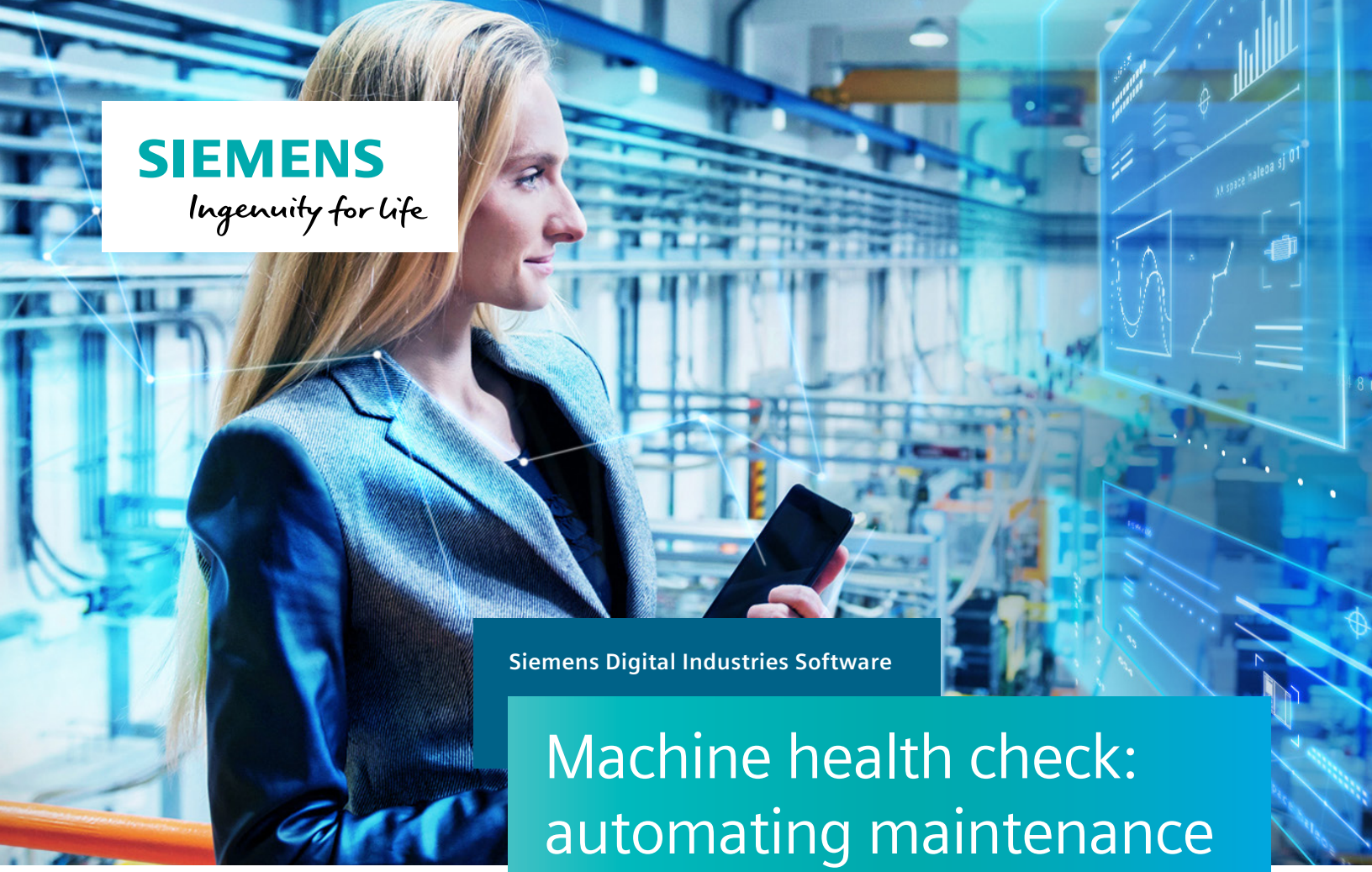

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Machine health check: automating maintenance

How the industrial IoT facilitates predictive maintenance

Executive summary

The sci-fi-sounding, near-magical benefits promised by industrial Internet of Things (IoT) advocates are fast becoming a reality, and one place they're taking hold is industrial industries. The transition is bringing unheard of capabilities, including autonomous maintenance in which the system essentially determines and carries out all aspects of maintenance.

