Asset Management (Maximo)

Using the Internet of Things for preventive maintenance

Watson IoT

IBM

– Gain operational effectiveness and
  Return on Investment (ROI) with the
  Internet of Things (IoT)
  and business analytics
– Infuse your asset management
  system with new cognitive capabilities
  for immediate insight into asset
  health and optimal preventive
  maintenance scheduling
– Manage your full asset portfolio with
  a single, integrated solution including
  Asset Health Insights, IBM® Maximo
  and Watson IoT Platform.

As much as 70 percent of your investment in preventive maintenance has no effect on your uptime metrics. How can you improve operational effectiveness and ROI?

"Unless there is a dominant age-related failure mode, time-based overhauls do not improve the reliability of complex items. In fact, it is highly possible that time-based overhauls would introduce [early life] failures in otherwise stable systems."

  - Dr. John Moubray, a pioneer in the science of reliability

The IoT is proving to be one of the great technology phenomena of our time. By infusing intelligence into physical objects, new capabilities such as cognitive computing are able to give businesses deeper insights into their assets and unlock the true value of the physical world. For the first time, this new world of cutting-edge machine learning and real-time analytics is combining with leading enterprise asset management platforms like IBM Maximo to give businesses a complete view of their assets - from a single seamless platform.

Your assets are the heart of your business. But are you fully utilising insights to optimise your preventative maintenance practices? With maintenance budgets running in the millions of dollars for many enterprises, the potential ROI from the optimisation of preventive maintenance can be significant. Many organisations that depend on physical assets to achieve their mission follow a mantra of *never fail* as a maintenance strategy. Yet operational and capital budgets are tightening, forcing companies to find creative ways to achieve higher levels of availability. They also must reduce unplanned corrective maintenance, while maximising ROI for limited funding by strategically deploying preventive maintenance.

Technology has rapidly evolved to help asset managers with this dilemma. Deploying and connecting sensors has become far less costly and asset management and analytics software can make sense of large volumes of data. IBM works with thousands of asset-centric companies - across all industries - and believes that by monitoring asset health and taking action on data from assets, companies can vastly improve how they conduct maintenance. In doing so, they will achieve much better ROI on their preventive maintenance efforts.
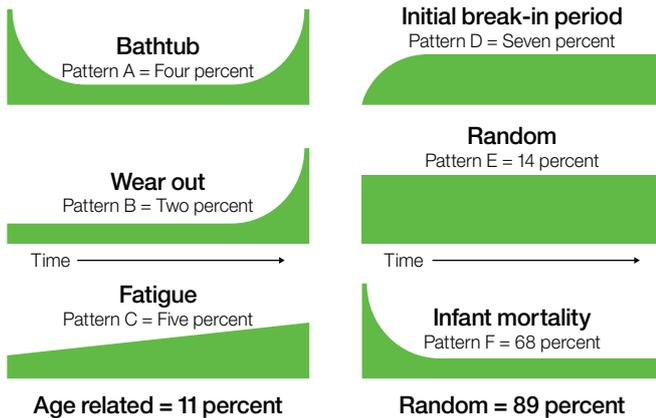
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Figure 1:
Failure curve models

How are traditional maintenance approaches failing?

Every maintenance team understands that under-maintaining assets can result in frequent and long breakdowns, high volumes of unplanned work and lost product and output. But the costs of unplanned corrective maintenance are less obvious - overtime salaries, expedited costs and even safety risks. This kind of maintenance can have a negative impact on the useful life of assets. Also furthermore, excessive maintenance of assets can also be wasteful. Over-investing in maintenance squanders precious resources, which directly impacts cost and profitability.

The bathtub curves seen in Figure 1 are used most commonly in reliability engineering to describe the ways assets fail. The size and position of the curves represent failure events at early, mid and late stages of an asset or component.

In the 1960s and 1970s, the airline industry and the US Navy performed studies to get a better understanding of how assets fail. The resulting failure patterns are categorised into two groups - age-related (left column) and random (right column). Only 11 percent of failures follow an age degradation pattern; 89 percent of failure patterns occur at random.

Given these patterns, how do you know when it's the right time to maintain assets? What is the best way to assess the health of your assets? Is it possible to get an early indication of potential failure if time in use is not a meaningful indicator?

