VOICE OF THE MACHINE®

# MANUFACTURING'S DIGITAL TRANSFORMATION

How a discrete approach to the Internet of Things can lay the foundation for growth

Parker

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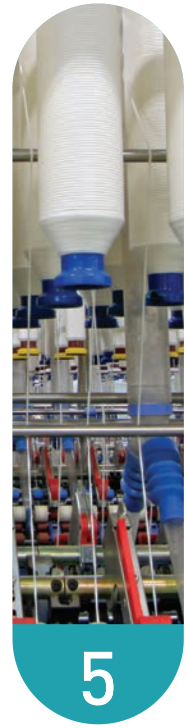




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CHAPTER 1

## PREAMBLE

The advent of the Industrial Internet of Things is often referred to as the Fourth Industrial Revolution.

Propelled by the ability to collect, store, retrieve, display, interpret and exchange machine data while connected to the internet, manufacturers today are grappling with a dizzying array of new ways to conduct their business, as paradigms for asset management and interactions with customers and suppliers shift.

Yet the data is merely a means to an end. The actual revolution hinges on an entirely new manufacturing infrastructure coming together around machine data that:

- Is inherent in original equipment
- Can be extracted with strategically positioned add-ons such as IoT-enabled sensors.

In these digital ecosystems, the real and virtual worlds converge in an Internet of Things and services that present the possibility of saving and making money in ways never before possible up and down the value chain. That's the power of understanding the health of machine assets before they break down, and carving out a market advantage based on the intelligence provided by connected devices.

Throughout the past decade, manufacturers have been working to adjust to all of the possibilities of optimized production and connected devices through condition monitoring, predictive maintenance and asset tracking. The road seems like one paved with good intentions – after all, running equipment to failure and scheduled walk-bys are ineffective approaches to productivity, continuous improvement and competitiveness. But it hasn't always been clear to end users what to do with the ever-increasing silos of data now available.

Taking a discrete approach to IoT can provide that clarity, and is the subject of this analysis. For the road of digital transformation is leading to the day when a company's value and competitive advantage may be defined entirely by its customers: first, what they believe you know about them, and second, how you use what you know to help them stay competitive.

CHAPTER 2

# TAKING A DISCRETE PATH TO IOT ROI

As management of plants and other assets grows more complex, integrating automated monitoring of key performance indicators at the discrete level provides a built-in safeguard against unplanned downtime or consequential damages.

And it addresses one of the roadblocks many discovered with a top-down enterprise-level path to IoT: the requirement for significant investments in infrastructure around equipment and business processes, with little ROI to show for it in the near term.

A detailed analysis by Accenture and GE revealed that in the Connect-Monitor-Analyze-Predict-Optimize continuum, companies reported a higher percentage of Analyze activity than Connect and Monitor over the course of IoT's time in their industrial space. In an increasingly connected world, these findings point to an out-of-sequence disconnect.

They suggest that efforts to understand the voluminous amount of data have come before establishing the connected infrastructure needed for data-driven decision making – and well before making a coherent business case for the data collection. In other words, the raw data available often has not been connected to the specific insights required.

Discrete IoT views a large machine asset as a collection of systems and subsystems with data onboard that can be given a voice with sensors, and deliver ROI in short order. Every subsystem contributes to the overall performance of an asset, and knowledge in that subsystem can be harnessed to assess its health or predict its failure. Consider which products in a motion control subsystem could provide safety, reliability and productivity insights. Pumps, actuators, valves and filters all contain current-state performance and diagnostic data.

Having a current-state view of machine health is better than nothing, but simply publishing it on a dashboard screen stops short of being able to optimize a system or a process. The greatest power of IoT stems from the ability to perform historical analysis with time-series data, whether it be KPI-driven alerts and alarms to maintenance personnel; profiles and trend curves that pinpoint root causes of failures; or notifications to ordering systems. One primary goal is to be able to examine the conditions preceding work orders, unplanned downtime or other failures as data is correlated and presented on user-friendly interfaces that make the decision options very clear.

## WHAT IS A SENSOR?

In motion control subsystems, pumps, actuators, valves and filters all contain current-state data about a machine's health that can be inspected, unlocked and sent from the equipment to a decision maker via networked, wireless sensors.

