T.A. Cook

A T.A. COOK WHITEPAPER

Two Life-Hacks for an Asset Digitalization Strategy

Ways to ensure a successful initiative

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Introduction

With digitalization at the forefront of manufacturing organization's minds, there has been a myriad of pilot projects and full scale implementations taking place across the globe. Using digitalization and predictive analytics to improve asset management strategies is certainly a top initiative as these companies work to extract additional value from their existing asset infrastructure. Studies have shown most companies agree that the benefits can be enormous and those that sit out of this latest business trend will be left behind as they miss the competitive advantage this innovation can bring. Making the transformation to using predictive analytics can bring its own struggles though. Recent studies have shown that ~80% of digital transformation initiatives fail to meet their objective and therefore, they never scale beyond their original pilots.

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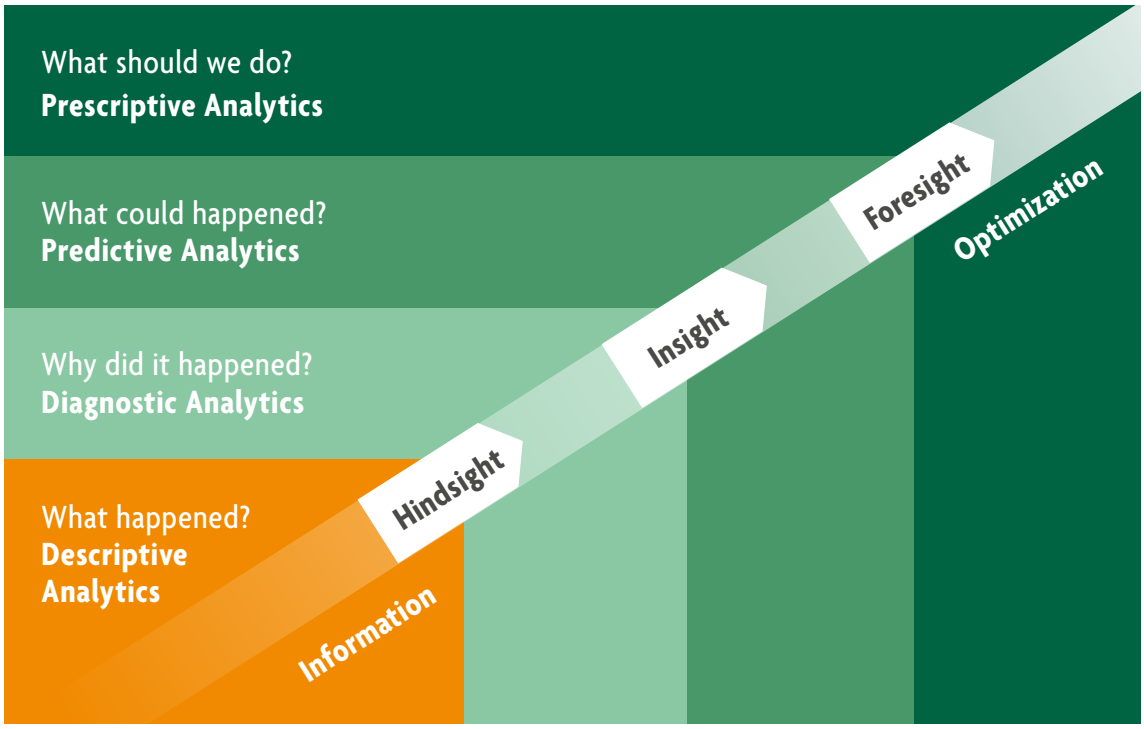
The purpose of having a digital asset management strategy is so an organization can move from Descriptive and Diagnostic analysis to Predictive and Prescriptive. Rather than making decisions based on what has happened in the past, they focus instead on what is going to happen in the future and take defined actions based on automated analysis.

After talking to many companies that have not had particularly good success deploying an asset digitalization strategy, our team of experts found that there is a common approach (or lack of) to their strategy. In this paper we will discuss two of the key components that will help to ensure success. I refer to them as "hacks", like a life hack* but instead, for asset management. Adding these components to your approach will not only increase the efficiency of your model development but also its efficacy once deployed.

***Life Hack**
Any trick, shortcut, skill, or novelty method that increases productivity and efficiency in all walks of life.



Data Analytics can be classified into 4 different types ranging from lagging information to leading information. Each type is more complex than the previous but can bring more value to the organization.

