VOICE OF THE MACHINE™

IoT Empowered

Using IoT Analytics to Build Customer Solutions

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USING ANALYTICS TO BUILD CUSTOMER SOLUTIONS

Data fuels the progress of our digital world in many ways: personal devices, medical systems and online commerce. But public works systems, factories and transportation can also benefit from the collection and application of data. This realization has driven heavy investment in the Internet of Things (IoT) across all major industrial markets. Everyone is seeking value in their IoT application. However, without a well-defined analytics strategy, it is hard to make sense of the data collected.

Device data has value when it can be collected, analyzed, interpreted and then used to derive insights to drive improvements in productivity. These productivity gains scale in value according to the level of insight and automation of the system in question. Solutions can be as simple as remote diagnostics and as advanced as self-optimizing control systems. The journey to move from diagnostics up through automation starts with understanding the problems that need to be solved.

In Industrial IoT, the primary objective is often to monitor and optimize equipment health and productivity. This requires machine-level insights so that machines can self-report the difference between optimum and actual performance.
But machines themselves tend to be systems of systems, each crafted from components. Often-times, generating insights at a machine or system level requires deep visibility at the component level. These components need to be represented digitally as models for expected behavior, and by combining these digital representations, customers can understand when their systems are exhibiting suboptimal performance.

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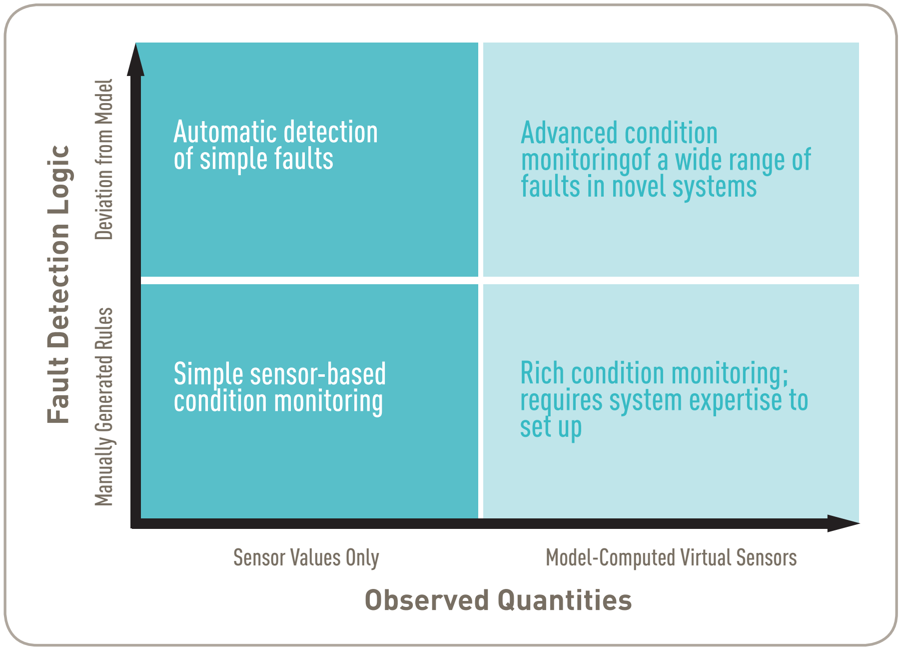
These component- and subsystem-level insights are where Parker Hannifin shines. In fact, Parker's century of experience in motion and control technologies and their understanding of systems and components are the foundation of the company. Parker's focus in IoT—through its platform called Voice of the Machine™—is on component- and subsystem-level insights referred to as Discrete IoT. Discrete IoT is a component-centric approach—where distinct component insights form the foundation for higher-level system, machine and even fleet-level productivity gains.

Parker's approach to deriving value from IoT centers on contextualizing the data collected from machines. Models of both the overall system and of the individual components are constructed and then leveraged to produce insights. It's a mirrored reality where digital twins of components are connected to build digital twins of systems, much like the way their physical counterparts are assembled. Once insights are identified, opportunities emerge for customers to create actionable improvements (e.g., adjustments, fine-tuning, modifications, changes) within their existing processes and systems. Supported with the model-validated insights, Parker's customers who leverage Voice of the Machine™ solutions

