Senseye Predictive Maintenance

Readiness for predictive maintenance at scale report 2023

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Introduction

Successful predictive maintenance deployments are about much more than just technology

What is predictive maintenance?
Predictive maintenance is a proactive maintenance strategy that utilizes data-analysis tools and techniques to predict when an equipment failure might occur. It therefore allows maintenance to be scheduled just in time to prevent the failure. It allows significant cost savings as maintenance is only performed when necessary, reducing downtime and extending the lifespan of equipment.

It is often confused with predictive analytics – while predictive analytics techniques may be used to inform a predictive maintenance strategy, they are unique and separate.

Readiness for predictive maintenance is not just about technology

Major manufacturers are showing surging interest in predictive maintenance (PdM).

Over the past seven years, we've seen a 275% increase in enquiries about technology that lets firms predict when machinery and components will fail, allowing maintenance at the optimal time.

Why? First, we see booming interest from manufacturers looking to move from preventative maintenance to a predictive strategy. These organizations are looking to realize benefits such as a reduction in unplanned downtime of up to 50% (cost avoidance) and a reduction in maintenance labor effort needed (cost savings).

We're also seeing the early adopters of PdM moving from using it in pilot schemes or protecting only their most critical assets, to monitoring and connecting all their machines, across all of their plants. PdM is finally entering the mainstream.

But how can you deploy successful predictive maintenance at scale? Essentially, success rests on two factors:

1. **Data maturity.** How close is the organization to collating and exploiting the data needed for PdM at scale?
2. **Cultural maturity.** PdM is not a plug-and-play commodity. It is a mindset. Does the organization already have the ways of thinking, clarity about goals and top-level buy-in that form the culture that leads to success with PdM?

This report is based on a study of major global manufacturers who are showing interest in predictive maintenance and have contacted the Senseye Predictive Maintenance team at Siemens. The study looked at their state of preparedness for PdM.

The key finding is that, in most cases, the data is there. Eight in ten forward-looking firms now have the data capture and storage capabilities to make Artificial Intelligence-driven PdM at scale realistic. This doesn't necessarily mean organizations are using retrofitted sensors: data from existing digitized machinery provides enough information in many use cases.

EXECUTIVE SUMMARY

- Predictive Maintenance (PdM) is now entering the mainstream among global manufacturers. There has been a surge in interest in PdM, with enquiries for Senseye Predictive Maintenance increasing by 275% over the last seven years.
- The early majority are adopting the technology. And early adopters are scaling it up to cover all their assets, not just the most critical.
- Interest has grown across all key sectors: Automotive, Fast Moving Consumer Goods (FMCG), Heavy Industry, and Oil & Gas.
- Interest is being driven by excellent results, such as a reduction of up to 40% in maintenance costs for Siemens customers, and a growing desire among manufacturers to become more efficient and productive.
- Success in PdM depends on two factors: data maturity and cultural maturity. Cultural maturity is about having in place the organizational commitment, targets and practices in place that support deployment of predictive maintenance.
- Cultural maturity is absolutely vital. Many forward-thinking global manufacturers engaging with the Senseye Predictive Maintenance team at Siemens have started collecting data that can make that a reality. Far fewer have the levels of cultural maturity required for successful predictive maintenance projects. A key part of that maturity is about being clear about desired outcomes and then driving towards them.
- Cultural maturity has clear quantifiable benefits. There is a very clear correlation between high levels of cultural maturity and lower levels of unplanned downtime and downtime costs. Organizations with the highest levels of cultural maturity also enjoy significantly better Overall Operational Efficiency (OEE) than those with the least developed maintenance cultures.
- Only 46% of major manufacturers engaging with Senseye Predictive Maintenance have the cultural maturity required to make successful deployment likely. This maturity involves proactive maintenance approaches, high-level buy-in, clear objectives of what the organization is trying to achieve through PdM, and ambitious KPIs.
- Levels of cultural maturity are growing as PdM goes mainstream. In 2018 and 2019 the average cultural maturity in our readiness index score was around 0. For the past three years it has been above 150. Attitudes towards maintenance are changing fast at forward-thinking manufacturers.
- Organizations that succeed with PdM projects have three cultural factors in common: they are objective- and metric-driven; there is buy-in from the very top; and end users are included in projects early; and they get expert support from vendors.
- Data maturity is less of an issue for those already considering predictive maintenance. 81% of forward-thinking manufacturers who have engaged with the Senseye Predictive Maintenance team have the required levels of data maturity to make AI-driven PdM at scale realistic. Levels of data maturity have remained relatively stable over the last five years.
- Data maturity does not necessarily mean retrofitting sensors to all assets. In many cases, the data provided by existing factory automation solutions is sufficient to allow PdM.

