Data sources connected to the Railway Cloud and Testbed Railway.

Results

Due to the experiments performed in ePilot, a framework and a testbed, aimed at facilitating a digitalised railway through testing of new technologies and innovative solutions has been established.

Railway 4.0 is the overarching framework that is designed to facilitate the choice of concepts, approaches, technologies and methodologies aimed at the development of the railway system, (see figure 3). Further, Railway 4.0 focuses on disseminating the experience and knowledge to involved stakeholders. Railway 4.0 provides the railway industry enhanced opportunities to collaborate, cooperate, test, and implement relevant research and development results in the areas of digitalised railway and eMaintenance. This in turn contributes to improved robustness and capacity of the railway transport systems, as well as increased cost efficiency of operation and maintenance.

The 'Testbed Railway' facilitates continuous online real-time condition monitoring of railway infrastructure and rolling stock in real time using state of the art technology. Today, the testbed covers two main lines, i.e. Malmbanan (the Swedish Iron ore line) and Haparandabanan (Haparanda line). These two lines are instrumented so that both infrastructure and the rolling stock can be monitored online and in real-time. The monitoring data is used for maintenance analytics, i.e. descriptive, diagnostics, prognostics, and prescriptive maintenance. In addition to included technologies, the testbed is supported by an organization (currently within the ePilot project) that manages administration, projects, education and communication.

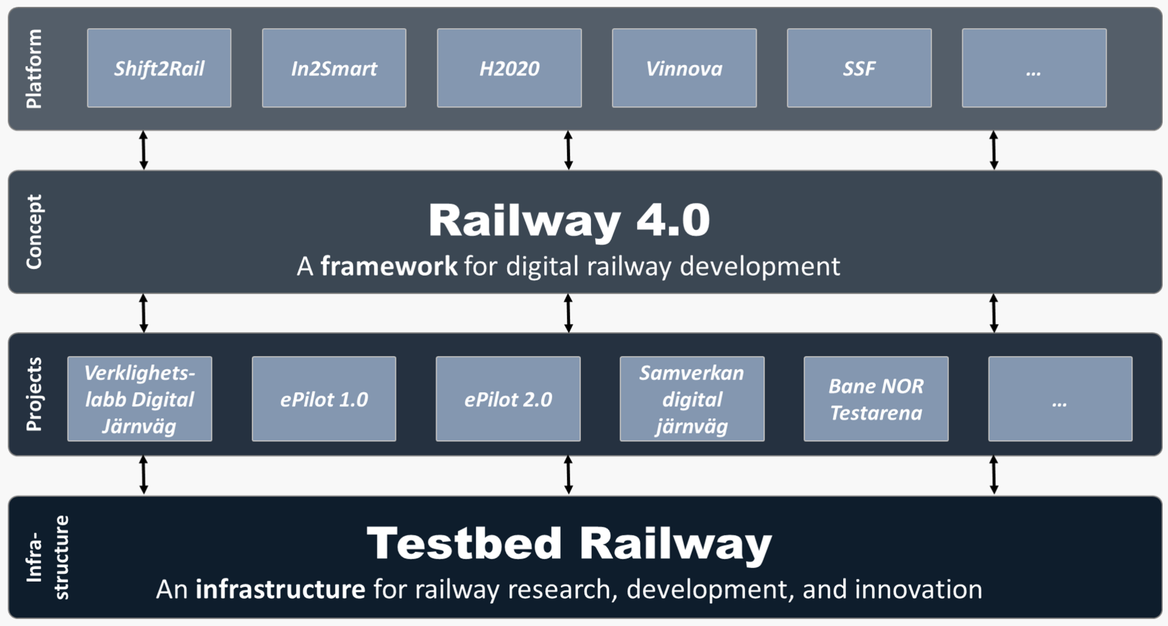

Figure 3: A visualisation of Railway 4.0 and Testbed Railway.

Conclusions

It can be concluded that one major prerequisite for an effective implementation and innovation process is the enablement and provision of a collaborative environment. A common area for multi-organisational collaboration together with a technology platform, enabling data sharing and Big Data Analytics, has been developed called 'Testbed Railway' with a corresponding framework 'Railway 4.0'. Testbed Railway can be used to strengthen the railway industry's adaptability and competitiveness by developing and providing a testbed for research and innovation in the rail industry, nationally and internationally. Further research will address issues like maintenance analytics, deep learning, machine learning, data sharing, data quality, information security and change management.

References

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