A sensor converts a physical condition such as air pressure, in-line and ambient temperature, flow or vibration into an electrical signal capable of being analyzed via the cloud or local applications for a manufacturing system.

Sensors are plugged into a machine's existing ports or through a custom integration, and trigger alerts or alarms when tied into a control system or gateway programmed to observe when thresholds for defined performance parameters are exceeded. In this way plant professionals can safeguard the peak performance of their operations.

With today's wireless sensors and powerful software, it is possible to:

- Notify responsible parties of an event requiring preventative or corrective action through text alerts
- View real-time actionable data in graphical form from a dashboard
- Export data for further analysis of historic trends to any internet-connected device

CHAPTER 3

# DUE DILIGENCE REQUIRED TO EMBARK ON DISCRETE IOT JOURNEY

It's not necessary or even desirable to convert an entire factory at once to IoT-enabled processes and machines. Discrete IoT, done properly, is a very scalable undertaking as needs, capacity and resources expand. Taking the following steps can ensure that the journey avoids common roadblocks.

**1 Enlist manufacturing and maintenance managers** to pinpoint the persistent problems and instigators of the most headaches from an asset management, safety or maintenance perspective. The issues may range from an excessive use of wear parts and other consumables, to components that are expensive or inconvenient to repair, to outright workplace safety concerns.

**2 Identify the precise data points that can provide insights** to address these issues. Is any of it already embedded in the asset but not being reported to the programmable logic controller (PLC)? Can the part or component manufacturer rectify that? Should some parts have sensors placed where they can unlock additional data? Collaborating with the equipment supplier makes it possible to get the answers here; they will understand the ratings, the operating conditions for which a product was designed, and engineering attributes of the product and how metrics can be provided that can lead to actionable programs. Note that it is not necessary to pull out every parameter to start, with quality of data being the end goal. The usual starting points for fixed assets are temperature, pressure, humidity and vibration.

**3 Determine the cloud platform and user interface needed** to establish and centralize data storage and transmission, using common application programming interfaces (APIs) that aren't platform-dependent. This should be an interoperable system to accommodate what likely is a potpourri of existing network, Ethernet-based and communication protocols. Data from the component or subsystem delivered to the cloud platform or on-premise edge device can be presented in context with other machine data for a holistic view, regardless of whether that data was generated by a Parker part or a component from another manufacturer.

**4** With the benefits sought from IoT adoption now clear, **pinpoint the optimal frequency of monitoring and data collection** for any given component or part. Taking a uniform approach to data collection and notification of anomalies can wreak havoc on operational costs and, with digitalization, is entirely unnecessary. As they would not be similar, it is important to distinguish the different schedules required to monitor for safety as opposed to the time elements impacting normal wear and tear of a part.

Committing to this level of examination before deciding to collect and interpret discrete data will pay dividends many times over as your digital transformation proceeds.

CHAPTER 4

## WHO HOLDS THE STAKES WHEN DEPLOYING IOT? EVERYONE.

A culture of silos has no place in a digital transformation. Going digital affects too many aspects of an organization, often in ways that only become apparent later on.

The decision to move into this realm requires a clear-eyed assessment of where your business is now, and where you want it to go, with input from everyone whose functional experience could be altered as a result of that transformation.

For example, if your responsibility is to ensure the highest level of uptime and safe operation for an entire manufacturing organization of factory assets, you know it would be valuable to have parts and components in that equipment enabled to alert you when service or replacement is needed. So you would want to be sure that the enterprise was selecting a parts supplier with the ability to design, manufacture, integrate and easily service such components.

But procuring the solution is just the beginning. What about managing the never-ending data stream created as a result of liberating the information contained within the now-intelligent parts? Can you integrate it with other databases to generate insights and drive value? What about data security and privacy? Do you have people with the right skills working for you now? Can they be trained or should new talent be recruited? What about paying for all of this?

These questions and many more inform what should become part of an ongoing cross-functional conversation within the enterprise. The idea of 24/7 connectivity can be very appealing, but the key to success is having a well-thought-out strategy to tie connected products to your specific core business and deliver those solutions to the end users who can benefit from them. That only comes from having a diverse group that is well informed and connected to the process because its members fully appreciate the stake they have in it.