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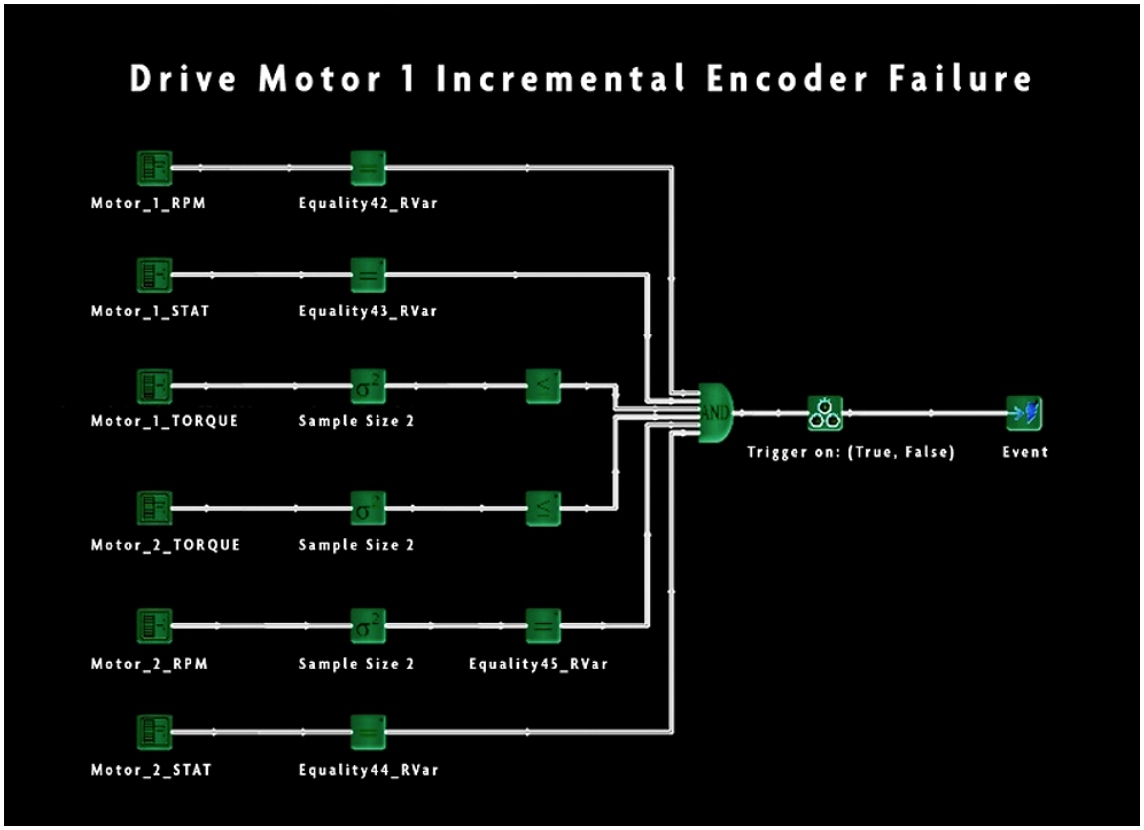
Hack 1 - The FMEA Advantage

Failure Modes and Effects Analysis (FMEA), when applied to asset management, is the process of reviewing equipment and their components to identify potential failure modes, their causes, and the effects of the failures. Mitigation strategies are then defined for each failure cause from one of the following options:

- **Predictive maintenance tasks –** use of technology to unobtrusively measure equipment condition
- **Preventive maintenance tasks –** reoccurring, scheduled overhaul or replacement
- **Detective maintenance tasks –** reoccurring, usually intrusive, inspection. Especially effective with hidden failures
- **Run-to-failure –** no predictive or preventive tasks assigned because the consequence of failure is low or palatable
- **Redesign or one time changes to eliminate the defect**

Asset digitalization strategies arguably add a sixth mitigation strategy. Like predictive maintenance tasks, it seeks to recognize the onset of a potential failure early however; with the introduction of machine learning techniques, the patterns that eventually lead to a potential failure are now able to be recognized, often in real time. This brings an even earlier warning thus allowing for more options of mitigation that are tailored to the business' current needs.

FMEAs should be used as a guiding document when building the digital strategy for equipment monitoring. Experience has shown that having FMEAs that are manufacturer/model specific



Example failure tree. Each node contains the business rules to determine if a failure exists.

create the right amount of detail for scalability later in the initiative. This will provide us with three distinct advantages.

1. Predictive analytic models should be failure tree based. The failure modes and causes that create an undesired state of equipment operation can then be analyzed using Boolean logic to bring together the series of lower level events that lead to the failure. The Boolean logic created then becomes the base of the analytical models used to monitor the equipment for the undesired state. Developing the fault trees becomes exponentially easier when the FMEA is available and utilized.

