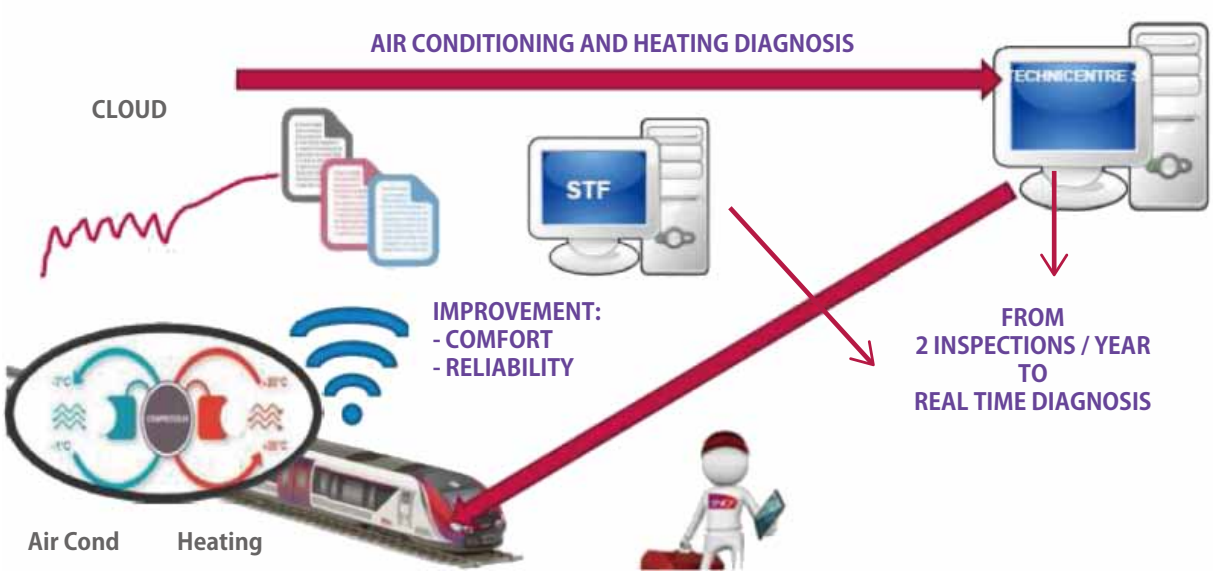
Digitalization in Maintenance at SNCF



Real time automated monitoring

Mr. Valéry Versailles
Head of department
Railway System Innovation & Research
SNCF

Railway is an old industry that has continuously improved for more than 100 Years. High level research have been conducted and are still underway as seen during last WCRR in 2016 in Milan and as we will for sure see at the next WCRR in 2019 in Tokyo. After all, there are still huge challenges to be addressed due to traffic congestion, climate changes and resources scarcity. Recent improvements in digital technologies allow now to make not only additional basic improvements but to be a game changer in the way railway systems are built, operated and maintained. At SNCF, one of our current concerns is to take the opportunity of digital technologies to drastically improve the maintenance of the assets, i.e. rolling stock, infrastructure and stations.

The challenges for the French railway maintenance can be summed up in three points:

- Permanently guarantee a very high level of safety and service for travellers
- Guaranty the availability of the assets in daily operations
- Pursue the endless quest for productivity, given the rail industry has intrinsically high fixed production costs.

We are now able to address these challenges thanks to recent and on-going developments of digital technologies such as Internet of Things, Artificial Intelligence, Machine Learning, Augmented Reality, Big Data, Cloud Based Technologies, Automation and Robotics, Digital Twins, GPS, RFID.

Here is how SNCF create value thanks to those technologies:

First, SNCF has integrated predictive maintenance in its process of digital transformation. The approach consists in collecting data of assets thanks for instance to IoT, drones, or satellites and makes a smart analysis of them to set up an alert system to prevent failures. Moreover, predictive maintenance aims to automate these tasks in order to have a real time precise and complete vision of the state of the assets. By using machine learning, the system is trained to learn trains, infrastructure or stations failures scenarios by crossing various types of data.

On a daily basis, SNCF performs real-time remote and automated diagnosis on various rolling stock types. As an example, the monitoring of doors and HVAC (Heat, Air Ventilation, and Cooling), with suppression of systematic maintenance, is now field-proven. Sensor data can help reducing the number and duration of rolling stock inspection.