PROGRESS TO PDM: THE PDM LANDSCAPE TODAY

Data-driven Predictive Maintenance (PdM) has entered the mainstream. Well-established and well-proven, it has moved beyond being a future or niche technology. PdM is no longer just about safeguarding the up-time of a group of critical machines (often with manual data analysis). Now, major manufacturers are working towards monitoring their whole asset base with AI-driven analysis to predict future failures.

275% increase in interest in PdM

Compared with 2015, Senseye Predictive Maintenance has seen a 275% increase in enquiries about capabilities that make scaleable and automated machine condition analysis realistic. Google searches for 'predictive maintenance' have doubled over the same period.

Two factors have driven this. Firstly, buyers in the early majority. Where early adaptors are visionaries, actively looking for breakthrough technology that could give them an advantage, the early majority buyers are more risk-averse pragmatists.

The arrival of the early majority into the market shows the technology going mainstream. A second driver has been the desire of early adaptors to use PdM across their operations, rather than just for pilot schemes or processes where unscheduled downtime was especially costly or troublesome.

We are seeing increased interest from firms who want the capability to make predictive maintenance sustainable and scalable.

Interest has grown among major manufacturers across all key industrial sectors: Automotive, FMCG, Heavy Industry and Oil and Gas.

Excellent results for PdM are driving interest
The benefits of PdM projects can be enormous. By bringing in PdM, Siemens customers have seen the following:

- Up to 85% improvement in downtime forecasting accuracy
- Up to 50% reduction in unplanned machine downtime
- Up to 55% increase in maintenance staff productivity
- Up to 40% reduction in maintenance costs

Seeing these kinds of results, it is little surprise that after successful pilots the early majority are moving towards implementing PdM at scale.

PdM means firms can service machines before they break down, not after. And it eliminates the need for exhaustive, costly preventative maintenance schedules. These gains mean large manufacturers have recouped the cost of their investment within three to six months.

Fixing before failure reduces the need for replacement parts by up to 40%, reducing wastage and carbon emissions. Condition monitoring also enables machines to run more efficiently, and more importantly provides greater insight into usage, which can reduce energy consumption. And PdM strategies allow organizations to cope better with the post-Covid retirement of many experienced engineers by codifying their knowledge, and focusing staff time where it is most needed.

So, how ready are firms to realize the benefits of predictive maintenance? The Siemens PdM Readiness Index

Successful implementation of a PdM strategy rests on two pillars: data maturity and cultural maturity.

1. Data maturity

The Siemens team behind Senseye Predictive Maintenance has developed a scale, measuring where a manufacturer is in its journey towards having the data-capture and storage capabilities that make sustainable and scaleable PdM possible.

Data maturity level

1	No machine or maintenance data
2	Weak machine and maintenance data
3	Data available but largely undeployed
4	Data used for basic condition monitoring
5	Advanced data used for advanced condition monitoring

Generally, organizations at level 3 and above can expect project success, sometimes with intensive support from a partner. For the others, preliminary development work will be necessary.

Our survey suggests that eight out of ten major international manufacturing firms (81%) have the data capture and storage capabilities required to make AI-driven machine condition analysis and PdM at scale realistic. Data maturity is strong in the sector.

2. Cultural maturity

Successful PdM projects rely on having the correct data-capture and storage capabilities, as well as an internal culture that buys into PdM and sets clear and ambitious maintenance KPIs. The cultural maturity scale helps manufacturers see where they are on this journey.

Cultural maturity level

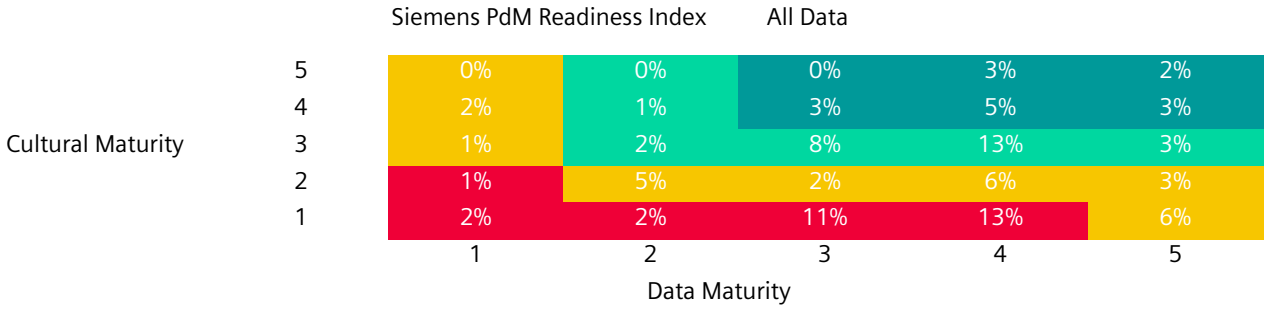
1	Reactive maintenance and no KPIs
2	Preventative maintenance and few relevant KPIs
3	Machine condition monitoring in some areas and KPIs to drive efficiency
4	Mix of preventative maintenance and condition monitoring to hit ambitious KPIs
5	Predictive maintenance projects live to hit ambitious KPIs

Generally, organizations at level 3 and above succeed in PdM projects. It is hard, for example, to leap straight from reactive maintenance to PdM.

