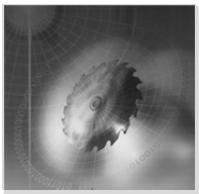

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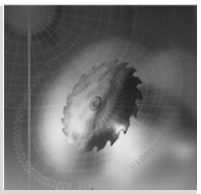

27th International Congress of Condition Monitoring and Diagnostic Engineering

Implementation of eMaintenance concept within the Swedish railway

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ABSTRACT

An available, reliable and well-maintained railway is the foundation for competition and market growth. Demands for high standards concerning reliable rail transport, tight turnaround times and high utilization of resources (machines, workshops, staff) allows for a minimum disturbance in the system, which could quickly disrupt the entire process resulting in lost capacity, delays and reduced quality to customers. The Swedish railway, after deregulation, in composed of several different parties, each one with individually objectives and strategy in maintaining their assets and rolling stock. Although some data is shared throughout the railway system, no greater sharing of operation and maintenance data exists, which creates the risk of sub-optimisation.

Luleå Railway Research Center (JVTC), since 2005, has continously conducted research in eMaintenance with the aim of using different types of condition data to develop decision support using preventive measures to reduce or prevent disruption of the railway system in a cost effective manner. eMaintenance aims to perform and control maintenance with help of condition data and is an interdisciplinary field based on information and communication technology (ICT) to ensure that maintenance is carried out in accordance to both the customer and the supplier's business goals and intrinsic components in all parts of a system's life cycle.

The eMaintenance concept has developed progressively over the years and now has been accepted for implementation as a pilot project called ePilot119. This is in the northern part of Sweden on track section 119 between Luleå and Boden. ePilot119 delivers a collaboration platform for the development of needs and requirements from various stakeholders to find solutions that enable and transform the Swedish fragmented rail industry to an integrated system. The goal of ePilot 119 is to demonstrate the advantages of working with information technology and data in real time to control railway traffic and service. The approach is based on enhanced collaboration methodology with a framework project and a central team that is unifying for finding smaller sub-projects for transform ePilot119 to a common natural process for sharing maintenance decision support for the railway. The pilot project aims to demonstrate that higher availability, enhanced capacity and a cost efficient railway operation can be created by using the information that is avaliable in the eMaintenance lab when used correctly. The goal, strategy and the methodology is to implement a natural approach to section 119 and then successively implement it in other sections of track in Sweden.

Keywords: eMaintenance, ICT, common condition data, railway

1. Introduction

The Luleå Railway Research Center (JVTC) has, since 2005, been involved in and conducted research in eMaintenance with the aim of utilizing different types of condition data to develop decision support using preventive measures to prevent disruption of the railway system in a cost effective manner. eMaintenance has been active in implementing the pilot project called ePilot119.

1.1 The eMaintenance concept and the eMaintenance Lab

There have been many attempts to define eMaintenance. Crespo-Marques and Iung [1] defines eMaintenance as "maintenance support which includes the resources, services and management necessary to enable proactive decision process execution. This support includes e-technologies (i.e. ICT, Web-based, tetherfree, wireless, infotronics technologies) but also, eMaintenance activities (operations or processes) such as e-monitoring, e-diagnosis, e-prognosis". Today there are five different views:

- A maintenance strategy, where tasks are managed electronically using real-time analysis [2]
- Support system to execute a proactive maintenance decision-process [3]
- A predictive maintenance system that provides monitoring and predictive prognostic functions [4], [5]
- A model enhancing maintenance efficiency [6]
- eMaintenance is a technological approach: Here, e-Maintenance is considered to be the integration of all necessary ICT-based tools for the optimization of costs and improvement of productivity through utilization of Web services [6]

However, eMaintenance addresses new needs and provides various benefits in form of increased availability, reduced lifecycle cost and increased customer value (Kajko-Mattson et al, 2011)
The eMaintenance Lab has been developed by a research team at Luleå University of Technology and is a platform for efficient decision making in maintenance. It provides a cloud based, one-stop-shop for data analysis, which aids research projects and maintenance practices. The eMaintenace Railway Cloud includes:

- a process for gathering information about remaining useful life, dynamic maintenance program, performance measurements, maintenance support and planning
- services, such as, wheel query, force data analysis, context adaption and data fusion
- data collected from Luleå Railway research station, Trafikverkets wheel impact detector and LKAB and Trafikverkets wheel profile detector

It will also in short add measurement data of track quality, failure statistics and inspection data.