An IoT-based predictive maintenance solution streamlines the move from previous maintenance methods by connecting factory assets and provides a central view of machine performance and health. In addition, predictive maintenance grasp the outputs of maintenance tasks, allowing them to make informed decisions that support operational and business needs.

Abstract

Industrial IoT-based maintenance systems can reduce downtime to near zero, eliminate unnecessary maintenance and the need to stock expensive replacement components, and shorten the time required to identify the root cause of asset failures. At a higher level, they help industrial organizations boost asset availability while also infusing greater automation into the process. The latest approach, dubbed prescriptive maintenance, solves the age-old problem of ensuring plants operate efficiently and productively.

From a financial perspective, there is a dire need to shift to more effective maintenance practices. Recent research from PTC calculates the cost of downtime in automobile manufacturing can cost $1.3 million per hour, while the ARC Advisory Group estimates the cost of unplanned downtime is 10 times that of planned downtime.

However, even as most companies are generally aware of what's possible with an Industrial IoT-based approach to maintenance, the question remains for most: How do I transition from my current maintenance routine to an IoT-based approach as quickly and inexpensively as possible?

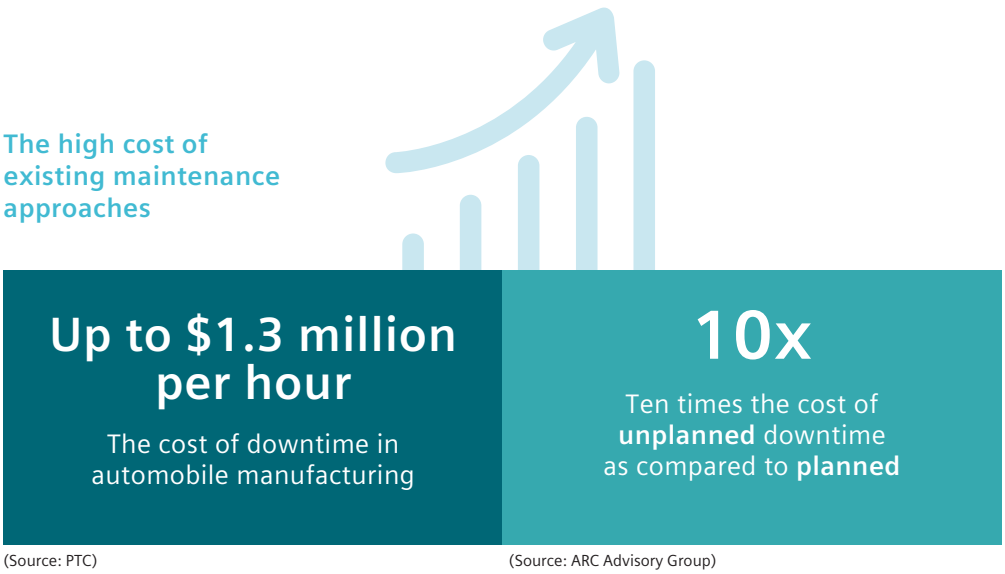


Figure 1. Unplanned downtime is a significant driver of maintenance costs.

The evolution of maintenance

To understand how to transition from reactive to prescriptive maintenance, it's useful to understand each stage of the journey.

Reactive maintenance: The most rudimentary form of maintenance is reactive. With this approach, also known as "run to failure," maintenance and repairs are made, or the equipment is replaced, only when necessary; that is, when it fails. The process is inefficient and results in production and productivity losses from unplanned downtime and more seriously, costly mechanical failures. Using this method, it is difficult – if not impossible – to track down the root cause of failures. Also, companies must stockpile replacement parts, which ensures quick repairs but also increases maintenance costs.

Scheduled (also known as preventative) maintenance: Moving to the next stage, maintenance is scheduled at specific intervals – regardless of machine health or performance – to reduce the frequency of reactive maintenance, including unpredictable, unplanned downtime and equipment breakdowns. Instead, the goal is to keep equipment operating at peak efficiency.

However, schedules rely on information provided by the manufacturer or are based on a calculated average or expected lifetime, which doesn't reflect what is really occurring. Some companies learned to listen to their long-tenured operators who had developed a keen sense of the signals – for example, the smell of an overheated part, the unusual vibration or sound emanating from a worn component – that signaled a potential stoppage. An attentive, knowledgeable operator considers actual conditions, but he or she is not scalable.