How Digital Twins Accelerate Condition Monitoring

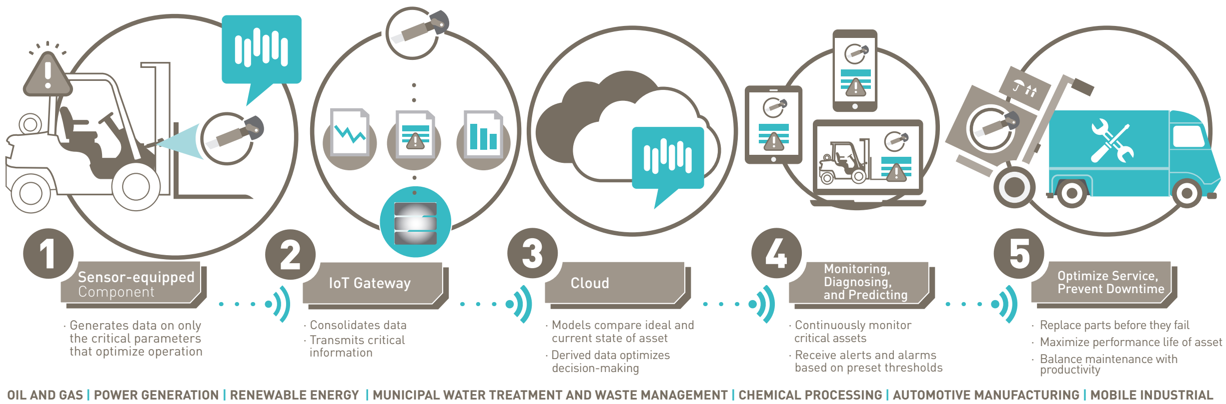


are better equipped for decision-making, planning and management of their operations.

How Discrete IoT Empowers Decision-Making

The real value of Industrial IoT comes from the ability to derive useful information from machine data. To enable that type of decision-making, machine- and component-level knowledge must be combined with top-level operational goals.

Taking IoT the “Last Mile” with Discrete Component Monitoring



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Consider the task of scheduling maintenance for a factory machine. Decisions about stopping machines, interrupting operations and performing maintenance often depend on many factors: What is the production schedule? Is there planned downtime coming up? How much will it cost to replace? What is the loss of performance cost compared to the cost of replacement? How long will the machine be down? If a worn component doesn’t get changed, how will that affect performance or safety? Understanding the answers to these questions is central to making better decisions. But just as important is collecting and analyzing the right data in a way that delivers actionable insights about the machine itself.

For instance, deciding what to do with a clogged filter in a machine requires an understanding of the possible scenarios that might play out if the filter continues to clog and decreases flow in the machine. Those scenarios include not only what happens to the filter but also the impact on the machine’s operation, such as diminished product quality, if attempting to continue to use the clogged filter. These types of questions can be addressed through machine and component models.

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In this situation, component modeling effectively tracks filter blockage over time, letting the machine operator know how blockage increases pressure and reduces filtration efficiency. However, determining when the filter reaches the point where it must be cleaned or replaced involves big-picture information about the operational tradeoffs between downtime and performance. This knowledge allows the machine owner to optimize machine health and output, improve service scheduling, calculate costs for downtime and minimize negative impacts of clogged filters. The jumping-off point for all of this analysis originates with the knowledge of a single component: the filter.

