IDEATION
CBM for all

Condition Based Maintenance (CBM) – No Excuse

Maintenance seems to be one of the less exciting activities, but if you get it right, it offers numerous rewards to corporations and individuals alike. The rewards are not just monetary, such as cost reduction, but they offer technical and intellectual satisfaction. The advances in technology have made certain strategies not only possible, but also easy to implement, so it is worth looking into the current trends.

Fundamentally, there are two most common ways to conduct your maintenance in a process plant:

1. You have scheduled maintenance shutdowns every few years and you overhaul a predefined list of equipment. Between these shutdowns you fix what needs to be fixed to get you to the next shutdown – **Preventive**, or **Time-based maintenance strategy**
2. You still have scheduled maintenance shutdowns every few years, but you only overhaul equipment that needs to be overhauled. In the meantime, between the shutdowns, you monitor equipment and fix it before it breaks down – **Predictive**, or **Condition-based maintenance strategy (CBM)**

Some people will also quote an approach called **Run-to-fail strategy**, which essentially means you wait until the equipment breaks down and then you fix it. However, this is more of an absence of any strategy rather than a strategy as such. Also, the percentage of the process plants that have this maintenance strategy is infinitesimally small.

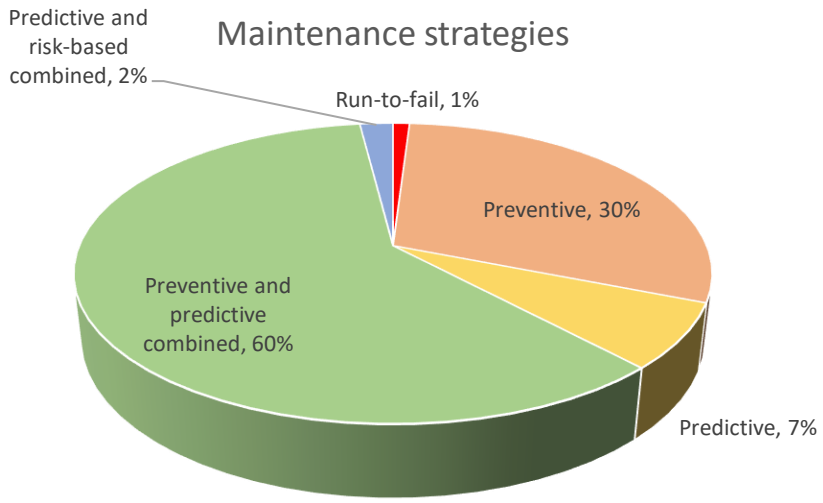
Some sources will advocate the presence of yet another strategy, called the **Risk-based maintenance** approach, but it is a very complex and somewhat academic approach. This strategy is very effective, but it relies very much on changing the whole culture of the organization, which is one of the biggest hurdles when implementing anything new. Currently it is considered as the avant-garde approach, only used in the elite high-tech environments, such as space programs, though you can find some rudimentary implementations in other industries.

So, how well are all of these maintenance strategies spread through the industry? There are various studies, and the results vary between different industries. We offer our **estimate**, based on different sources and only relevant for process industries. We believe that the split is estimated to be as follows:

- 1% Run-to-fail strategy
- 30% Pure preventive maintenance strategy
- 60% Combination of preventive maintenance and predictive, i.e. condition-based maintenance for selective equipment
- 7% Pure condition-based maintenance on all currently available equipment
- 2% Condition-based combined with advanced risk-based maintenance

Clearly, the most dominant category is the one with some combination of preventive and predictive (condition-based) maintenance. The mix of these two strategies will be determined on the basis of what equipment is used and which condition-based detection methods are available for this equipment. Some equipment is difficult to diagnose, or the methodology is so complex that end-users

have no capacity to learn and adopt it, although they would benefit from it. A quick takeaway here is that condition-based techniques and equipment need to be simple, intuitive and easy to implement, as otherwise they will not be adopted, regardless of their value.



There is no doubt that the whole industry would benefit from moving towards greater adoption of the condition-based maintenance. Some companies have made more progress than the others, and it is interesting to know what motivated them to do so.