2. As discussed earlier, FMEA worksheets include mitigation strategies for defined failure modes and causes. When defining a digitalization strategy for monitoring equipment, one is most likely replacing previously defined tasks. For instance, previously defined inspections may be replaced with new, continuous monitoring strategies based on sensor data being collected. On the FMEA

worksheet, simply add what sensor data can be used to identify the failure cause and define the online rules for detection. The advantages of doing this are:

- The documentation will leave a "bread crumb trail" on what has been included in a model and why.
- It provides information to the rest of the organization on how the analytical models work. This transparency provides acceptance within the organization for the new digital strategy. No one trusts a "black box".
- As the digital strategy is documented, gaps on failure causes not able to be monitored are easily identifiable. Add a field to the FMEA worksheet to document what sensors would need to be added to bring those causes into the digital strategy. This will also help build the business case later for adding those sensors.
- Documenting the digital strategy will help assist with making notifications of a deviation more prescriptive in the repair actions that are needed.

An important thing to remember is that when older mitigation strategies are replaced with new monitoring and analytics, the previous task needs to be removed from the system in order to realize the financial benefits of an asset digitalization strategy.

3. While everything described so far may seem like an enormous amount of effort, the payback for it is scalability. Once a new digital strategy is completed, the approach can be applied across like-for-like assets. This will greatly accelerate the transformation across the enterprise helping to realize other value levers such as quicker training and learning of the predictive models.

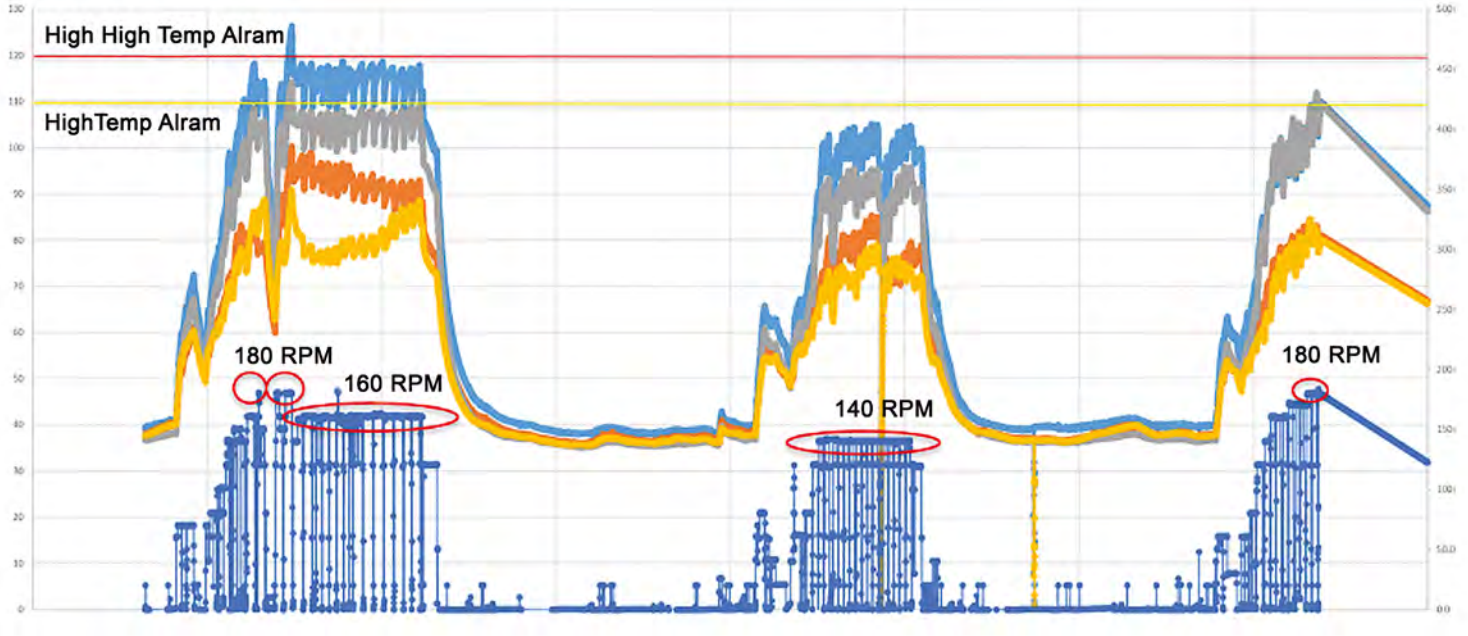
Hack 2 - The Need For Correlated Data

For many years, companies have used Distributed Control Systems (DCS) that received sensor data for running a plant system. Many of the sensor inputs were programmed with alarm setpoints to warn an operator of a problem. While this is useful and allows the operator to adjust operating parameters as required, it gives no real insight to potential equipment issues unless an alarm cannot be cleared and a call goes out to the maintenance crews to investigate. At this point, a system may be already experiencing an equipment problem thereby making the repair a high priority and having a cascading effect to operational availability and the maintenance schedule.