Some organisations study usage counts, such as flow meters, revolution counts or materials produced, as an indicator of an asset's condition. However, these are indirect measures; they are not actually monitoring the asset and may not always apply or correlate with the failure patterns. For some assets, manual inspections or meter readings are used to indicate the condition of an asset. But this is a costly and subjective approach that relies on worker experience and knowledge. Besides, with many experienced workers retiring, this approach may not be sustainable even if it was proven accurate.

Fortunately, technology has evolved to augment human intelligence and monitor asset health more accurately. This is what IBM refers to as asset health insights, a new technology solution that combines traditional Asset Health Insights with sensors and cognitive computing to provide a superior approach to maintenance that optimises investments and helps to achieve better outcomes.

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What is asset health?

Most equipment manufactured today have built-in sensors and provide real-time information to industrial control systems such as Supervisory Control and Data Acquisition (SCADA) systems, Building Management Systems (BMS) or Programmable Logic Controllers (PLCs). For older equipment, there are simple ways to retrofit assets with sensors. Also communications networks that gather data from assets - in the form of cellular networks, wifi, Bluetooth and other technologies - have become more economical and ubiquitous even in sensitive plant environments.

As a result, operations teams can make use of streaming data from assets to monitor equipment performance and watch for early warning signs of failure. Asset management solutions have evolved accordingly:

- Out-of-the-box (OOTB) technologies are now available to collect, filter and map real-time data from equipment and make it available to reliability engineers and maintenance professionals for optimising preventive maintenance
- Cloud technologies are providing a cost-effective way to aggregate, store and use advanced analytics against massive amounts of data coming from equipment, in combination with other sources
- Analytics technologies are becoming more powerful in not only capturing tribal knowledge of engineers, but also for uncovering new, hidden patterns that can be used to predict failures. They are also becoming simpler to use, even by those without advanced statistical knowledge. Today's flexible analytic technologies work with data from multiple sources and in different formats. They even make sense of non-traditional, unstructured data formats such as video.

In a recent study published by ARC Research, 65 percent of predictive maintenance signals are communicated to maintenance teams, but only 23 percent of these signals are integrated with work management systems. This means that companies aren't taking full advantage of the data produced by their assets. ARC Research says that as much as 50 percent of preventive maintenance work routines could be eliminated by transitioning practices from time-based predictive maintenance cycles to condition-based cycles.

While operating metrics such as units produced are critical data, they are only part of the information needed to gain a true understanding of asset health. Other data contributing to an accurate determination of health include age, service history, failure history, configuration changes over time and numerous other data points through an asset's lifecycle.

Your assets are talking. Are you listening?

There are many use cases where real-time information can inform and optimise preventive maintenance. Consider the following industry examples:

- *Pharmaceuticals:* 'The air pressure readings on both sides of my filter don't match up.' This information could drive a replacement only when needed, eliminating the cost and disruptions of unnecessary filter changes
- *Utilities:* 'The amp and voltage levels from my fan are fluctuating.' This indicates and predicts a bearing fault, helping to avoid potentially catastrophic downtime
- *Retail:* 'The refrigeration unit in my cooler in store 10 has been running continually for more than four hours.' This is an indication that there may be a leakage of cooled air. Repair of door springs could save wasted energy and prevent spoilage
- *Rail:* 'The oil viscosity in a locomotive with a certain component configuration is consistently higher than other locomotives.' An analysis of underperforming components can help drive improvements in other faulty configurations and reduce the number of failures across the fleet
- *Oil & Gas:* 'My compressor is being overused,' Energy consumption outside acceptable parameters indicates that the compressor is being taxed beyond its capacity for the purpose. Changing out the compressor to a larger model reduces the number of failures, while improving safety and lowering costs.

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This information is typically stored in an enterprise asset management system such as IBM Maximo Asset Management. Thus, in order to provide a complete picture of asset health, we need to analyse real-time and historical sensor data, along with the asset history.

A comprehensive asset health system provides analytic tools that are easy to use and designed for the specific needs of engineering or maintenance professionals. Bringing filtered and relevant real-time information together with asset and maintenance history into a simple but customisable application revolutionises the way preventive maintenance is optimised.