1.2 ePilot119

The pilot project ePilot119 is a three years duration projects sponsored by Trafikverket (Swedish Transport Administration). It will be conducted on the railway section between Boden and Luleå on the Iron Ore Line, see Figure 1.

Figure 1. The Iron Ore Line

It invites (whom also has signed a letter of intent) all parties involved in the operation and maintenance of the section, i.e. infrastructure manager, traffic operators, maintenance contractors for vehicles and infrastructure, suppliers and consultants. The Railway Research Center (JVTC) at Luleå University of Technology will act as a facilitator and provide the platform and the Railway cloud.

The objective is to improve the transport system so it can contribute to higher availability, increased capacity and cost efficient railway operation by implementing results from research and development project, using an holistic approach, an open collaboration amongst all parties involved and a common desire for reaching the overarching objectives i.e.:

- Fewer and shorter interruptions
- Improved availability
- More effective and efficient maintenance
- Improved quality

Gradually the project will be extended to cover other track sections.

1.3 Section 119

Section 119 between Boden and Luleå is 34 km long single track with six meeting stations, 2 of those allow passenger exchange. The traffic consists of mixed traffic i.e. both passenger and freight traffic, and has an annual volume corresponding to approximately 23 MGT. On average about 50 trains pass the section, each day, including ore trains with an axle load of 30 tonnes, freight trains with axle loads of 22.5 – 25 tonnes and passenger trains. The speed varies from 50 km/h for loaded ore trains up to 140 km/h for the passenger trains. There are several parties involved in operation and maintenance of the system, see Figure 2.
These parties have different requirements for collecting data for maintenance decision support. The infrastructure manager needs information about how the section is operated in terms of amount of trains and axles, train speed and actual axle load, vehicle characteristics, but also data about asset condition and the degradation rate. The traffic operator needs condition monitoring information, e.g. trend data for wheel degradation.

The maintenance contractor's need data on asset condition, amount of traffic, type of vehicles, amount of train kilometres and the supplier wants to know where the asset/component is installed how it is used and what kind of failures that has occurred.

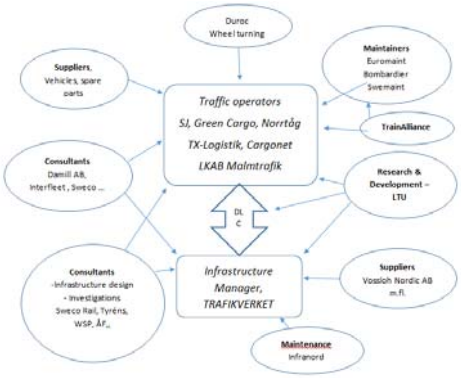

Figure 2. Railway Parties [7]

2. Approach

To enable the project to be successful it requires active participation, accountability, transparency about its operations, economic preconditions and that stakeholders and parties involved help each other to make good decisions This has been done by forming a consortium consisting of a central steering committee, a staff, a Central Project Team (CPT), a reference group and a number of sub-projects, see Figure 3. The tasks for the sub-projects and their sub-project-leader are to drive the improvement work and implement the results amongst appropriate parties in the railway system. The staff inculdes personnel with information and communcation skills.

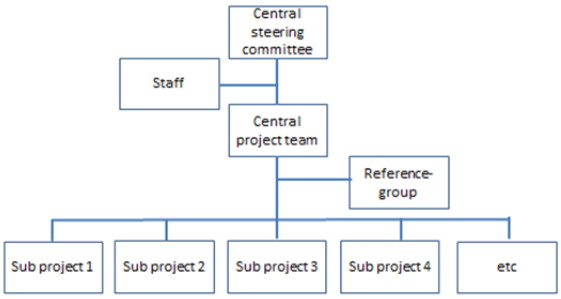

Figure 3. ePilot119 organization

CPT is a neutral and objective team that acts as a facilitator and provides the opportunities for using and developing new applications for eMaintenance decision support. The team works process oriented to create an industry wide decision support, based on condition data and implement the results of ordinary activities, educate, raise knowledge and disseminate the results of operations, in Sweden and in the world. The objective is that at least two successful sub-projects could be implemented in other parts of the rail industry.