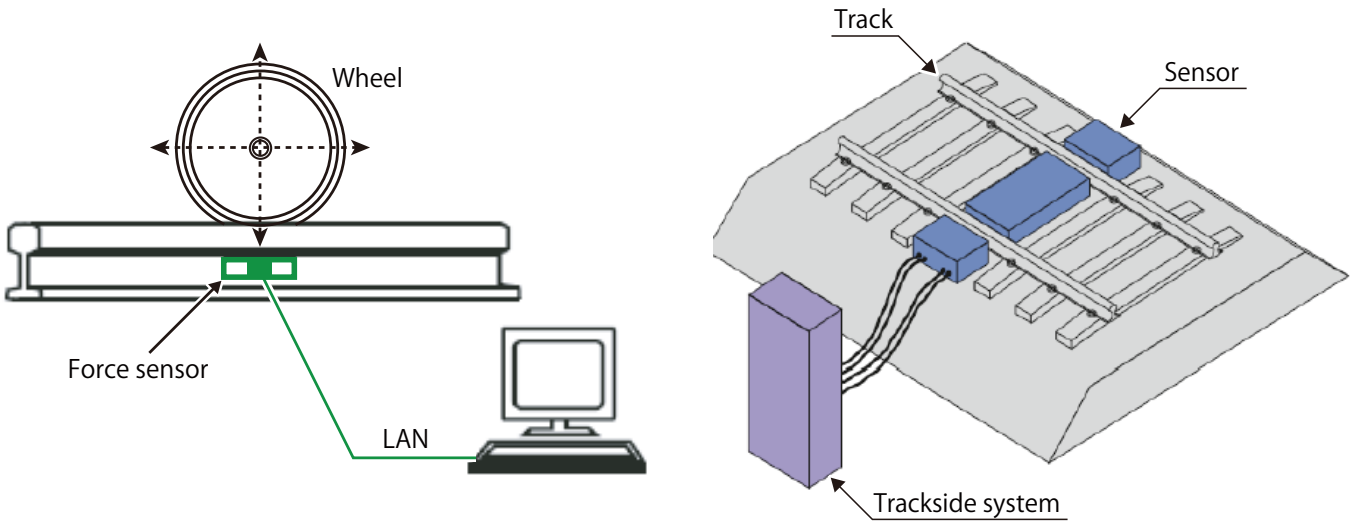
Additionally, the recent integration of few Way-side Train Monitoring Systems enabled gathering data concerning the rolling stock circulating on specific localisation of the railway network. Each time a train circulate through these systems, related forces and solicitation are gathered and stored in a dedicated database. The data gathered mainly concern the loadings, the speed and the balance of the weight (Left/Right and Front/Back) along each train.

A track monitoring system based on "light" sensors installed on commercial trains allows a daily continuous monitoring of track defaults and their evolution with short time-gap. Part of the post-processing is done on-board and the data are transmitted thanks to a 3G connection between the on-board system and a dedicated server. The multiplicity of data gives robustness, an adapted post-processing gives the benefit of the system.