An asset digitalization strategy should have a goal of identifying the onset of failure early. Mature programs are capable of recognizing a series of events that occur before the onset of the failure allowing data driven decisions to be made based on operational needs. To do this well, and to advise correctly on actions to take, we must move from using single sensor inputs that trigger alarms to a program of considering multiple correlated inputs that can determine the cause of the problem. Utilizing machine learning with this method will also allow for recognizing the data trends earlier that lead to the specific cause. Consider the following event.

A critical, variable speed asset was triggering a high temperature alarm from a water cooled, drive motor bearing. Fearing the worst, it was decided that the drive motor would be changed out with a new spare. The repair would only cost $65k for the motor and take 238 man-hours. The site also experienced 96 hours of downtime resulting in $2.4 million of lost revenue for the repair.

One year later, (to the month) the new motor began to trigger the same high temperature alarm. The site decided to grease the bearing which silenced the alarm so they thought the issue was resolved. Within a week of the event, the new digital monitoring system was set up and the analytics model picked up several deviations almost immediately, triggering an investigation. The results found:



Data plot for bearing temperatures versus RPM

- For the current ambient temperature, bearing readings were +30C higher than any other like equipment across the company.
- The high temperature alarm triggered when the driven equipment speed was increased to >160 RPM.
- Once the bearing had been greased, the equipment speed had also been reduced to 140 RPM. (which was the real reason the alarm quit)
- Throughout the last year, the equipment had never been operated above 140 RPM.
- Bearing temperatures were only 5 degrees C below the alarm threshold and if the speed was increased back to >180 RPM, it would trip the high temp alarm again.

How were these facts discovered? The models did not take into account just the temperature reading from the bearing. Instead, several data points were correlated within the model:

- **Bearing temperature**
- **Ambient temperature**
- **RPM**
- **Acoustic / Vibration readings (same sensor)**
- **Cooling water temperature in and out**

Separately, all the readings appeared within limits but when correlated together, a true bearing defect would have also affected other sensor inputs. For example, acoustic readings would be elevated as well as the cooling water temperature out. Because the model utilized multiple inputs for each failure cause, it was easy to recognize that the assumption from the technicians that the bearing just needed grease was incorrect. A quick test found that the signal converter from the sensor to the operator's control panel was bad. The problem now became a $300 fix with no unplanned downtime. By utilizing the new models and analysis techniques, the site was able to avoid another needless and expensive repair.

Conclusion

Digitalizing asset monitoring and creating predictive analytic models is bringing enormous benefits to those companies making the investment. Solving “What Could Happen” by using a structured approach and basing the model creation on failure modes and their causes, will allow the team to stay focused and relevant to the defined initiative. Multiple data inputs for each failure cause will aid in the “What Should We Do” analysis allowing the system to be prescriptive in the actions that are recommended. Making these types of data driven decisions on equipment repairs is now becoming the “new normal”.

About the Author

Tim White, Senior Manager

In his role as Senior Manager at T. A. Cook Tim White is focused on providing services related to Digital Asset Performance Management. Previously he worked in industry as a Global Director for Asset Management, responsible for 83 sites across the globe. Tim brings this real-world experience with him as he engages multiple clients to help them solve their asset management and maintenance strategies.

Contact:

About T.A. Cook

Optimize technical and organizational processes and ensure maximum productivity and availability: The management consultancy, T.A. Cook, supports leading companies from the process industry with the design and implementation of asset performance and asset management strategies. The company's consultants, engineers and Change Management coaches rely on state-of-the-art digitalization tools and management methods to provide unique expertise in maintenance, precision maintenance, engineering and reliability management as well as production and supply chain management.

Founded in Berlin in 1994, today more than 160 employees work worldwide to support customer projects, to identify and optimally align performance-relevant factors for their industrial customers. In addition to the integration of state-of-the-art technologies and approaches, it is the experience gained from countless customer projects which helps to ensure the success of each individual measure.

In 2020, T.A. Cook was named by the Scientific Society for Management and Consulting (WGMB) as a „Hidden Champion of the Consulting Market 2020" in the category „Asset Performance Management" and relegated well-known industry giants to the ranks. T.A. Cook was also named as a „Leader in Asset Performance Management" by the US-based ALM Intelligence 2019.

Today, workshops, seminars and conferences are also part of the company's portfolio.
To transfer know-how and share experiences, the company organizes, among others, the TAR Turnaround Summit, the maintenance conference MainDays, various SAP conferences and interactive workshops such as TARfighter. In addition, T.A. Cook organizes focus group meetings where leading industry experts can meet to discuss and exchange information on benchmarks and next practices.

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