Our survey suggests that only five out of ten (46%) have reached the levels of cultural maturity (3+) likely to make a PdM strategy the transformative success it could be.

The PdM Readiness Index

Using questionnaires filled out by manufacturers from around the world, we've been able to judge their maturity in terms of data and culture. With this information, we can see how ready major manufacturers are for sustainable, scaleable PdM. We compiled the results in the table below.



We can see, for instance, in the top right corner, that 2% of firms have the highest levels of data and cultural maturity (5). And in the bottom left, we see that 2% have the lowest (1). Everyone else is somewhere in-between.

We have divided firms into four groups based on how likely a PdM project is to succeed at scale. Some have the data and technical capabilities in place, but not the culture. Others have neither (red). And some have both (dark green).

17%	Project success likely with customer becoming autonomous
28%	Project success possible with some CSM
25%	Project success doubtful and will require significant CSM
30%	Project success highly unlikely

The key messages from the index are:

- **Half of large manufacturers are sufficiently mature** in their data practices and organizational culture to make PdM successful without significant customer success management (CSM) support. The other half would either require more significant CSM or would likely fail without preliminary work.
- **The main challenge is cultural.** Only one in five (19%) manufacturers are at the top two levels for organizational culture. By contrast, more than half (57%) have reached the top two levels of data maturity. Most firms have the data.

We have seen that the benefits of successful PdM strategies are enormous. The question, therefore, becomes: can we change our culture and data capture capability to ensure success?

The rest of this report focuses on what improvement in these areas looks like, and how manufacturers can achieve it.

DATA MATURITY: WHAT DATA DO I NEED FOR PREDICTIVE MAINTENANCE AT SCALE?

Data maturity level	
1	No machine or maintenance data
2	Weak machine and maintenance data
3	Data available but largely undeployed
4	Data used for basic condition monitoring
5	Advanced data used for advanced condition monitoring

The right machine-condition metrics to use for a PdM project are any which successfully predict oncoming problems. That means any variable that will change with the degradation of the machine or its components.

The common myth is that this has to mean data from retrofitted sensors. That is only sometimes the case. Retrofitting vibration sensors is usually necessary only with the most critical assets – where manufacturers need very early warning of any possible failure. Otherwise, existing data is sufficient.

For 90% of uses, the information that most machines produce anyway – through Programmable Logic Controllers (PLCs), motor drives or Manufacturing Execution Systems – will be enough to enable successful PdM.

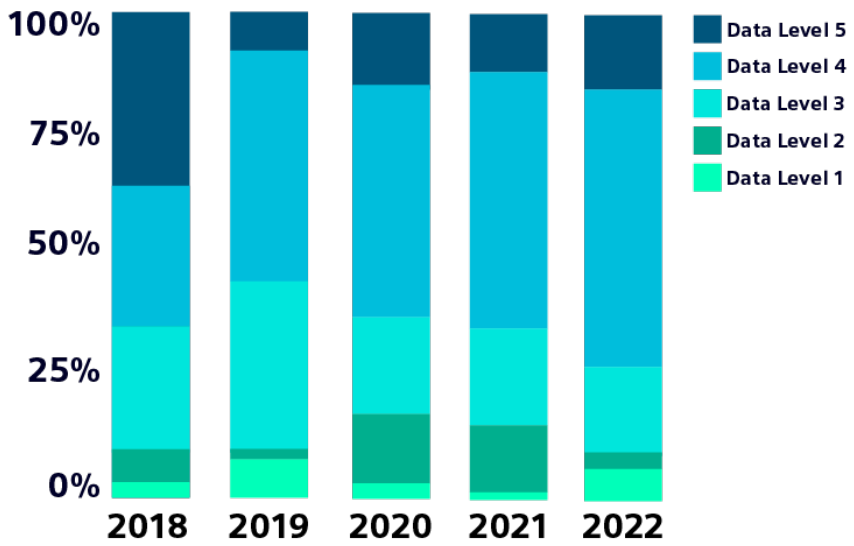
For example, changes in current drawn, torque, pressure or flow can all indicate the beginning of failure. These can all be analyzed with statistical methods and machine learning algorithms to warn of impending failure sufficiently early to allow managed replacement of components.

