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Lean Takes A Leap with IoT

How Companies Are Already Turning the Promise of Tiny Sensors into Massive Efficiency Gains

Lean and Internet of Things (IoT); combined, these two phenomena promise staggering advances in waste reduction and profitability. In fact, forward-thinking companies (see Cases 1-3) are now building on returns they've already realized by "super-charging" Lean with IoT, a combination that will grow in power as sensor technology becomes more accessible and widespread.

Most Lean practitioners recognize the potential of IoT, but too many struggle to make a concrete business case for implementation.

Cisco projects the global economy will employ more than 50 billion of these connected devices by 2020. That's six devices for every person on the planet, measuring and sending all kinds of data–everything from temperature to location to orientation–in real-time; no manual human input required. Lean practitioners will translate this tsunami of information into entirely new levels of sustainable efficiency.

The greatest Lean advantages will go to early IoT movers. Companies willing to explore, implement and iterate now so that successes can be scaled across the value chain as soon as possible.

Yet many Lean professionals struggle to begin their own IoT journey. They recognize its potential, but a concrete business case for implementation remains elusive. Or to paraphrase one executive: "I need a better grasp of the 'how' before I can make a case for the 'why.'"

Fortunately, the familiar principles of Lean—and real-world examples—can provide a kind of road map companies can use to get from the promise of IoT to a clear case for implementation. NEXT PAGE ▸

KEY TAKEAWAYS

- The combination of Lean and the Internet of Things (IoT) promises staggering advances in waste reduction and profitability.
- Early movers will shape the IoT disruption while those late to the game will be forced to react to it.
- Despite its potential, too many Lean practitioners still struggle to make a solid business case for IoT.
- The familiar principles of Lean—along with real-world examples—provide a kind of road map companies can use to get from the promise of IoT to a clear case for implementation.

The Three M's — Muda, Muri, Mura

When Taiichi Ohno became Toyota's Assembly Manager in 1945, he understood that waste reduction would necessarily result in higher product quality. Today, Lean proponents carry on his legacy as they systematically identify and eliminate waste. Ohno's three primary waste categories, each identified by their Japanese words…

Muda - Human activity that consumes resources but produces no value.

Muri - Unnecessary stress on equipment and employees.

Mura - Waste from uneven flows and imbalances.

Of the three, Ohno identified muda as having seven distinct facets that detract from customer value. When combined with IoT sensory technology, Ohno's Lean principles can dramatically reduce operational muda in the following ways:

Muda — 7 Wastes Eliminated by Lean + IoT

Eliminating waste, or "muda", is a key philosophy of Lean. Waste is traditionally categorized and the quest is to continuously drive down waste by eliminating non-value added activities time spent across a value chain. The use of sensors can greatly reduce key types of wastes in ways not previously possible.

Wait Time — Motion sensors can measure the amount of time a product has (or hasn't) been moved. Manufacturers can configure alerts to warn them if a product has remained untouched for longer than acceptable times. Embedded sensors can also automatically launch troubleshooting measures if a delay could result in a missed target ship date. These systems aren't limited to shop-floor operations. Disney uses the same technology to reduce queue times at theme park attractions.

Transportation — GPS coordinates track how far a product moves during an order fulfillment lifecycle. Aggregating this data provides insight into how to optimize order fulfillment when alternative plants and warehouses are available. This can be especially valuable for products whose distribution costs make up a large component of cost of goods sold.

Inventory Control — Sensors mounted on stock units can link physical inventory to distribution centers using GPS coordinates. This simplifies cycle counting and increases visibility into the reorder process. Consumer products companies can reduce inventory buildup, enhance flexibility and even satisfy customer demand by capturing consumer behavior data with sensors embedded into connected devices.

Overproduction — Real-time sensors can send a "stop-the-line" message to prevent upstream processes from producing too much inventory too quickly. The same sensors can automatically restart production when stock levels return to acceptable thresholds. In global manufacturing operations the same algorithms can regulate and control product movements throughout the entire supply chain—a landmark breakthrough toward achieving Lean principle of demand pull.

Combined with IoT sensory technology, Ohno's Lean principles can dramatically reduce operational muda.