Scheduling maintenance introduces new problems: It is expensive because parts are replaced or serviced before they need to be, and spare parts must be kept in inventory. It's time-consuming because equipment must be repeatedly taken offline, interrupting production.

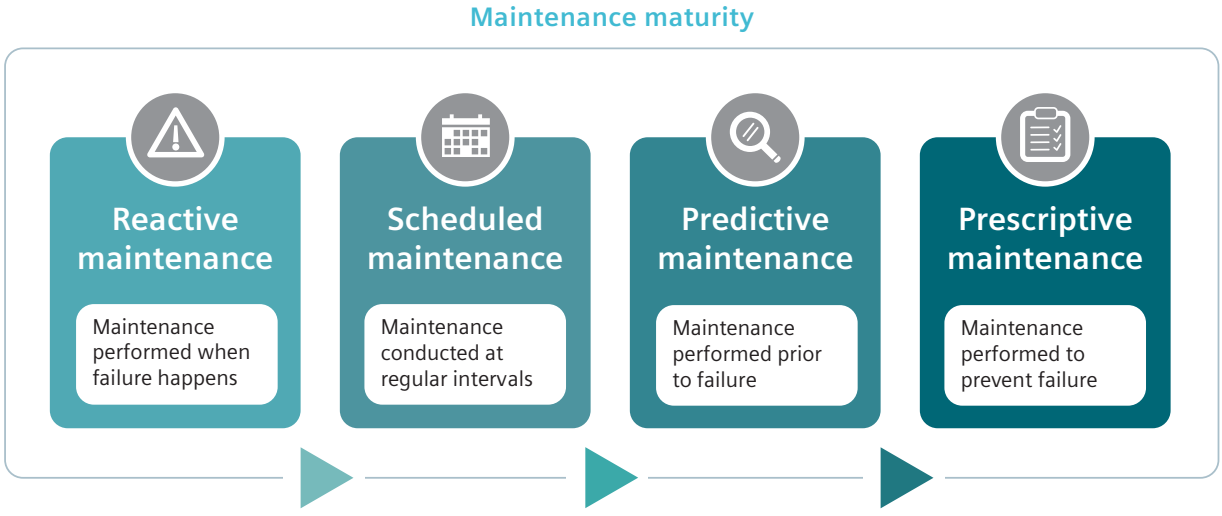


Figure 2. The four stages of industrial maintenance maturity.

It's error prone because it relies on outdated information. Some companies at the more mature stage of scheduled maintenance address these issues by deploying modest amounts of automation. For example, companies have deployed enterprise asset management (EAM) or computerized maintenance management systems (CMMS), which maintain a computer database of information about an organization's operations and enables some preventative maintenance techniques. Although these systems maintain information that helps plan, optimize, execute and track needed maintenance, they still require significant manual work to retrieve, compile and analyze data – a daunting, resource-intensive task.

The benefits of predictive maintenance

The U.S. Department of Energy statistics show predictive maintenance can deliver the following:

- Achieve 25 to 30 percent return-on-investment (ROI) with lower maintenance cost
- Decrease failures 70 to 75 percent
- Reduce equipment downtime 35 to 45 percent

Reactive maintenance costs four to five times as much simply because failed equipment reduces overall plant productivity, causes inventory backup and reduces overall efficiency.

Predictive maintenance

Often confused with preventative maintenance, predictive maintenance begins to make use of industrial IoT capabilities to identify more precisely when equipment requires maintenance – as close to failure as possible – to get maximum uptime and reduce maintenance costs. Predictive maintenance uses data gathered from IoT-connected equipment continuously over time and provides a far more precise trend profile based on performance. Data is collected as the equipment is running, so it doesn't need to be taken offline.

Deploying effective predictive maintenance requires an IoT system to integrate several crucial components, including wireless-enabled sensors on equipment to produce data and network capabilities to share it with the ability to do advanced analytics.

With data from sensors monitoring equipment and performing automated data analytics governed by an IoT-based predictive maintenance solution, companies eliminate the guesswork that characterizes scheduled maintenance and instead can leverage insights based on real-time measurements, reducing and often eliminating errors.