The benefits of asset health systems go beyond optimising maintenance and obvious cost savings. Aligning maintenance investments to the demands of equipment saves money and improves effectiveness, allowing equipment to perform at the optimal level. Work planning becomes more efficient, as well, creating savings beyond core maintenance and mitigating operational risks. Labour costs are typically reduced using asset health solutions and worker health and safety is improved because operations teams are able to avoid dangerous, ad hoc projects and conduct maintenance procedures only when required.

How do asset health solutions work?

The IBM Maximo Asset Health Insights solution comprehensively manages asset health for an organisation's entire asset portfolio. The process begins by gathering data streaming from sensors using the Watson IoT Platform to illustrate real-time condition data. Data from intelligent sensors can feed directly to the platform or by connecting to an existing control system (SCADA, PLC or BMS) through gateways such as SCHAD's Automatic Metre Reading product.

This data is then combined with historical data in IBM Maximo, where engineers can define baseline health for each asset or for a class of assets across their operations. The streaming asset health data is used to monitor the health of assets against the pre-defined rules. It is then scored and visualised to easily understand potential problem areas and accelerate preventive maintenance.

Dashboards display assets and their health in intuitive ways such as in a map, list or hierarchical view. Operators can explore the health of individual assets for further analysis or information, such as sensor or meter data history or current operating condition. External data, such as weather conditions relevant to an asset or the type of operation it is performing, can also be brought into the system and visualised to help improve maintenance decisions. For high-risk assets, notifications can be sent automatically based on a change in health status.

Because of data, operations teams can plan preventive or corrective maintenance based on a deep understanding of asset performance patterns. If issues should arise, IBM Maximo offers complete tools across the asset maintenance lifecycle, including mobile solutions to help field operations mitigate issues quickly and effectively.
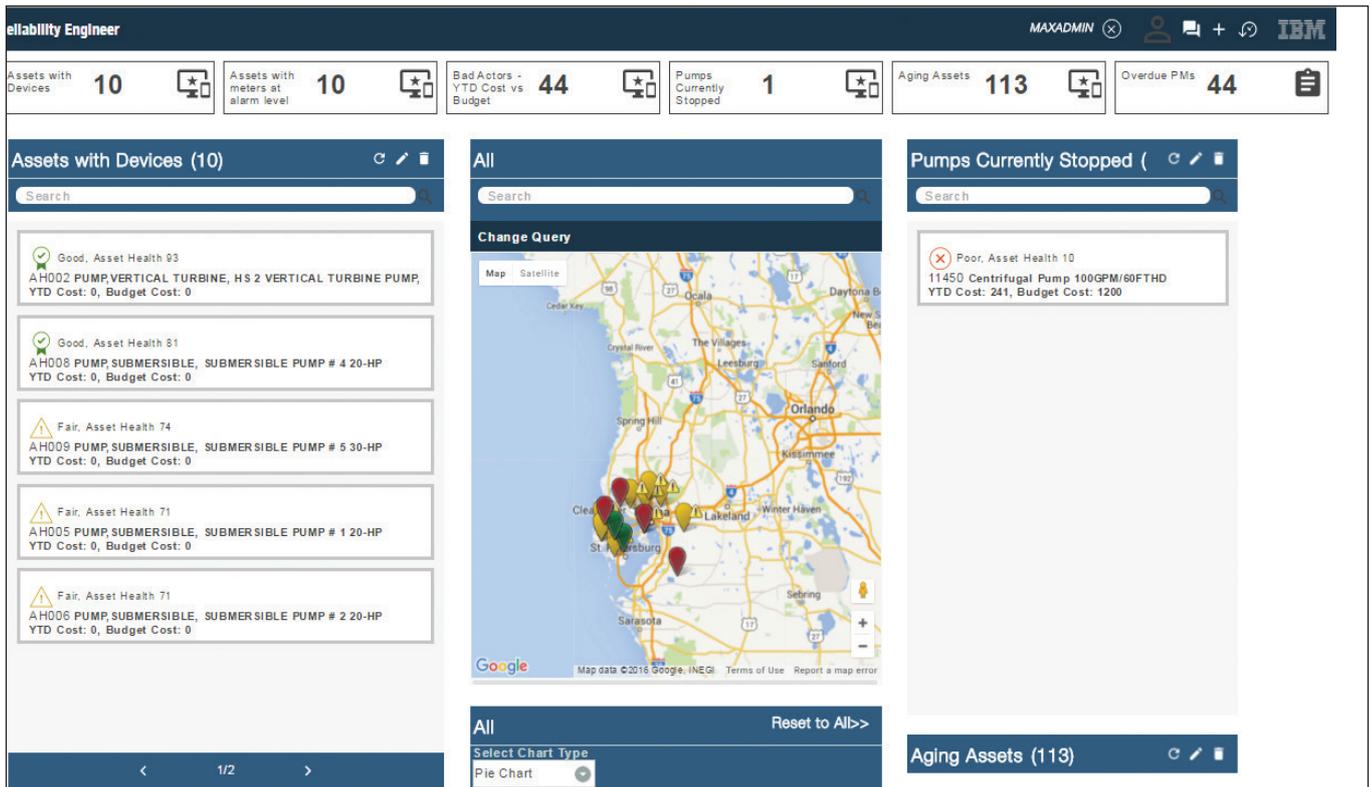
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Figure 2:
An asset health dashboard provides comprehensive understanding of current asset health.

