Multitrillion Dollar Choices: IoT and the Future of Manufacturing

The world's factories depend on production lines that were never designed for digital connectivity. These so-called "dumb" machines may be a multitrillion dollar drag on manufacturing, which accounts for 16 percent of global GDP and 14 percent of employment. However, making these machines "smart" will require significant investments in an industrial Internet of Things (IoT). The immense cost of production line breakdowns – and the complexity of preventing them – will motivate business leaders to take this leap and transform the future of manufacturing.

The Multitrillion Dollar Opportunity

The IoT buzz has produced a vision of Industry 4.0 in which machines can be controlled, monitored and optimized anywhere in the world via the Internet. This future is closer than many industrialists realize.

Analysts at the McKinsey Global Institute estimate that IoT will have a $1.2 to $3.7 trillion economic impact on factories by 2025. This range is so wide because the predictions come with qualifications. For instance, "operations optimization" could account for $1.7 trillion alone, but McKinsey's estimate presumes that someone will develop effective machine learning algorithms and analytics platforms for this purpose. This, in turn, presumes that factories will install high-bandwidth industrial networks, rig tens of thousands of machines with sensors, aggregate their data in the cloud, and then run these algorithms.

Although we're dealing with many "ifs", evidence suggests that manufacturers are willing to make this leap of faith. PwC found that 35 percent of U.S. manufacturers are "currently collecting and using data generated by smart sensors to enhance manufacturing and operating processes," and another 41 percent have plans to do the same.

A Substantial Investment

Producing a new IoT watch or coffeemaker for consumers is relatively cheap, but replacing old productions lines with new smart ones would be exorbitantly expensive. Thus, if we wish to reach Industry 4.0, our only viable option is to retrofit existing production lines with IoT sensors.

This process demands a significant investment. A factory could easily spend $200,000 on a high-capacity wireless network. Each machine in the production line may require multiple sensors, and the cost of one ruggedized sensors can range from hundreds to thousands of dollars. If you have 10,000 machines, this adds up quickly. If we factor in the costs of data infrastructure, technical staff and software, too, the price tag grows.

Thus, manufacturers may hesitate to deploy IoT technology unless is solves problems they can't address with an analog fix. For instance, at ATS, one of our customers had a packaging machine that used to consistently fail after X number of boxes. The empty box would jam the whole production, resulting in expensive downtime. So, they positioned a powerful fan to blow on the production line. If a box was empty, it would get blown off the line.

This is an elegant fix, but giant fans can't prevent the most insidious breakdowns: the ones that seem invisible and unpredictable. Equipment can fail for many different reasons. Abnormalities in temperature or pressure could overheat the machine; lubricants may need to be replenished; O-rings can wear out.

Unlike the box that gummed up my customer's operation, we can't normally detect and prevent these problems without vigilant monitoring of their symptoms. That is why predictive maintenance, powered by IoT, could reduce factory costs by 10 to 40 (by McKinsey's estimate). More causes of breakdowns are invisible than visible.

The Gamble

I see IoT predictive maintenance taking off before "operations optimization" because of how people think about economic choices. Psychologists Daniel Kahneman and Amos Tversky have shown convincingly that human beings fear losses more than they value equivalent gains. In other words, preventing breakdowns is psychologically more rewarding than improving the efficiency or productivity of an operation. This is especially true in vertical like the auto industry, where Nielsen Research found that downtime costs an average of $22,000 per minute.

If predictive maintenance does become the gateway to widespread industrial IoT, what will adoption look like?

First, manufacturers will need to set up wireless networks so they efficiently collect and transport data. They will need to either own or lease data infrastructure that can aggregate data from this network and rapidly make it available for analysis.

Second, they will need to install a variety of IoT sensors that collect data on temperature, pressure (e.g. for hydraulics, fluids, air, etc.), weight, closures and vibration. These sensors have to be ruggedized so they can survive in extreme environments. Heat, dust, grease, pressure and corrosive chemicals can overwhelm all but the toughest sensors.

Third, manufacturers will have analyze sensor data for patterns and apply what they discover. Let's say the data reveals that one machine normally operates at 72 degrees and fails at 78 degrees. It would make sense to set 75 degrees as the trigger temperature that warns maintenance about the looming breakdown. Similarly, if X level of vibration indicates that a bearing is near failure, sensors must trip warning systems at a value below X. In all cases, this step will involve finding thresholds and setting triggers that allow maintenance teams to react before problems occur.

Industry 4.0 is one of the fastest growing and most valuable sectors of IoT because it could have a multi-trillion dollar impact. However, manufacturers will have to take risks now and commit to this vision if we are to realize the full potential of IoT within 10 years.