CHAPTER 5

# LISTENING TO THE SOUND OF OUR OWN VOICE

As the digital era dawned and its possibilities became clearer, Parker explored the ways in which motion and control products could create customer value via uptime and productivity gains by fully leveraging analytical capabilities of IoT.

Parker also intended to accomplish this by first addressing the challenges discussed on the previous pages. The near-term IoT objective for improving service to OEM customers was to provide better reliability and higher performance for the components and systems they source.

Today, Parker's Voice of the Machine™ offering makes it possible to identify a serviceable event through precision measurement and threshold alerts, and continued development of these technologies will make equipment issues easier than ever to address. That is Parker's play in this stage of the evolution of the IoT revolution.

Engaging expertise across Parker was a nuanced process of change management. While the focus in IoT may initially emphasize the "build" part of a new solution, the "operate," "sell" and "service" elements of the solution are critical for a company like Parker. That meant engaging plant operators, planners and maintenance team members to provide the support they need to achieve alignment. Providing the support they need to achieve alignment means something different to each of these functions.

It should be noted that a very common hurdle at the outset stems from the IT part of digital transformation, a process that sometimes requires ingenuity and persistence to put in motion. Establishing that secure gateway to the internet calls for cooperation among many parties, and might even require temporary workarounds such as cellular communication into a piece of equipment until the top-down solution is available internally.

To deliver on the promise of true collaboration required close working relationships and a high degree of transparency. Adhering to these tenets enabled Parker to arrive at what its smart product offering would ultimately look like.

CHAPTER 6

## HOW SMART DO WE WANT TO BE? HOW PARKER WORKED TO DEFINE VALUE AND MOVE ON FROM THE ANALOG WORLD

In the early stages of IoT adoption, Parker identified an internal application by troubleshooting a custom pump half the size of a car that was burning out seals.

The hydraulic chiller would not cool the machine down and eventually took the equipment offline for more than a week. Only after the strategic placement of flow and pressure sensors was it discovered that a cracked manifold was burning out the seals. "It opened our eyes and other people's," said Parker Project Manager Don Groce.

Workforces at lean manufacturing sites should already be on board. They'll want to know: What more can we collect that day-by-the-hour tracking reports don't capture? Is a piece of equipment even running? What is the cycle time? How can you ensure you'll never get to that critical red supply level? Groce says that focusing on the basics will soon set the imagination to wondering just how much smarter you can be in a digital world.

If a machine has an 85% uptime goal that is being hit very rarely, that degree of inefficiency is ripe for examination. Not every machine has to run at that level, but for 24/7 assets, a properly configured dashboard can bring issues to immediate attention instead of many elapsed hours later when a supervisor discovers it during rounds.

> **"We have dozens of CNC machines. With IoT we can see that they are very stable; the air they need is being reliably satisfied by the compressors."**
>
> **CY FRENCH,** Plant Manager, Parker Tube Fittings Division

More complex is exploiting the production angle to more deeply analyze root causes of downtime. Yet these things must be addressed for equipment that is directly tied to productivity.

Parker began by educating facility-based maintenance supervisors and value stream managers about the data it is possible to gather, starting with something as simple as demonstrating the capabilities of a dashboard from a mobile device for a glimpse of real-time activity at another facility.

Another key task was conducting a comprehensive site survey to identify opportunities for sensor placement that would unlock insights from actual processes and systems. From a maintenance perspective, it wasn't hard to see which questions would yield immediate needs to get smarter:

- What's your worst nightmare on any given day? Which equipment does it involve?
- What equipment has a recurring tendency to go off course? For example, in Parker's world, accumulators are often located in out-of-the-way spots and prone to losing pressure. Knowing when they need a recharge eliminates unnecessary worry.
- Which custom equipment has no spare parts/can't be repaired quickly?
- What can happen on a weekend that you'd prefer to tend to before Monday shifts?
- What legacy equipment is most mysterious to you? No matter how old a machine is, there is always a place to put a sensor, as Parker learned in the example on the previous page.

Some of the other areas for monitoring at Parker now include:

- Amperage on braiding machine motors to prevent drive failures
- Air pressure and pH level for regulated discharge wastewater
- Machine tool pump coolant levels to maximize tool life
- Chiller pump temperatures for 24/7 extrusion process

Life can change a lot when you're not waiting for the next fire drill. With expanded knowledge and control, roles can switch to being proactive and forward-looking.

