QVARTZ | ANALYTICS

Predictive maintenance an effective means to big savings

September 2017

Preface

Predictive maintenance has been around for 20 years, so it is by no means a new concept. However, factors such as lowered maintenance costs with reduced downtime and the rapid expansion of the Internet of Things (IoT) are expected to greatly increase the demand for predictive maintenance solutions and services[1]. Adding to this the immense development that has taken place within technology during the last couple of years, predictive maintenance is more relevant today than ever before, and consequently, more and more companies are investing in it.

In its simplest terms, predictive maintenance provides predictions of asset or component failure based on machine learning algorithms. These algorithms analyse the historical data patterns from various sensors embedded in and around the asset, along with relevant external parameters, e.g. weather and temperature. Predictive maintenance has demonstrated promising results including eliminating breakdowns by 35% to 45% – and reducing downtime by up to 75% across industries. Furthermore, it provides an opportunity to optimise planned maintenance by providing relevant insights, which can enable the maintenance staff to skip the regular maintenance cycle by utilising the predictions made by the machine learning algorithms.

Predictive maintenance requires preparation

Even though technical advances have made predictive maintenance more available than ever before, most companies are not sufficiently prepared to take full advantage of the technology and apply it to their own operations. Typically, two key aspects are missing:

- *First*, a clear understanding of scenarios where predictive maintenance will be useful and the potential cost savings must be in place. Predictive maintenance can enable you to predict the failure, but you will not get significant savings by avoiding the cost of spare parts required to repair the failure. The failure will in all likelihood still take place, however; the significant cost savings are realised by other means, e.g. reductions in unplanned downtime, which can have a far bigger impact on your operations.

- *Second*, it requires a certain level of maturity from the company: of having the necessary data stored and available in real-time. Without such maturity, there is no solid basis for building a reliable model for predicting when maintenance is needed. Just knowing that you have a sensor in your assets will not suffice; you need to ensure that you have the right quality and reliability of data – and that you can read your data, even if it is in a propriety data format from the original equipment manufacturer.

Beside the technology and data, you also need to address the adoption of technology and the new ways of working for your maintenance team.

Getting prepared and succeeding with predictive maintenance

With this perspective, QVARTZ aims to highlight that predictive maintenance is about more than mere technology. It is not just about the data and analytics, but more about the choices you make at various stages to maximise the value it can create for your business. In order to succeed with predictive maintenance, you need to go through the four steps described below. Each step is in itself essential – and all steps are equally important.

1 www.prnewswire.com/news-releases/predictive-maintenance-market-by-component-deployment-type-organization-size-vertical-and-region---global-forecast-to-2021-300427316.html

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STEP 1: Defining the purpose

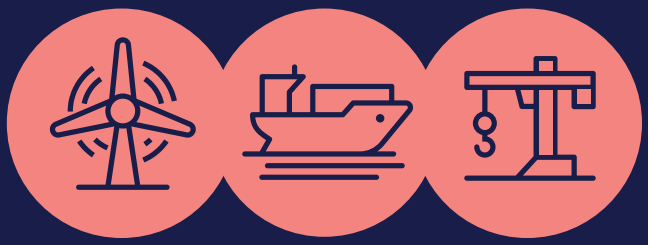
In order to ensure the success of a predictive maintenance project, a clear definition of the purpose is required. The purpose should be based on several aspects, determining the need and objective for the maintenance. We propose three overall aspects:

Preventive Maintenance

Condition based Monitoring

Predictive Maintenance

The need for predictive maintenance
Starting out, you must determine the need for predictive maintenance, i.e. is it at all relevant for your company? If your operations are asset-critical, this might call for predictive maintenance, however, you should also consider other aspects, e.g. high unplanned downtime for key assets, or high planned maintenance costs due to more frequent maintenance. Additionally, do consider if the downtime of the key assets really influences your operations. In some industries, such as drilling, the need for redundancy due to compliance will minimise the potential savings predictive maintenance can bring to your bottom line.



The prioritisation of assets in scope
Developing machine learning algorithms for every asset takes some time, and hence it is often beneficial to prioritise the sequence by which you will start applying predictive maintenance in your operations. Additionally, you need to make a choice on the scope of the predictive maintenance, i.e. will you address the breakdown of a complete asset or focus on a type of failure that is prominent across many key assets? In order to determine which asset/s to focus on, consider the cost of maintenance, level of criticality, total number of units in operations, etc. for each asset in order to determine where predictive maintenance will create the most value.