Motion — Movement sensors applied to key equipment and inventory items collect value chain improvement data. Skilled professionals can then perform cycle time and "spaghetti" analysis to improve facilities layout and optimize distribution routes. Outputs like these help firms to strive for the Lean principle of perfection.

Defects — Slow manual Quality Assurance processes delay quality improvement initiatives. IoT sensors overcome this by detecting products that deviate from the standard physical process flow. Quality teams get immediate notification of defects, allowing them to fix more problems sooner. As a result, defect rates decrease and customer satisfaction rates dramatically improve. Detecting conditions that could lead to an outage saves maintenance costs and keeps revenue streams flowing. Swedish toolmaker, AGA Linde, is decreasing preventive maintenance burdens by providing immediate weld quality feedback with IoT sensors (see Case #1).

CASE #1

AGA Linde Reduces Rework with Immediate Machine-based Feedback

Companies who hire arc welders depend heavily on individual employee productivity and skill. Inconsistent weld quality costs firms heavily in terms of rework and wasted materials. Most weld failures can be traced back to a welder's failure to raise the melting temperature high enough to fuse two metals together.

Veteran welders have the training and experience necessary to manipulate weld temperatures consistently. However, due to the global shortage of skilled tradespeople, construction firms must often send junior welders into the field before their skills have had a chance to fully develop. This often results what Lean Thinking author, James Womack, calls the muda of defects — unacceptable quality problems which must be fixed before the product can be released to the customer or the general public.

Ericsson and Swedish gas provider, AGA Linde, are teaming up to address this problem with IoT technology. Smart sensors embedded into the welding guns, themselves, notify welders when temperature falls outside of standard tolerance levels. With this immediate feedback, even junior welders can stop the process and fix the temperature problems on the spot, allowing them to produce standard quality welds the first time. By reducing the muda of defects and rework, companies have reduced weld quality issues by 20 to 50 percent, saving time and money.

Muri — Relieve Over-Burdened People and Processes

Overtaxing systems and employees can lead to unnecessary waste. Overburdened equipment wears out faster and must be replaced sooner. Excessive overtime requirements result in accidents and other costly mistakes. Long term employee stress also costs you in terms of lost productivity and higher human resource expense when workers look for– and eventually find–less stressful jobs. Identifying and addressing these stress points is crucial to streamlining your operations.

Don't be surprised, however, to find some employees and systems overtaxed simply by reducing muda and increasing overall system throughput. Removing inefficiencies can expose inherent bottlenecks you never noticed before. Sensory technology can help identify and reduce overload conditions.

Biometric devices for employees coupled with other sensors can identify and predict employee fatigue. Many accidents happen as a result of human overwork, so early detection can avoid workplace injuries and accidents. As you would expect, insurance companies have been promoting the use of sensors on construction workers to measure strain and excessive workload, as fewer accidents result in fewer claims.

Machine maintenance, both preventative and reactive, can be optimized with sensors to identify dangerous conditions that could result in an outage. Diebold reduces this form of muri by embedding IoT sensors in their ATM machines (see Case #2). They can also spot environmental circumstances which may create risks, such as blockages or air quality issues.

In order to prevent resource overuse in the value chain, we should actively monitor all critical components that could result in a single point of failure. Petroleum companies, for example, transport oil and gas through pipelines across large geographic areas. If pipe pressure exceeds safe levels, the company risks long term damage to the pipe, and possibly even a rupture. A major spill could cost millions in business disruption, EPA fines, and damaged reputation.

Pressure sensors could avoid this risk by sending warning messages to field engineers as soon as they detect an overload condition. Early detection can save money by extending the service life of the pipeline and preventing a financial and public relations disaster.

Decreasing overuse almost always improves overall value chain reliability. Encourage your teams to constantly ask, "what indicators of degradation would be helpful to predict likely maintenance and reliability issues?" The answer will indicate what type of sensor could capture this data flow. Starting with the problem or data to be captured is one of the best ways to apply IoT to decrease muri.

Mura — Create Flow Through Integration Across Ecosystem

Mura, the Japanese word for unevenness and variation, can result in fluctuating demand and chaotic system behavior. We want to smooth out the peaks and valleys of effort to achieve a more balanced workflow. Elimination of work in process (WIP) can go a long way to creating balance within any production system.

