Aalto University

LUT Lappeenranta University of Technology

MFG 4.0

Make Maintenance Better

Notes on Operations Research Afternoon

@Aalto 4th Sep 2018

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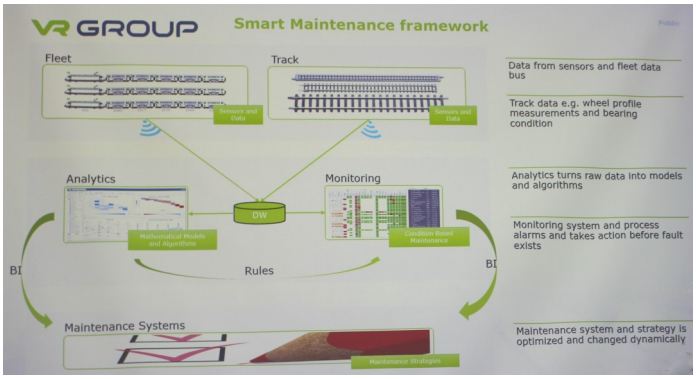
The rise of "Big Data analytics" changes the implementation of industrial maintenance. The first OR Afternoon on maintenance optimization and management Aalto University together with industry partners and researchers from Aalto and Lappeenranta University of Technology (LUT). The event was organized by Aalto Centre for Operations Research and it was a part of Manufacturing 4.0 –project funded by the Academy of Finland. The industry presentations showed that there is an on-going demand for data-driven applications in the maintenance activities. **Pekka Mild** from Maintpartner introduced their commercial data-application, which analyses the signal data from industrial processes. The idea is in dynamic comparison of signals (and their relationships) focusing on the observed abnormal behavior, which may indicate faulty operation.

Pekka Mild (Maintpartner Oy)



Smart Maintenance framework from Mikko Alanko's presentation

Mikko Alanko from VR (national railroad company in Finland) discussed some of the recent developments in railway car maintenance. The amount of sensor data gathered from railways is increasing and there is an on-going shift from time-based maintenance to condition-based maintenance. Due to the safety considerations, however, the absolute amount of condition-based maintenance has some limitations. Another concern, according to Alanko, was the amount of redundant data collected, which has no evident implications to maintenance actions.

After having listened all the presentations of the day (including research-focused session in the morning with six presentations), would raise **two directions** regarding the development of maintenance management:

1) Applications related to maintenance and process data management with the use of machine learning methods and parallel computing (i.e. "Artificial Intelligence" in a narrow sense). **Olli Mali** from Kone noted that majority of the current AI-applications are still more or less (set of) functions, where some inputs x:s are fed into a computer resulting into y after going through set of functions (= algorithm). Although it may seem intelligent, there is seldom any 'human-like' reasoning behind the two magical letters of AI. That is, as mentioned also by Pekka Mild, there is still a constant demand for human expertise when it comes to the interpretation of observed signal deviations. I would add also that there is an (almost) untapped resource of text data provided by the operators which could be taken into use by advanced text analytics methods.

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2) System based view on maintenance connecting maintenance activities with overall cost-benefit analysis and spare parts logistics. **Alessandro Mancuso** from system analytics laboratory (Aalto) proposed that the maintenance of industrial operations should be viewed as dynamic systems instead of focusing the analysis on the individual components. In other words, some faulty equipment per se may not pose a risk for the overall system, but its significance changes as a function of the other process equipment as well. For example, if you have two bicycles at home, which you use for commuting, then having one inflated tire in the morning is not critical to (your process of) bicycling to workplace.

Professor **Mikael Collan** **(see presentation here)**

Regarding the logistics side of maintenance, Professor **Mikael Collan** from LUT presented a future scenario on what might happen if 3D-printing technology evolves to a point, where spare parts can be increasingly printed "on the spot". He suggested that the role of traditional logistics providers and spare parts manufacturers diminish creating business opportunities for new types of digital platforms controlling the "recipes" of 3D-printed spare parts and distributing them (via 3D-printers) to operators of industrial operators. Here, I believe system approach is required to demonstrate the benefits of the logistics chain as a whole for both the industry and academia.

These above mentioned two points have some interesting implications to academic and industrial practices. First, developing new, improved methods for individual component analysis is rather a rather clear way to make a scientific contribution: if you can improve the old calculation method's efficiency by, say, 5% then it's a scientific contribution. However, from the practical point of view, system based models for maintenance would be welcome despite their lower scientific recognition. Why? Because their implications generally contribute to the practice in a way, that every CEO understands: the money. In the academia "publish or perish" -principle still holds drawing researchers attention to methodological details.

I think these types of seminars bring out the "big picture". This possibly helps to bridge the gap between theory and practice creating a win-win situation for both the academics as well as for the Finnish companies.

More about MFG 4.0 Project