The cognitive future of asset health

While asset health solutions are leveraging innovations in business analytics and IoT to deliver results, the potential is not yet fully realised. As insights from asset data are aggregated and analysed, new models of normal and abnormal emerge. For example, increased power demands for the startup of a pump drawing heavy materials might be normal for that type of product load. Similar power demand for a pump drawing lighter loads, however, could be indicative of a problem. These comparisons shed light on previously unknown behaviours and equip maintenance teams with more precise insight into how assets should be behaving. The next evolution in this area of analysis is based on machine learning. As cognitive models continually improve, they can provide prescriptive recommendations for next best actions, further augmenting human knowledge with technology.

The cognitive computing capabilities of IBM Watson can consume and understand large data sets that are impossible for humans to easily analyse. As part of the IBM Watson IoT division, Maximo Asset Management capabilities are now augmented with world-class analytics to make real-time recommendations on maintenance based on asset health, offering the promise of previously unthinkable levels of optimisation and reliability.

Organisations that are considering a more predictive approach to maintenance may also be interested in IBM Predictive Maintenance and Quality capabilities, which use a multitude of other data, including historical and real-time asset performance data, to develop models that identify pending asset degradation or failure. Then, through integration with Maximo, work orders are initiated to proactively remedy problems.

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How can you get started?

Your journey begins with a better understanding of asset health to drive greater levels of efficiency and reliability:

– Leverage OOTB capabilities, such as SCHAD's Automatic Meter Reading solution, to collect real-time usage information in the IBM Maximo Condition Monitoring solution and to link early warnings to mobile work teams

– Define thresholds for asset performance indicators in IBM Maximo Asset Management for some of the simple uses cases that can optimise preventive maintenance. Examples include temperature, pressure or energy meter thresholds

– Begin to collect, store and analyse your real-time information in the Watson IoT Platform

– Implement the new Maximo Asset Health Insights add-on module to combine real-time and historical sensor readings with related static information on the asset - such as its age, past failures and work routines - letting you gain insight into how to optimise preventive maintenance strategies.

Many publicly available studies articulate the problems with current maintenance practices. For decades, the industry has been aware of the unpredictability of asset failure patterns. Due to the high-risk nature of their operations, the only solution for *never fail* situations has been to over-ensure uptime with redundant equipment and too many parts on hand - an unsustainable model. Fortunately, technology has evolved to answer this problem.

Costs of sensors and communications have come down; cloud computing makes the information ubiquitous and secure. This makes it a good time to explore your opportunities to drive costs out of maintenance while mitigating risk to your operations - the time to see what IoT and IBM cognitive analytics can do for you the health of your assets and your organisation.

Learn More

Explore the power of Watson IoT Asset Management Solutions
ibm.com/internet-of-things/iot-solutions/asset-management

Explore the business value of enterprise asset management platforms in Industry 4.0 by reading the White Paper
ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=TIB14016USEN

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