Higher-end IoT-based predictive maintenance schemes leverage artificial intelligence (AI) and integrate CMMS capabilities. As an example, a machine senses a drill bit wearing out, orders a new one, alerts the service department to send someone to install it, and forwards the purchase request for the new part to the CMMS. All this information is stored in the CMMS, which performs a variety of functions, including maintaining and organizing regulatory compliance data, tracking completed tasks, compiling labor costs, managing vendors, performing purchasing activity, monitoring assets and producing data needed for budgeting.

With an IoT-based system, companies can incorporate additional advanced analytics capabilities into their predictive maintenance solutions, which allows them to create insights that drive significant performance improvements, including the following:

- Asset perfomance management – models the structure of an industrial process and enables companies to track specific data sources that are relevant to determining machine performance
- Fleet management – provides an overview of a company's assets by allowing users to establish performance parameters and set an alarm to go off when performance deviates from expectations

Higher-end IoT-based predictive maintenance schemes leverage artificial intelligence (AI) and integrate CMMS capabilities.

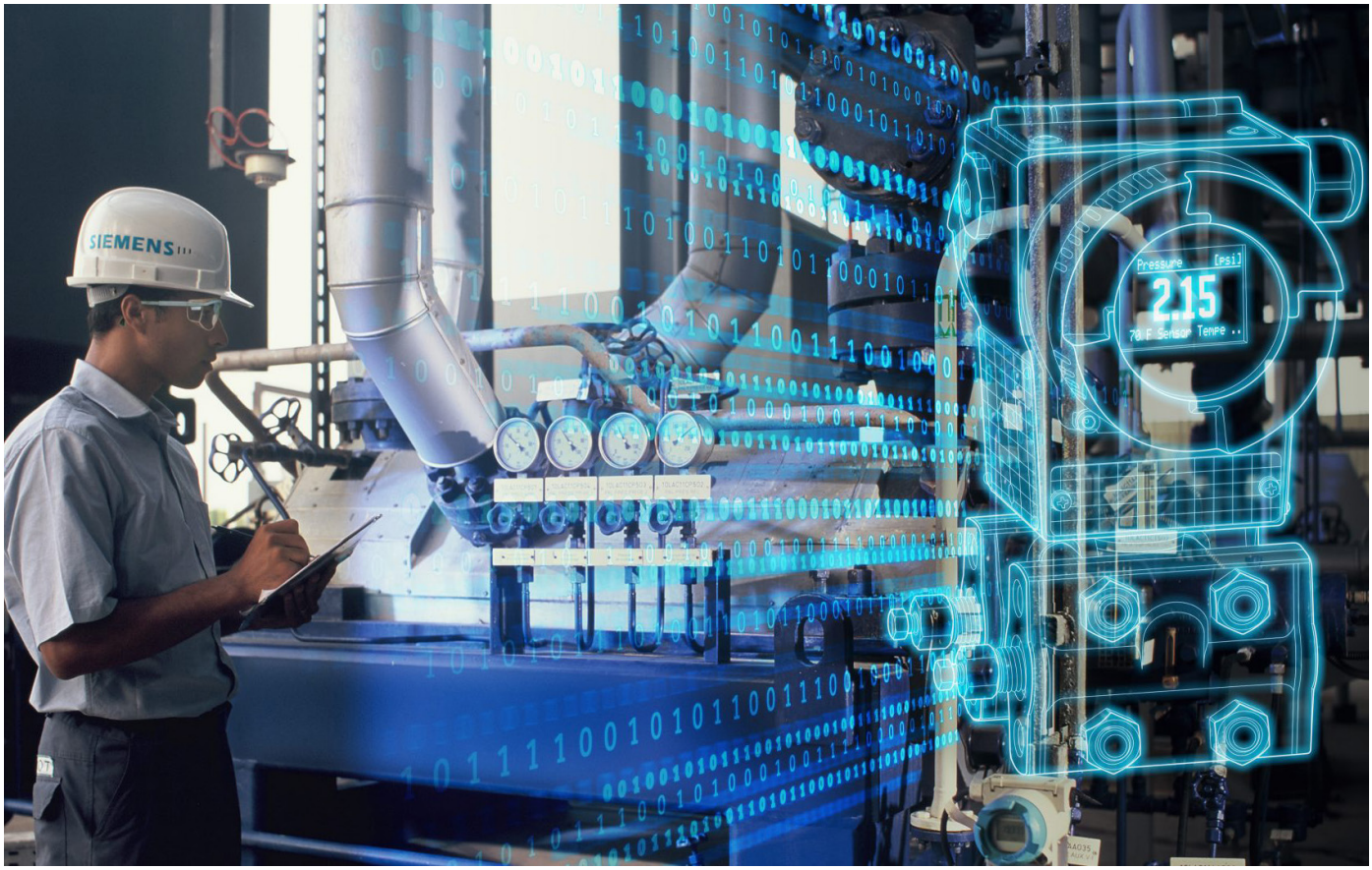
Real-world results

Predictive maintenance is already being deployed by companies that want to elevate their maintenance programs to the highest levels of maturity. For example, a service provider that helps rail operators increase their return-on-assets (ROA) while improving the reliability and safety of rail transport. The company's goal is to help organizations reduce maintenance costs and unplanned downtime, as well as increase the efficiency of operation planning while reducing risks and costs.

Using an IoT-based solution, the firm detected the initial stages of an asset failure, which helped prevent downtime. The solution also increased the efficiency of operation planning, which reduced maintenance costs and energy consumption, making its rail service more competitive with other transport options. Because the system also performs much of the maintenance it identifies, the company reduced unnecessary transfers to maintenance, leading to greater operational efficiency.

As a result, the firm:

- Proved asset reliability of greater than 99 percent
- Optimized operation planning with up to 20 percent fewer delays
- Achieved more effective root-cause analysis and reduced complex fault resolution times by more than 20 percent



Take predictive maintenance to the next level

While predictive maintenance enables smarter and faster root-cause analysis, reduces unnecessary downtime and provides visibility into the health of remote machines, prescriptive maintenance moves facilities to a more automated approach. With an IoT-based prescriptive maintenance approach, industrial facilities gain the ability to have the maintenance system resolve issues autonomously.