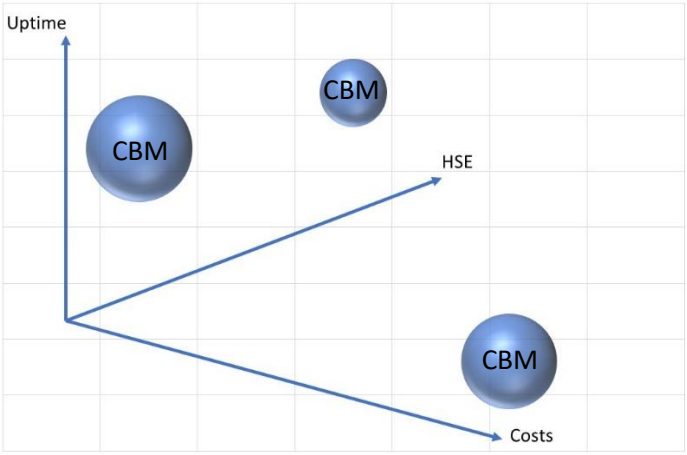
Again, various sources will quote different percentages and different motives, but fundamentally the companies adopt condition-based maintenance for the following reasons:

1. Uptime improvement
2. Maintenance cost reduction
3. Equipment reliability and lifetime expectancy extension
4. Reduction in health, safety and environmental risks
5. "Because we can, and it makes sense" – technology readily available and mature enough

The graph below depicts the three major motives: the uptime, costs and HSE (Health, Safety and Environment). Different companies will find one of the three motives predominant, though all three play a role in the decision making process.

To assign the percentages to these motives is much more difficult. What we mean by this, is answering the questions, such as: by how much will the uptime go up, or by how much will the costs go down, etc. The specific percentages in response to these questions will depend on the type of equipment, current practices, presence of other risk factors, organisational agility, and many other factors.

So, what is necessary to have in place, in order to adopt condition-based maintenance? Apart from the will to do it and successfully negotiating various cultural and operating barriers that every organisation has, there are some technical aspects that we would like to concentrate on.



Let's first make a point that one category of equipment is particularly missing out on condition-based maintenance, and these are various mechanical pieces of equipment. Many electrical and/or electronic equipment is already networked, or wired, so some level of condition-based monitoring is already present. A great deal of mechanical equipment is not networked, or wired, and as such is hardly ever subjected to condition monitoring. Occasionally, technicians will do the walkdowns and use the specialized instruments to analyse the conditions of selected pieces of equipment. However, this is time consuming, requires specialized tools, as well as the knowledge of how to use the tools and interpret the results.

Clearly one of the first pre-requisites for implementing the condition-based monitoring is some form of a network, or at least wiring the equipment. Most of the time this is either not possible, or prohibitive from the cost point of view. This is the first hurdle that CBM stumbles upon and falls in many organisations. Fortunately, robust industrial wireless technologies, such as BLE (Bluetooth Low Energy) and WIFI mesh networks, are eliminating this obstacle and making it a thing of the past.

If we now have a wireless technology, the next question is: what kind of devices should we network? The new generation of MEMS chips/sensors comes to our rescue. They are small, energy efficient components, that will sit inside the CBM device and perform the monitoring tasks with ease and efficiency unheard of just a few years ago.

Although the devices are wireless, and chips are low-power, they still need some energy to function, so the question is: how do we power these devices? Again, the technology comes to our rescue and we can use different types of long-life batteries to power these devices. Combined with smart energy management and wake-up call methods, these batteries are supposed to power the CBM devices for a number of years.

OK, now we have the network, the devices, the power, but how will they operate to support condition-based monitoring? Well, we said that we have sensors embedded and that they can monitor a number of physical signals/conditions. These signals need to be converted, subjected to calculations, analysed, interpreted and communicated, if appropriate. Unlike in the past, there is no need to send these signals to some smarter boxes (controllers or central consoles) that are designed to do all of this. Everything happens in the condition-monitoring device. The small devices become the unit equipment servers, capable of doing all of this. Using the Internet of Things (IoT) technology, everything is done locally and then just broadcasted (or, "advertised") to the system that is designed to take some action.

Let's assume, as an example, that the condition-monitoring device establishes that a safety valve has popped. Historically, operators would rarely even know that it happened. Today, with a CBM device, this information is instantly advertised to the enterprise system that immediately issues an inspection work order, with a specific location, equipment tag number and the description of the condition that needs to be checked.

We can see that condition-based maintenance is the main-stream reality and, providing that the cultural and operational obstacles are not present, there is absolutely no reason why it should not be implemented. It is easy, intuitive, does not require special expertise, and the threshold to implement it is so low that there is no excuse not to deploy it. As the title says: No excuse!

Ideation AS was formed with the intent to develop and launch a series of devices that will be used for the purposes of condition-based maintenance. The first device in the series is called CBM Predictor and it has been architected as an IoT device. It is simple, easy to install, it requires no knowledge of the embedded algorithms, it communicates with the cloud via the Bluetooth or WIFI network, and it reports only actionable information when appropriate. It is designed to monitor Process Safety Valves (PSVs) and notify customers of the popping action and potential subsequent leaks, that occur as a consequence of failure to re-seat.

In summary, CBM Predictor is designed to contribute towards the **Uptime improvements**, to reduce the **Maintenance cost**s, provide **Equipment reliability and lifetime expectancy extension** and to **Reduce health, safety and environmental risks**. We have to say that the reason that you can implement it **"Because you can, and it makes sense"**, is also there. So, No excuse!

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