The components to focus on
Once you identify an asset you want to focus on, consider if you should focus on the failure of a specific component of the asset or you should focus on a specific failure that happens across many different assets. For example, during predictive maintenance of 2-stroke engines, we decided to focus on a type of failures which happen a lot more frequently (covering more than one component) instead of focusing on a specific component. This resulted in higher potential of savings and reduced downtime. However, these choices are not always obvious on the surface.

STEP 2: Securing the neccesary data

During machine learning, the most time-consuming, comprehensive and frustrating part is always the data cleaning and validation. However, this is a necessary step and it must not be neglected, because if the data is not good or reliable, neither will the model or the predictions be.

Examining the accessibility and quality of the data is an important part of this, i.e. determining whether or not the necessary data is available and in a proper condition to build a reliable model. More often than not, this is not the case, and this can stall a predictive maintenance project for more than a year, until enough sufficient data has been collected.

Some of the questions that need to be answered when determining the quality of the data are the following:

The accessibility of current data
Can I access my data? Is my data readable? Am I legally allowed to access it? Some components are created by manufacturers to store data, however, the data might not be available to the end-user, or be stored in a format that the end-user is not able to read. Other times, the end-user is not legally allowed to use the data. Many key assets out in the field are not always developed for today's big data and analytics age; hence, it is not uncommon that asset users do not have visibility in terms of readability of the data, legal access or proper understanding of what the sensor is actually capturing.

The quality of the data
After obtaining access to the data, one needs to check if the data is reliable and continuous. Is the quality good enough, and do we have enough data to build a model with the desired accuracy? Furthermore, it needs to be examined whether enough usable documentation for the data exists. As an example, while capturing the data for 4-stroke engines, the data seemed available on the surface, but when diving deep down to look for data availability for every single day of the last few years, many gaps of missing data came to the surface. As a result, only a limited amount of historical data could be utilised to train the models.

The need for external data
Finally, one should consider what other sources of data to include besides asset data: inventory reports, operational log, human resource data, weather reports, etc. A failure in an asset is not always influenced by the operations taking place inside the asset, but may also be heavily influenced by the conditions under which the asset is performing. As an example, if you have a key asset responsible for drilling, different types of external data besides the sensor data from the key asset – hereunder weather, non-drilling activities on the platform as well as the stages of drilling – can add additional valuable insights.

STEP 3: Choosing the right approach and the right provider

After securing the necessary data, the desired outcome for the predictive maintenance, e.g. the level of accuracy, coverage and lead time, should be defined. Once this is in place, the next step is to identify which model will suit the specific problem the best, and to engage with relevant technical providers.

Define the desired outcome of the PdM findings
Several questions should be considered when defining the desired outcome of the predictive maintenance project. First, the level of granularity should be determined: How many failures should the PdM cover (e.g. if there are ten failures, how many of the failures should be highlighted)? What should be the level of accuracy of the model (e.g. if the model indicates three failures, how accurate was the model in predicting each failure)? It is important to keep in mind that whenever the model requirements are increased (i.e. more customisation), the cost and time of development will also increase, and hence, the right balance between cost, time and customisation should be clearly agreed upon.

Determine the best suited technology solution
When the contours of the PdM project are clear, the next step is to determine which models and technical providers will suit the project best. Should it be a custom model, a black box approach, a hybrid model or other? This is a classical sourcing assignment, where one scans the market for suppliers and engages with them to determine who can best fulfil the needs.

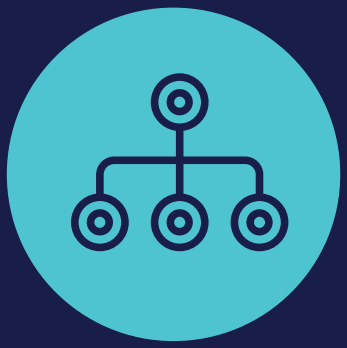
Even after the data has been handed over to the technical provider, frequent touchpoints and collaboration with the technical provider are still essential to succeed, since they often come with a theoretical understanding of models, but lack the understanding of the concrete business, which instead often lies with the subject matter experts operating in your maintenance team. The amount of time and resources that needs to be put in to this part of the process should not be underestimated. A common mistake is to assume that the resources needed are purely technical IT resources who understand the data. However, people with actual business knowledge are also critical.