Before starting two minor sub-project were conducted. The first one aimed to describe the baseline i.e. the initial situation (in both hard and soft parameters), i.e. what were the conditions when ePilot119 started. The goal was to describe the initial situation so clearly that it can be used in other sub-projects to measure improvements in the operation and maintenance of /on track section 119 and also deliver a questionnaire with key indicators by which it becomes possible to measure the change relative to baseline.

The second subproject was aimed to find the hindrance and the pitfalls which can cause that a new product, method or innovation not can be implemented.

3. Results

The project started with a kick-off. All parties were invited. The agenda included a short description of the project, a presentation of the section (asset, traffic, problem areas, and available maintenance system), a presentation of eMaintenance and the objectives and the organization. A major part of the agenda was a workshop with the objective to find low hanging fruits for improvement i.e. project with high priority to be solved, with high potential to be successfully implemented and with short pay-off time.

The results from the baseline project confirmed that the parties and stakeholders welcomed this project and had high expectations of the benefits of an open collaboration, sharing data and building up an advanced and integrated platform for utilization of advanced information technologies. The second project revealed some hindrance for implementation. These were mostly related to internal agreements amongst different parties, making it unclear who's responsible for the maintenance activities or lack of incentives or demands.

Another issue that created some delay at the beginning, concerned how to handle the background, progress and solutions of the subprojcets i.e. who will be owner of data, demonstrator and the results. A special process manual, a guidance for was immaterial properties solved this problem. ePilot119 has so far resulted in 14 sub-projects of which 3 started within 2 month. These projects focused both on solving problems for train operators, infrastructure managers, maintenance contractors and suppliers.

A minimum requirement for starting the project is that there should at least be three parties involved. In the initial phase for two of the projects it became clear that many of the railway parties had slimmed and tight organisaitions which decreased their opportunities to act as project leader. This was solved by providing resources for the project administration from the central project team.

4. Discussion and Conclusions

The Swedish railway sector was deregulated in the end of 1990 and the beginning of 2000 ending up in a vertical organistion containing of infrastructure managers, traffic operators, real estate managers and suppliers of trains. The collaboration between the parties involved are regulated in contracts (see Figure 4), often without incentive and some time without objectives to to deliver available and safe railway transports.

This became very visible during the harsh winter in 2010 when the railway system in Sweden collapsed during the months of January to March. It became clear that there is a need for more collaboration, exchange of information and data and implementation of new platforms for meetings.

This was confirmed by the baseline project that showed the high expectations on ePilot119 to provide an industry-

common approach to improve operation and maintenance of the railway system.

Since the railway is a system where all subsystems (track, vehicles, etc.) must work together even if subsystems are owned by different parties, it is important that maintenance data to provide important information for correct maintenance decisions are collected, analyzed and delivered back in the right format to the right recipient. eMaintenance offers such a platform. Further research remains to convert the current manintenance data into correct data for maintenance decision.

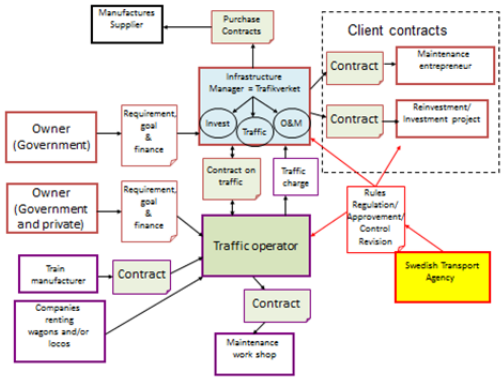

Figure 4. The Organisation of the Swedish Railway.

Acknowledgements

We would like to thank Trafikverket (Swedish Transportation Administration) for their financial support of this project as well as the participating railway organisations and companier

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