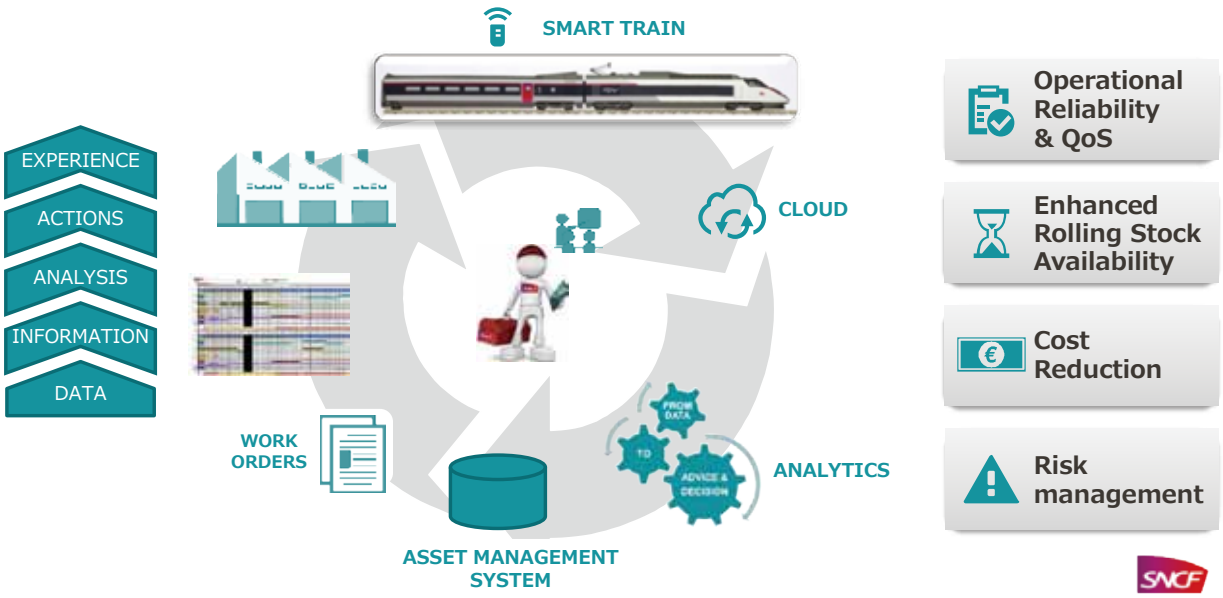
Our rolling stock automated diagnosis system prescribes the most probable troubleshooting tasks, and for newer rolling stock an automated validation of maintenance status replaces manual work. This automated test is also launched after repair, in order to check the system's status.

We are currently moving from digital maintenance to digital operations: Rolling stock fleet status is already deployed and running in some of our fleet supervision centres. For the railway network, four supervision centres manage the alarm received from sensors installed on more than 3000 km of line.

Standard consumer products as smartphones and tablets also play a major role in the digitalization of the maintenance. 90,000 employees of the company use them in their daily tasks. Thus the maintenance staff has a quick access to digitalized maintenance documents, has a direct connexion with the components manufacturers or internal experts hotlines and can make real time records. Of course the customers are also connected and this is an additional opportunity. An App has been developed to allow the customers to send an alert in case of stations equipment failure thanks to a QR code flashing. This allows the teams in charge of the station equipment maintenance to get



Schematic representation of WTMS systems



A vision for the future, starting yesterday

the information quickly and carry out the necessary repair.

Train depots are now organized as Factories of the future. Drones are used to inspect the top of the trains, technicians have real time assistance from experts thanks to glasses with augmented reality and cameras, 3D printing is used produce locally spare parts that are delivered to the technicians with autonomous vehicles.

One of the most recent projects developed at SNCF is Lidar. Thanks to sensors placed on the network monitoring trains, this technology allows to scan and map in 3D all the elements of the infrastructures (rails, catenary poles, signalling, structures, vegetation ...) with few millimetres accuracy. In one hour, Lidar is able to read on 50 kilometres of track when it takes normally six weeks. The tool improves agent's safety as it reduces their needs to go on the tracks. Thus, Lidar contributes to the traffic robustness and industrial maintenance performance.

Vibrato is part of the innovation that we developed at SNCF regarding infrastructures. This application uses the accelerometers and gyroscopes embedded on the driver tablets for real-time monitoring of vibrations occurring online in order to trigger earliest targeted maintenance works as soon as possible. Vibrato sends a geolocated file in real time towards a processing and operating platform. The data are then combined with those of the other trains. If an abnormal vibration is confirmed, a team is sent to inspect the track.

Digitalization is by no means an end itself and expertise still sits at the core of the solutions. Deploying digital solutions in an old industry like Railway transportation requires then several major changes in the management. First a lot of new skills are required, then an adapted recruitment program must be launched and appropriate training must be implemented for existing employees. The shift from standard preventive maintenance to predictive maintenance is a culture change that must be managed from the top to the bottom of the organization. Finally, the various solutions will have to be designed with the experts and end users so that they will be consider as a positive change.

Conclusion

The contributions of recent digital technologies developments to the field of maintenance are numerous and allow optimizing all aspects, from the detection of failures, to the achievement of maintenance. They even make it possible to act proactively over the product life cycle. The technology itself will not make those improvements and will only be an enabler. As for all the major changes that transformed the industry in the past decades, human will be a major factor to consider for a company that launches the digital transformation of its activity. This is of course true for the railway maintenance.