STEP 4: Implementing the solution in the organisation

The last important step is to implement the solution developed by the technical providers, ensuring that it lives on in the organisation and that the required savings are realised.

Set long-term financial and strategic goals for the PdM project
Here, one should consider what the long-term savings potential should be, what steps are required to realise these savings and how to maximise ROI while reducing the risks. To realise the savings for PdM, having only one proof of concept will not suffice, as there are many complex elements to consider. Digital maturity of the operations (i.e. understanding of the digital data, quality, format, etc.) and the type and age of the asset as well as the organisation are some parameters that will influence how quickly you can realise the savings.

Engage and mobilise the organisation
Finally, the maintenance staff and the subject experts need to be engaged and mobilised, so that they believe in the project and take responsibility for carrying it out. If this buy-in is not secured, you might not realise the identified potential, as the success of predictive maintenance is highly dependent on the staff who will utilise predictive maintenance in their everyday work. Machine learning is a great technology, however, it still needs human input (in most cases) to inform the machine if what it has predicted is correct or not.



Determine the organisational impact
Change is not easy, and if it is not communicated correctly, the PdM technology might be perceived as a threat by the existing maintenance staff, resulting in a slower rate of adoption – hence reducing realisation of identified value potential in time. Besides the human mindset, an organisational change is typically required to support the PdM since new processes will be needed, e.g. how to make decisions based on your own experience as well as from the insights given by the PdM. To determine what the new organisation should look like, it needs to be considered what specific processes, skills and capabilities that need to be developed to support the project. Based on this, one can determine what this will mean for the organisation.

Only the beginning of the journey

Upon successfully completing all four steps, a fully functioning predictive maintenance system has been implemented and is ready to be put to use. However, having reached this stage does not equal that the work is done. Like all other business initiatives, one needs to monitor the system continuously, ensuring that the maintenance staff are using it and that the model is regularly improved as new data becomes available.

Finally, when the savings start to be realised, it is time to consider which assets should be next in line for a predictive maintenance project. Implementing predictive maintenance in one part of the operations is a necessary place to start, but only the beginning of a long and exciting journey.

Is predictive maintenance relevant to you?
> Take the survey to find out.

Are you interested in discussing the relevance and potential gains of predictive maintenance for your company? Please contact Rahul Shah directly.

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PdM Journey

CHOICES (Strategic choices)

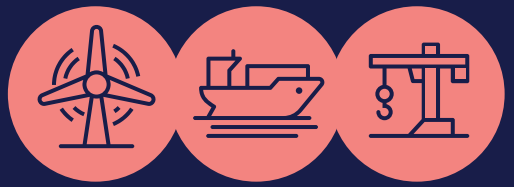
Purpose

Pm

Cm

PdM

- Why do I need *predictive maintenance*?
  - Isn't *preventive maintenance* (Pm) and *condition based monitoring* (Cm) enough?
  - I have high redundancy for my key assets, do I still need PdM?

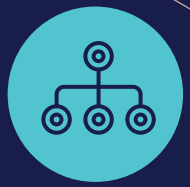


- How should I decide which assets to prioritise? Which parameters should I consider?
  - Cost of maintenance
  - Number of assets
  - Level of criticality

- What specific element/s should the PdM focus on?
  - Critical component/s
  - Specific type of failure
  - Unplanned failure
  - Planned failure

Implementation

- What is my long-term saving potential?
- What specific steps are required to realise the savings?
- How do I maximise ROI and reduce risk?



- What organisational changes are required to support PdM?
- What specific processes, skills and capabilities do I need to develop?

- How do I engage and mobilise my maintenance staff?
- How do I enable my subject matter expert?
- What specific start, stop and continue should I consider?

TECH (Technology solutions)

Data

- Do I have access to the data I need?
- Am I legally allowed to use the data?
- Is my data readable?
- Is my data reliable & continuous?
- Do I have enough documentation for my data?

- Besides asset data, what other sources of data should I include?
  - Inventory reports
  - Operational log
  - Human resource data
  - Weather

Modelling

- What level of granularity is required to operationalise PdM findings?
- What is the right balance between cost, time and customisation?

- Which technology solution will best suit my needs?
  - Custom models
  - Black box approach
  - Hybrid model
- How do I best utilise my subject matter expert?

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