Most forward-looking large manufacturers engaging with PdM specialists are already gathering enough data to implement PdM across their assets. For these manufacturers, the data challenge in scaling up PdM may be less tough than they expect. This approach will be significantly cheaper than retrofitting sensors, especially when the downtime associated with installing sensors is factored in.

This is reflected in our survey, which showed that 81% of firms who had contacted Siemens had already reached a level of data maturity to make PdM possible. However, this almost certainly over-represents the wider level of data preparedness, as our figures are for firms already considering PdM solutions. Other manufacturers will need significantly more support in developing data maturity.

We have also seen manufacturers converge around the cloud as the best place to store data, further improving readiness for PdM. Even the producers of traditional, on-premise factory-historian technology are reacting to industrial IoT platforms and moving to cloud-based storage too.

All of this helps explain why our metric of data maturity has remained remarkably stable over the past five years. (Though we would add the caveat that, in our experience, manufacturers overestimate their data maturity and do actually need data support once they understand better what is needed to implement PdM at scale.)



The apparent slight tailing off of data readiness in the past two years is explained by the fact that less tech-savvy firms are also starting to approach providers like Siemens as interest in PdM starts to go mainstream.

Key advice: While organizations will want to have critical KPIs in mind from the start of planning a PdM project, many need to include a preliminary step. **First, set operational, early-stage targets** related to the system's installation and adoption. For instance, a target for the number of connected machines or for how widely the technology is used. This helps teams gain an understanding that can help them realize wider business KPIs.

Key results of data maturity: Our study suggests that the **total cost of downtime in facilities with Computerized Maintenance Management Systems (which centralize maintenance information) is 28% lower** than in facilities without them.

CULTURAL MATURITY: WHY CULTURE IS VITAL FOR SUCCESSFUL PDM:

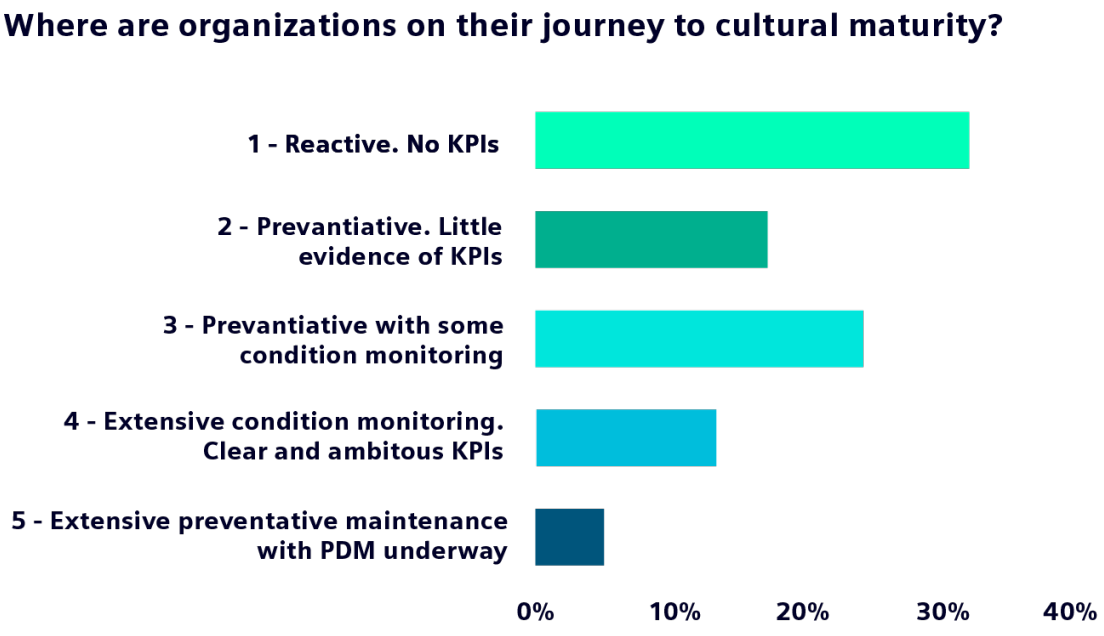
It's not generally data collection and technology holding businesses back from reaching Predictive Maintenance readiness – it's culture.

This is the clearest message of all coming out of our analysis. 51% of organizations are still at the lowest two levels of cultural maturity. This makes success unlikely, whatever their level of data sophistication.

