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# Predict the Unpredictable with PREDICTIVE MAINTENANCE 4.0

Predictive maintenance 4.0 is expected to drastically change the maintenance market. Besides the traditional reliability engineer we will begin to see new roles in the maintenance & asset management department: the data scientist.

**PDM 4.0** is seen increasing the predictability of the assets and the processes. Companies that apply PdM 4.0 will have a strategic advantage to their peers that steer away from PdM 4.0, a market study carried out by Mainnovation and PwC reveals.

– The potential benefits of PmD 4.0 are very high. If maintenance has the ability to predict "unpredictable failures" we can take a big step in competitiveness. On the other hand, there are some major challenges: PdM 4.0 requires a huge change. A lot of companies focus on the technical and technological change, but underestimate the organizational implementation, says Partner at Mainnovation **Peter Decaigny**.

PdM 4.0 requires a complete culture change: PdM 4.0 tools will have another position in the decision process. The tools will suggest the moment to stop an installation or to change process parameters. This has to be embedded in the daily operations.

The study that was executed between October 2016 and June 2017 was conducted in three countries: Belgium, Germany and the Netherlands. A total of 280 respondents submitted their answers.

– We have seen that many companies are ambitious when it comes to PdM 4.0; half of the companies we surveyed have plans to implement PdM 4.0, one in three wants to do so within the next five years. We have also seen that companies' current predictive maintenance capabilities are not yet at the level needed for PdM 4.0. We can conclude that significant efforts and resources will be needed to implement PdM 4.0, Decaigny says.

According to Decaigny, uptime improvement is the main reason why respondents have plans for PdM 4.0. Other important reasons relate to other traditional value drivers in maintenance and asset management such as cost reductions, lifetime extension for ageing assets and the reduction of safety, health, environment and quality risks. Respondents also identified a number of critical success factors for PdM 4.0 implementation. The availability of data was mentioned most often as a critical success factor, followed by technology, budget and culture.

– At this early stage in the PdM 4.0 lifecycle, companies still see considerable technical obstacles to its implementation. However, they recognize that PdM 4.0 implementation is not a purely technical challenge. Companies should also pay attention to organisational dimensions, and ensure the project management and change management skills needed for a successful PdM 4.0 implementation.

## Building data analytics capabilities

Success with PdM 4.0 will ultimately depend on skills and knowledge. The report shows that lack of skills or competencies in the company's workforce is the biggest challenge respondents see when it comes to using data analytics.

– We found that only 27% of our survey respondents currently employ reliability engineers in predictive mainte-

nance, and even fewer (8%) employ data scientists. Companies' biggest obstacle, thus, may be their ability to recruit the people needed to put PdM 4.0 in place.

Companies generally understand that it is critical to have in-house data analytics capabilities in order to successfully drive Industry 4.0 applications. Building these capabilities takes, however, far more than hiring new talent with PhD's in statistics, data science or AI.

– No matter how much talent companies bring on board, these talents will not be as effective as they could be without the right organisation and governance in place. Perhaps the most important aim of designing a PdM 4.0 governance structure is to create an environment in which data scientists and reliability engineers can interact and complement each other.

A good first step for companies considering how to best arrange their data analytics could be crossfunctional expert teams with reliability engineers, operators, process technologists, data scientists and IT specialists who together develop new ways of working and communicating. All such aspects of a PdM 4.0 implementation require a robust a digital culture.

– PdM 4.0 cannot be implemented in complete isolation within the maintenance organisation. It should be embedded into an overall digital manufacturing strategy that is owned and fully supported by top management.

## Who are the front-runners in PdM?

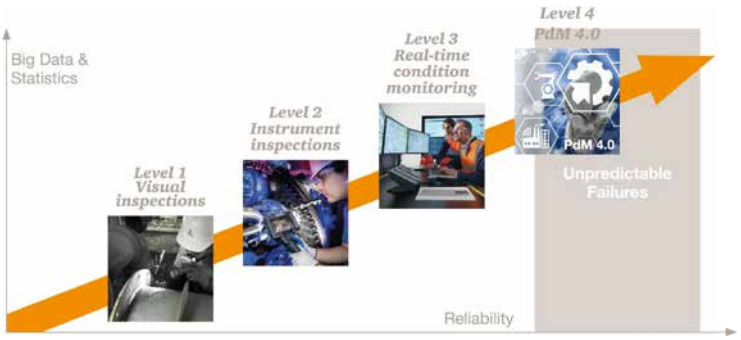
Companies with similar assets are further ahead in terms of predictive maintenance than companies with unique assets. This can be attributed to the fact that a base of similar assets provides a richer data set for advanced analytics.