How Digital Twins Deliver Insights

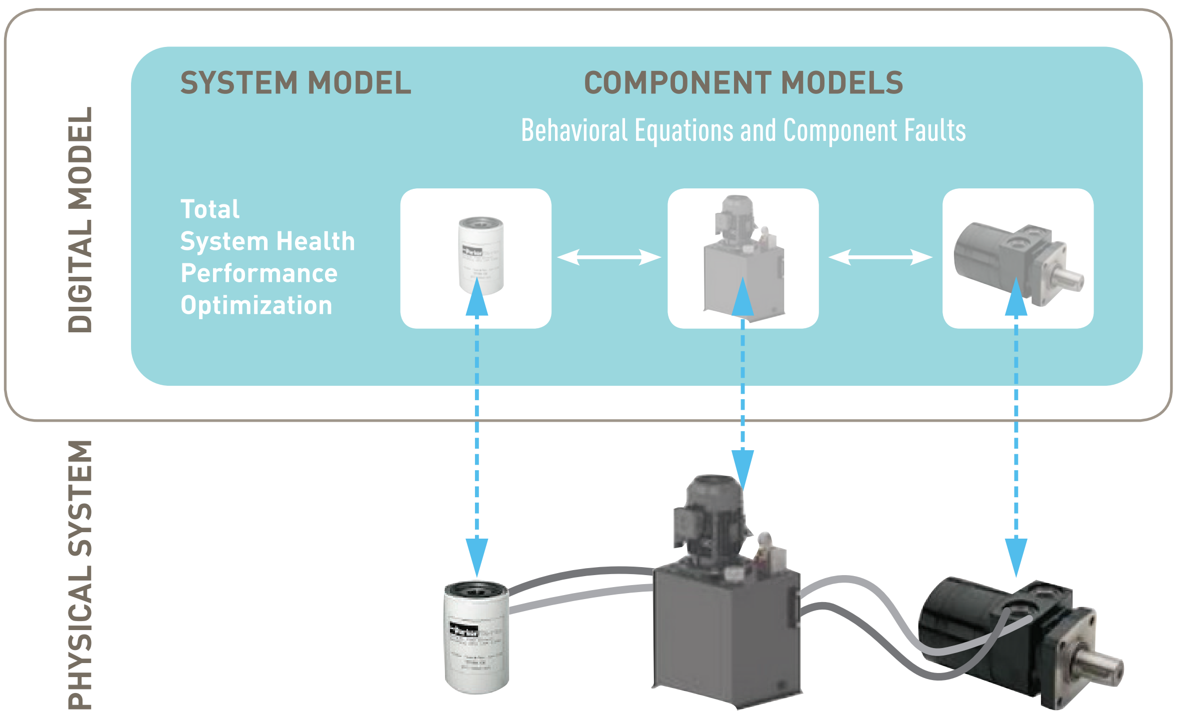
In many cases, data enables optimization of Parker's products in customer applications. The ability to maintain online virtual models (digital twins) of physical assets is key to the process. Sensor data from the actual device is sent to the cloud, where the digital twin algorithm maintains parity with the asset's current state. It's the actionable insights discovered through these digital twins that guide IoT analytics at Parker.

The most immediate use of a digital twin is to compare the ideal or expected state with the current state of the machine. If the component is working as intended, these two should align. Any discrepancy can provide insight about what is broken on the machine and the amount of service life remaining in consumable elements inside the machine. Digital twins form the foundation of advanced condition-monitoring.

For example, Parker's IQAN® Connect product helps OEMs remotely connect to the electronic control systems in heavy-duty mobile machinery, enabling them to collect diagnostic information as if they were in the field, hooked up to a test set. Comparing actual and expected component performance enables weekly reports on overall fleet health and alerts that customers can receive recommending action.

Another way digital twins enable insights is by allowing customers to infer physical values that are not directly or easily measured, helping to reduce measurement costs and decreasing the number of data points needed. Additionally, quantities that are not measurable, such as fatigue state or wear levels, can be effectively estimated. This helps move from a "measure everything" mindset to measuring as little as needed and computing the rest.

System Digital Twins from Component Models



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Finally, digital twins help by allowing customers to explore future outcomes for a range of possible scenarios. For example, questions such as: “When will this filter clog enough to affect quality of output?” and “What would happen if I did nothing?” can be answered. Knowing how each scenario will play out provides actionable information. Exploring how different decisions impact the future and choosing the best course of action, yield performance optimization. Digital twins enable predictive scenarios where operators, or even the machines themselves, can choose the actions that lead to the best possible outcomes.

As an example, it’s possible to detect leakage on a hydraulic cylinder. But if that cylinder is part of an excavator on a job site, you’ll want to relate that cylinder’s hydraulic fluid loss to declines in excavator productivity. You’ll also need an operational model for how the equipment is expected to perform and be maintained. With both of those models in hand, the rising cost of reduced productivity can be weighed against downtime for maintenance, allowing the service to be scheduled at the optimal time. Increasingly, digital twins will enable critical decision- making at the enterprise level.

The use cases for digital twins in analytics continue to evolve. The latest trends include using real-time machine-learning models to adjust the definition of optimal performance to account for localized operational conditions and using artificial intelligence to predict the most-likely failure modes.

FORWARD THINKING

Parker is dedicated to delivering actionable insights on the many discrete components and subsystems it sells to customers. As such, it is devoting significant resources to component modeling of its connected products. This means customers can rely on Parker to simplify their own analytics journey by delivering product-level insights that they can then aggregate to their system-, machine- and fleet-level solutions. All of this powered by Parker's Voice of the Machine™ IoT platform.

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