Cultural maturity level

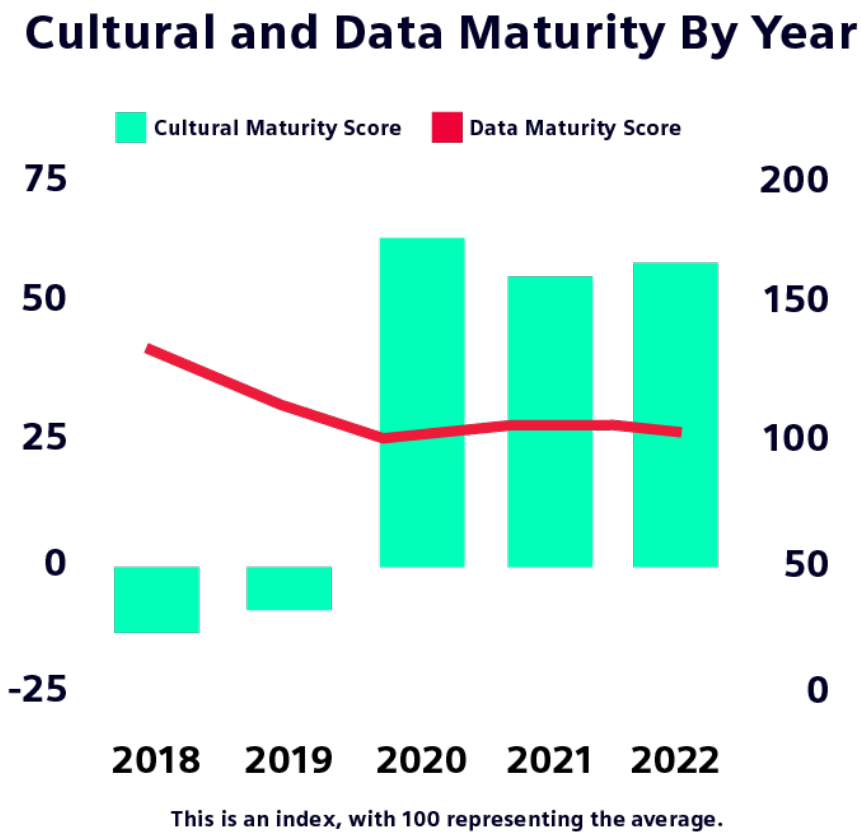
1	Reactive maintenance and no KPIs
2	Preventative maintenance and few relevant KPIs
3	Machine condition monitoring in some areas and KPIs to drive efficiency
4	Mix of preventative maintenance and condition monitoring to hit ambitious KPIs
5	Predictive maintenance projects live to hit ambitious KPIs

Where are organizations on their journey to cultural maturity?



Of the 81% with the right levels of data maturity, half (41%) don't have the workplace cultures and practices to make success likely. By contrast, there are only 6% of manufacturers where lack of data is the blocker.

That said, cultural maturity is improving, as the table below shows:

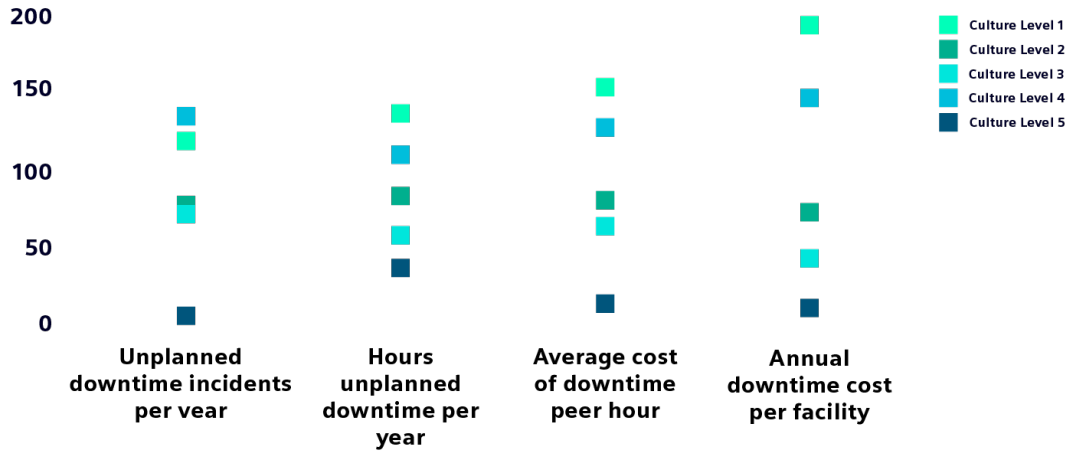


Why does culture matter?

Culture matters because having the data needed for PdM is only helpful if the business has the mindset to trust it and use it to bring about business value.