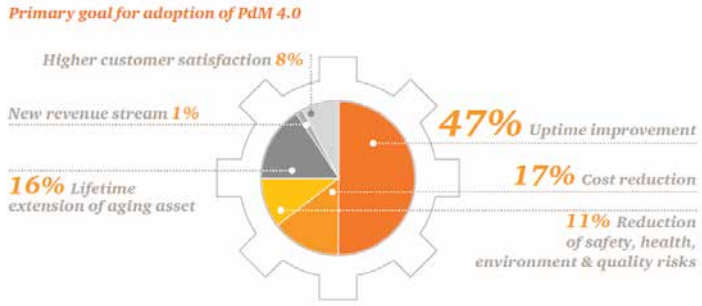
Looking across business sectors, the rail sector seems to be a front-runner in applying PdM 4.0: 42% of respondents in the rail sector are at level 4, compared to 11% overall. This confirms our perception of the rail sector as being innovative and sophisticated in the field of maintenance.

Comparing the three countries targeted in the survey, PdM 4.0 is more popular in Belgium (23%) than in the Netherlands (6%) and Germany (2%). Belgium is also considered a front-runner in real-time condition monitoring.

## CASE: Growing Pressure on Infrabel's Maintenance

Infrabel is the state-owned company responsible for Belgian rail infrastructure. Infrabel spends around a billion euros each year on the management, maintenance and development of rail infrastructure, which contains over 3,600 kilometres of railway lines, 86 signal boxes, 10,249 main signals and almost 12,000 civil infrastructure works like crossings, bridges and tunnels. Over 4,200 trains run on the Belgian railways each day, and the number of daily passengers has in-




***Why do companies want to adopt PdM 4.0?***
Knowing that almost one in three companies have ambitions to adopt PdM 4.0 in the coming years, it's worthwhile taking a closer look at what drives companies to implement PdM 4.0.

Respondents expect PdM 4.0 to contribute to further improvements in all 'traditional' value drivers in maintenance and asset management. Uptime improvement is clearly the most important in this regard, with almost half of the companies in our survey identifying it as their primary goal for implementing PdM 4.0.

creased by 50% since 2000, to 800,000.

Pressure to improve the safety and reliability of rail infrastructure has also increased for a number of reasons:

- Safety is of paramount importance. To improve safety for its employees, for example, Infrabel wants to reduce the number of visual inspections by maintenance crews walking along the tracks.
- The railway network is becoming increasingly strained. Not only due to an increase in passengers and freight trains, but also because new high-performance trains exert greater stress on the tracks. A busier schedule also means smaller windows of opportunity for maintenance. Planned downtime must be communicated to railway operators a couple of years in advance.
- The general public and governments are demanding safety and accuracy. Every incident is negative publicity for Infrabel and further increases pressure to prevent future incidents.
- In the coming years, Infrabel will be confronted by a wave of retirements and will have to find ways to replace the knowledge and experience it will be losing.
- There is a trade-off between safety and reliability. The installed base of smart assets needed to monitor and improve safety is accompanied by additional susceptibility to failures compared to the old dumb assets, and hence necessitates additional maintenance.

## Making dumb hardware smart

In response to these challenges, Infrabel has invested heavily in automating a number of maintenance processes. It has become exceptionally strong in developing innovative condition monitoring tools such as sophisticated measurement trains for inspecting tracks, railway ties and overhead lines; cameras mounted on overpasses to monitor the panthographs of passing trains; sensors for detecting overheating in shaft sleeves on passing trains; semi-automatic vehicles to check whether sign-post visibility meets the regulatory requirements; and meters to detect drifts in power consumption, which usually occur prior to mechanical failures in switches.

## Building organisational foundations

A number of organisational changes will be encountered when deploying smart condition monitoring tools. The once very fragmented maintenance organisation has been fused into larger units in order to reap synergy-related benefits. At Infrabel headquarters in Brussels, a central Data Cell has been created where increasing volumes of data generated by these tools are collected and analysed. A wide range of home-made IT applications for maintenance is being replaced by a single tool where data from various systems is integrated and standardized. A number of pilot projects to test predictive analytics in maintenance have been started, and Infrabel is currently recruiting data scientists to take its maintenance operations to the next level.

## On the eve of a new era in maintenance

By making these preparations, Infrabel has put itself in an excellent position for the large-scale application of data analytics in maintenance. Even though this implementation could face a few regulatory hurdles - stemming from strict safety requirements and current regulations that prescribe a minimum number of visual inspections per year, Infrabel is still expected to make progress in this area.

That would be a major step along the way of what Infrabel, describes as "a complete transformation of Infrabel into a digital enterprise in which 'basic' assets are replaced by smart assets that are integrated in an Internet of Things. This transformation enables Infrabel to become increasingly data-driven in its decision-making." ■