With IoT, companies can further augment the power of prescriptive maintenance using AI and machine learning in combination with sensors to diagnose the root cause of problems, indicate appropriate remedial actions and manage the entire maintenance process. Companies that integrate their systems with the IoT can build a prescriptive maintenance approach that not only knows when maintenance must be undertaken, but also who should perform the work and at what cost. An IoT-based prescriptive system also allows companies to automate all aspects of maintenance, including ordering the required parts, scheduling the service, accounting for the time and cost, keeping track of parts on hand and ensuring that the job is informed. All these steps can be performed by the system autonomously in a fraction of the time required by any previous maintenance scheme.

Prescriptive maintenance also enables industrial teams to review and simulate the system's suggested remedial actions, so they can choose the resolution that aligns with their operational and financial goals. Additionally, it helps operators understand when operating conditions, such as running a pump at a supplier's recommended discharge pressure or temperature, are leading to suboptimal health or performance so they can proactively correct them.

Manufacturers that deploy a prescriptive maintenance solution significantly reduce costs, prolong asset life and optimize factory production.

The accuracy of prescriptive maintenance systems becomes better over time based on the accumulation of data and analysis of equipment characteristics and behavior, failure modes and many other events that occur during operation.

Ultimately, prescriptive maintenance delivers more significant insight into the health and performance of critical assets, so industrial teams are better able to predict asset failure and act before downtime occurs. Because they can maintain assets on a need-only basis, virtually eliminating unplanned downtime and unnecessary maintenance, companies that deploy a prescriptive maintenance solution significantly reduce costs, prolong asset life and optimize factory production.

Conclusion

As the industrial IoT becomes mainstream, companies that fail to implement IoT-based prescriptive maintenance capabilities will be unable to meet the new industrial maintenance benchmark: zero unplanned downtime. To remain competitive, companies must optimize asset performance and minimize failure, as even brief periods of downtime can result in reduced revenue, excessive overhead and strained resources. Margins are razor thin in manufacturing, so excessive maintenance costs and lost production time are unacceptable. During unplanned downtime, no value is produced even as overhead continues to grow and employees, from the factory floor to information technology (IT) to customer service, must scramble to mitigate damage to assets, revenue and public perception.

Industrial IoT-based predictive maintenance solutions simplify the transition from earlier maintenance methods by facilitating the seamless connection of all factory assets and enabling a centralized view of performance and health. Further, leveraging predictive maintenance empowers manufacturers to better understand the outputs of various maintenance tasks, allowing them to make informed decisions that align with companies operational and business needs.

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