This is why cultural maturity is a better predictor of maintenance performance than data maturity, as the table below shows:

Performance by cultural maturity



This table suggests a clear correlation between high levels of cultural maturity and all of the following maintenance KPIs:

- Number of unplanned downtime incidents
- Hours of unplanned downtime every year
- The average cost of an hour of downtime
- Total annual downtime costs per facility

It is also clear that organizations with the highest levels of cultural maturity enjoy much better OEE than those with the lowest. Cultural maturity seems to bring efficiency.

In short, culture matters.

But culture is not a straightforward matter. In our experience, there are several key features of the cultures at firms succeed in reaping the full benefits of PdM.

1. They are objective-driven

Not knowing where you want to end up can only result in getting lost. Company culture needs to ensure appropriate goals are established at the outset.

Metrics and objectives drive these manufacturers. They are capturing their current effectiveness within maintenance, downtime and spare parts consumption. There are clear objectives coming down from a high level in the business. For example, reducing energy consumption. They understand what they want from PdM from the start and know what business pain they want to ease.

That might mean a substantial cut in corrective maintenance costs, say 50%. Or it might mean a 50% reduction in scheduled maintenance costs. But it needs to be clear and quantifiable – what gets measured gets done. Seeing the demonstrable results also helps win over end users on the maintenance teams. Just setting 'Bringing in PdM' as an objective is too vague.

Once they have identified a goal (cutting costs, cutting downtime, improving quality), they assess their current technology.

They make good use of investments they've already made. Excellent PdM can be run from the data provided by existing sources like Programmable Logic Controllers.

2. There is buy-in across the business

PdM requires a significant shift in mindset – especially for the third of firms in our survey that still rely primarily on reactive maintenance. There needs to be buy-in from stakeholders across the organization.

- **Senior leadership and C-level executives**
  The move to PdM needs to be owned and championed by those at the top of a business, and they also need to make it clear that they will support maintenance teams through the transition to a new way of working. PdM requires trust. To build that, successful projects start showing that PdM makes savings and makes things easier on the frontline. This means being effective in communicating the benefits clearly and quickly. Good communication is essential to effective PdM projects.

- **Maintenance teams**
  The solution will only be embraced or deliver hoped-for benefits with proper buy-in at the user level. A recent study in the Harvard Business Review identified the main barriers to technology adoption in the workplace. The two biggest hurdles were proper training on technology tools (64%) and employee resistance (53%). The

potential upside of new technology means little if employees can't or won't use it. So early in the process, successful manufacturers appoint PdM Champions from the frontline team to drive adoption and best practice across the organization.

- **IT**
  IT support is needed to assist in the integration of key systems and advising on how to fit PdM with their existing IT infrastructure. Issues around allowing secure data sharing should also be tackled early. There may be policy hurdles as well as technical ones to overcome.

- **Operations**
  Plant managers and factory floor engineers (the ones who work with these assets daily) will have the best knowledge of where improvements and efficiencies can be made. We advise clients to make these key end users part of the solution rather than the problem. Getting these crucial stakeholders involved early improves engagement with PdM. First-hand testimony from end users also provides valuable insight that can be applied to later transformation efforts. The relationship between a well-trained, positive operations team and new technologies can be a strong circle.

3. They get expert support

PdM is not a product. It is a mindset and methodology enabling a system of work that utilizes various technologies. What it looks like will differ depending on your needs and situation. Good PdM projects, therefore, need support.

These are the foundations for building a strong PdM culture.

Key advice: Predictive Maintenance is not an off-the-shelf commodity. Successful PdM is a project for the whole organization not just a purchase affecting only maintenance teams. It is a change in philosophy not just a change in technology. Approached in that way, its benefits can be huge.

Key results of cultural maturity:

- Facilities doing at least some Condition Based Monitoring (cultural maturity level 3) lose 10% fewer hours to unplanned downtime.

- Facilities where OEE (Overall Equipment Effectiveness) is an established KPI suffer 35% fewer failures and lose 41% fewer hours to unplanned downtime. The cost of that downtime is 82% lower than in other facilities.

JOURNEY TO PDM: LESSONS FROM TWO MAJOR MANUFACTURERS

Automotive manufacturer: Building a culture in which PdM succeeds

Global automotive manufacturer turns vast amounts of sensor data into massive downtime reductions.

Customer objectives

The customer is a major global manufacturer producing vehicles in 20 countries worldwide, including Japan, the US, and the UK. Its global vehicle production volume exceeded 4.7 million in 2020, with products and services provided in more than 190 countries.

The issue it faced was the key one highlighted in this report – excellent data maturity that needed turning into meaningful business gains. The manufacturer had abundant sensor data but insufficient skilled resources to analyze it manually.