"To ensure compliance with industry standards and in our own new product qualification processes, we now want to expand IoT into our mechanical lab," said Parker Manufacturing Engineering Manager Larry Kunkel. "There would be a lot of value in knowing the current state of the hydraulic impulse testing machines in there, that shoot hot oil through hoses at 60 cycles per second."

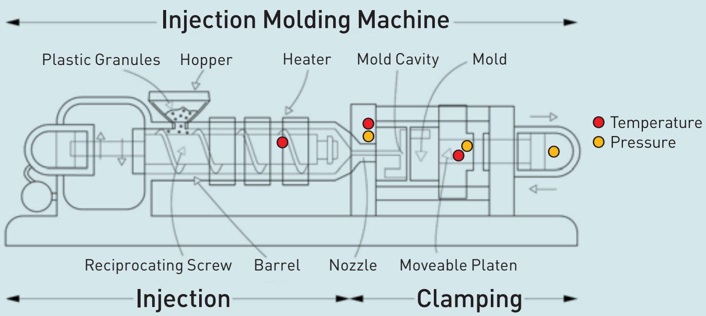
With that freedom from analog concerns comes the ability to move away from lagging indicators to leading indicators, of instilling a more predictive maintenance focus to avoid downtime and gaining a clearer understanding of what processes are capable of to achieve quality, safety and reliability.

## CASE STUDY

A Parker customer that makes washing machines and dryers had been using manual diagnostic test tools for their manufacturing processes and machines where a majority are hydraulic-based assets. In the factory, an injection molding machine and a stamping press were driven by the same hydraulic power unit (HPU) located 20 feet off the floor at the top of the machines.

In order to diagnose or evaluate each asset, a maintenance technician had to use a manual diagnostic tool connected to the HPU to collect pressure changes at points of interest. On the floor, a second technician watched and cycled the machine. Those technicians then tested several points individually, which took hours. Because the manual diagnostic devices had long cords connecting the sensors to the handheld meters, the testing setup was cumbersome and time consuming. Technicians would shut down the machine due to safety risks, then set up the tools to take readings, which further extended downtime and led to missed revenue opportunities.

Given this situation, the customer was receptive to a streamlined solution that involved only a single maintenance technician testing functions, taking readings and observing processes. Parker installed its SensoNODE sensors at each of the five points of interest, with the technician now able to run the machine and use the Voice of the Machine solution to track all pressure measurements at once, as well as watch the machine functions from a safe area. Issues were resolved quickly and the final customer received quality products on time, leading to increased satisfaction and loyalty.




CHAPTER 7

## WHERE DO WE GO FROM HERE?

Once having identified areas of value that discrete IoT can produce, it will be easier to consider ways to broaden deployments across the enterprise.

The challenge of moving from a successful pilot program to a broad deployment can be daunting and shouldn't be undertaken lightly. But if you have identified high-value use cases, addressing that is the next step. Proceed on the premise that no $20 part should ever take down a critical system anywhere, and visibility into your processes should not be tied to having to be physically present in the area. Know that monitoring energy consumption on a piece of equipment could lead to better understanding energy costs by product type and, in turn, scheduling the highest consumers to run at non-peak periods.

Developing a deployment framework that considers things, connectivity, collection, lessons learned and action at each stage can help impose discipline across the process and increase the likelihood of success. Says Parker's Don Groce, "In a perfect world, you would scope out capital costs for a number of plants. But implementing IoT is always a gradual process. Every maintenance supervisor has discretionary spending they could use, adding a few sensors to key pieces of equipment and watching what changes. Work the plan, a little at a time. One project leads to another. Once you see the value of it, it permeates the whole building. Then it can be taken division-wide."

The Industrial Internet of Things is at a crossroads wherein manufacturers are ready to fully realize digitalization's promise in a world of connected devices. If properly exploited, opportunities to forge symbiotic long-term relationships between end users and component suppliers can make ongoing asset intelligence a routine feature of doing business smartly, leading to equipment uptime, the potential for aftermarket business, and loyal satisfied customers.

### THE VALUE OF DISCRETE IOT

- Reduce Downtime and Service Costs
- Improve Efficiency
- Increase Product Lifecycles
- Lower Total Cost of Ownership

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