As cultural maturity grew in the organization, they were keen to realize the benefits of using data and machine learning to influence maintenance. In 2016, it embarked on a PdM program to reduce production downtime by up to 50% across thousands of machines.

Solution

Senseye Predictive Maintenance experts supported the manufacturer for more than five years, gradually expanding its PdM capability across global production sites.

Over time, it has become autonomous in the scaling of its PdM. Engineers can now onboard new machines and integrate with other enterprise software without Siemens' support.

Over 10,000 machines of 100 different types are remotely monitored using Senseye Predictive Maintenance's proprietary machine learning algorithms. These include robots, conveyors, drop lifters, pumps, motor fans, and press/stamping machines.

Over 650 engineers and maintainers now use Senseye Predictive Maintenance to optimize maintenance activities and make repairs months before machine failure.

Benefits

"Siemens is supporting our Predictive Maintenance program across multiple production facilities and has helped us lower overall downtime and increase OEE."

- Tens of millions of dollars saved in saved downtime
- Rapid Return on Investment – less than 3 months
- Up to 6 months advance warning of machine failure
- Reduction in preventative maintenance and secondary activities
- Year-on-year OEE improvements

Siemens has supported the manufacturer to reach a level of cultural maturity when it comes to maintenance that is allowing it to get the full benefits of the data it was already compiling.

Aluminum processing: Building data maturity without retrofitted sensors

Leader in aluminum processing achieves Return on Investment in months without new hardware

Customer Objectives

A global leader in bauxite, alumina, and aluminum products, the manufacturer is built on a foundation of strong values and operational excellence dating back over 130 years.

This production giant operates plants worldwide, managing many diverse assets of different ages and capabilities.

Since 2018, the manufacturer has worked with Senseye Predictive Maintenance in achieving best-in-class technology and operational practices for Predictive Maintenance.

With difficult margins in the global aluminum market and increasingly demanding operational and production efficiency targets, it established a global corporate initiative to tackle these challenges and focus on adopting the best maintenance practices.

It was looking for a robust specialized solution delivering PdM using existing machine and maintenance data feeds.

Also, the solution had to be used by machine operators without requiring complex and lengthy setup or extensive training and be rolled out to different sites around the world whilst providing a rapid return on investment.

Solution

The customer selected one of its aluminum smelter plants in East Iceland as the first site in a structured global deployment.

Designed as a zero-waste-to-landfill project, this site is among the most environmentally sustainable facilities of its kind.

To enable Senseye Predictive Maintenance at this site, the software was connected to the site's existing machine and maintenance systems, including OSIsoft PI and Oracle EAM. Siemens delivered a unified and powerful intelligent solution without installing a single new sensor.

The client now monitors critical machinery across key lines, adding more assets regularly and easily.

Maintenance personnel now get two weeks' warning before issues develop with saw motors due to loose components, helping to avoid 12 hours of unplanned downtime on each occasion – leading to significant improvements in OEE. Senseye is used on more than 1,000 smelting pots and is operational plant-wide. This is spreading to other plants too.

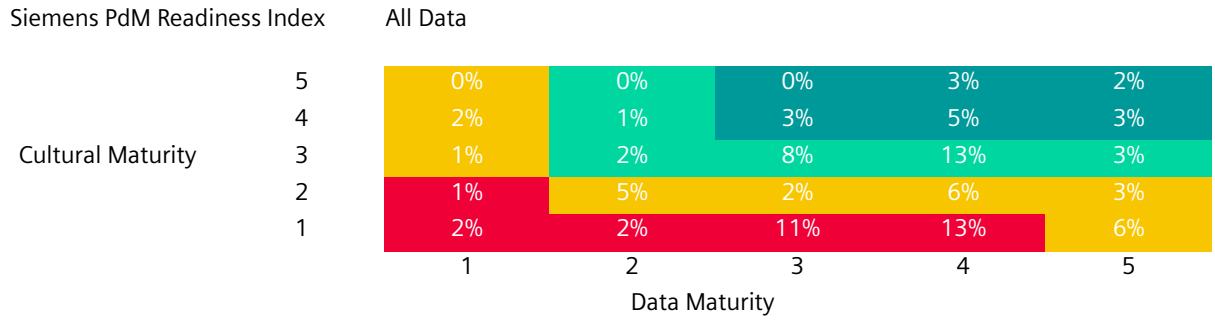
Customer Benefit

- Existing data and infrastructure investments leveraged
- Reduced unplanned downtime by 20%
- Improved operating efficiencies and reduced maintenance costs
- Achieved ROI within 4 to 6 months
- Roll out of Senseye Predictive Maintenance at additional sites.

The project shows PdM's success, even when using only machine data already being captured.

GETTING READY FOR PDM: HOW TO IMPROVE READINESS

The four colors in the chart show different levels of readiness for PdM. Companies in the red zone need significant preparatory work before PdM will likely work for them. Success in PdM is very likely for those in the dark green zone.



So, how to move towards being PdM prepared?

Red quadrant organizations – what to do next

For most businesses, moving out of the red quadrant – where success with a PdM project is currently highly unlikely – is all about culture. Our evidence suggests that the most urgent need for most of these firms is to grow in cultural maturity when it comes to maintenance. Of the 29% of firms in the red quadrant, the vast majority (four out of five) have already reached levels 3 and 4 in data maturity. Access to information is not the problem: only one organization in ten is still at level 1 for data.

For most, the most urgent task is to improve their awareness of state-of-the-art practices.

- Work with a trusted partner to see what leading businesses are doing and the benefits they are reaping.
- Begin to identify your current pain points around maintenance.
- Ask: What would be an outstanding result for us with regard to maintenance? With a partner, identify some KPIs you want to work towards.
- Identify the people on your team who are enthusiastic about the journey ahead. They will become your PdM champions as you move on.

Orange quadrant organizations – what to do next

Firms are stuck in the orange quadrant either because they are at level 1 for data maturity or have yet to move past level 2 for cultural maturity.

Level 1 data maturity means the firm's assets don't have sensors. This may be fine; information from existing control systems is often enough for effective PdM. But some initial networking work may be needed as you move towards compiling all the data from your assets in one place, in a form usable for PdM.

To progress, they need to:

- deepen their understanding of world-class maintenance practices
- get clear organizational buy-in for the journey towards PdM.
- leave any remaining commitment to reactive maintenance instead of committing to a widespread preventative maintenance culture.
- most businesses will start to form a PdM team at this stage to lead further developments.

Light green quadrant organizations – what to do next

A firm in the light green quadrant will have the data basics. Data from sensors and control systems will be fed to an accessible data store in the cloud. As well as raw data, the firm will have started processing that information in a way that allows simple condition monitoring of its assets. In some cases, these data efforts will have reached levels 4 and 5 already, where the business will be doing advanced condition monitoring and beginning some experiments with PdM.

Again, however, the key here is usually something other than the data. Indeed, 57% of firms have already reached levels 4 and 5 of data sophistication. The information and systems are there. But of that 57%, only a quarter have reached the dark green quadrant of success. This is, again, because the level of data sophistication is running ahead of the level of cultural maturity and organizational commitment.

To deepen that culture, firms will have:

- an established in-house PdM team
- clear buy-in from the very top
- KPIs capturing what the firm wants to achieve with PdM
- worked with trusted partners to allow the key people in the organization to develop a deeper understanding of the data flowing from its production processes and assets, and what it says about efficiency and areas for improvement.

At this point, the benefits of PdM lie before you, ready to realize.

NEXT STEPS ON YOUR JOURNEY: INTRODUCING SENSEYE PREDICTIVE MAINTENANCE

Our research suggests that most organizations will need support to get their data and culture to the place they need to be to enjoy the full benefits of PdM at scale.

This is why we've developed the Senseye Knowledge Platform – this is a framework composed of a methodology and a toolkit for deploying predictive maintenance projects based on our Siemens AI enabled predictive maintenance platform – Senseye Predictive Maintenance.

Briefly put, the methodology is a phased approach that will be familiar to plant engineers and operators as well as machine builders:

1. Scope: Project scoping, objectives, resources, kick-off

2. Design: Asset analysis, failure modes, data selection

3. Deploy: Implementation, data collection, machine learning, user training

4. Operate: Failure prediction, asset inspection, maintenance, review

5. Refine: Retrospect, adoption, scaling, integration

In all, it comprises a collection of 25 steps and associated tools, including a ready-to-use end-user app, to help you hugely increase your chances of success in a predictive maintenance project.

For more information about Senseye Predictive Maintenance please visit:

www.siemens.com/senseye-predictive-maintenance

METHODOLOGY

This report was informed by an ongoing study by Senseye, part of Siemens since June 2022. Since 2015, we have surveyed 174 large manufacturing and industrial businesses about their data and technical capabilities, working practices and performance across a range of KPIs commonly used by maintenance professionals.

This report focuses primarily on the five-year period 2018 - 2022, and findings from 144 online interviews with maintenance, engineering and IT professionals at large organizations in the Automotive, FMCG, Heavy Industry and Oil & Gas sectors.

Data about the benefits of predictive maintenance (PdM) come from live deployments of Senseye's AI-driven PdM software at large manufacturng and industrial organizations.

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