Instead of "pushing" WIP ahead, design your systems to wait for a "pull" signal before starting the production of the next item. Electronic or visual signals such as kanban can be used to act as a type of organizational pacemaker to regulate flow. As systems evolve, latency tends to creep into trigger thresholds, so you should analyze and tweak pull signals periodically.

Because IoT sensors send data instantaneously with no human interface, they can be programmed to failsafe misinterpreted pull signals. Likewise, they can coordinate complex scenarios of multiple interconnected flows which can't be integrated any other way.

Leveraging data captured by IoT devices, companies can reduce costs and more accurately forecast demand. Skilled data scientists can program algorithms that account for weather, fuel prices, market seasonality, supply chain integration, and combined demand signals to enhance the entire global supply chain.

By taking advantage of innovative sensory technology and big data capabilities, you can better understand your market's pull signals and dependencies to reduce mura and increase return on investment. Coca-Cola's innovative Freestyle vending machines accomplish IoT sensors to reduce stockout risk (see Case #3). The same sensors help them maximize the Lean goal of flow by more accurately predicting consumer demand.

CASE #2

IoT Sensors Reduce Downtime in Retail Banking

While retail banking customers find ATM outages inconvenient, Diebold finds them downright costly. Heavy-than-normal usage over a prolonged period of time can overtax an individual machine and cause an outage, usually in a high traffic location. The ATM machine manufacturer/operator earns 87% of its revenue from teller machine operations, so muri in the form of downtime can cost Diebold millions over the course of a fiscal year.

Smart IoT sensors embedded within Diebold's ATM machines compare real-time operations to predetermined baselines. If they detect significant deviation from expected transaction loads, they automatically conduct root cause analysis and attempt to fix the problem remotely. In the case of a component failure, the system automatically recommends steps to address mechanical fixes based on collected diagnostic data.

IoT technology has paid off in reduced outage costs. 17 percent of ATM malfunctions are now fixed remotely. For issues that require a service technician visit, problem resolution times have dropped from an average of 1 - 3 hours down to 30 minutes, resulting in significant cost savings and increased customer satisfaction.

How to Get Started – Think Big, Start Small, Move Fast

The most important thing you can do to get started using Lean with IoT is to take deliberate action. Those who wait for the smoke to clear will find that the best opportunities have been taken by the visionaries with a bold plan and a sustainable business model. So as you plan your IoT initiatives, keep these three thoughts firmly in mind:

Think Big — Metcalfe's law states that the value of a network is proportional to the number of connected nodes. That being the case, the IoT with its strategically-placed army of high-value, always-on sensory inputs produces an exceptionally strong network.

Don't be fooled by a sensor's size. These tiny capture devices can uncover significant amounts of hidden waste from even the largest operations. While it makes sense to start small, create a vision and design an extensible architecture enabling sophisticated data leverage throughout your entire value chain.

Start Small — Companies who benefit the most from Lean and IoT view it as a journey, not a project. As the proverb goes, every journey starts with a single step. Every capability you add, no matter how small, helps build momentum toward to goal of capturing operational intelligence to eliminate muda.

While Lean adoption certainly benefits from executive sponsorship, it doesn't have to start there. When vision starts from the middle instead of the top, companies can create IoT momentum quickly by eliminating waste at the line level. The resulting successes will invariably get top management's attention.

Move Fast — Create cross functional teams with ability to make decisions and create bold moves. At Amazon, "two pizza teams" are created for key initiatives as a type of skunk works squad tasked with pinpointing potential value opportunities. Figure out your version of small cross functional teams with the essential skills, including legal and design, to launch your first IoT initiatives.

Time is of the essence. Those who fail to capitalize the IoT opportunity now will be forced to react to the disruptive changes imposed by those who took early advantage.

The Lean philosophy is, at its heart, completely focused on waste elimination. Data, such as Kanban cards, is at the heart of signaling pull, communicating status, and creating flow. IoT is a critical component to supercharge your Lean ambitions. The philosophy and tools are the same—what's different is the scale, frequency, variety and intensity of data and feedback signals available.

Time is of the essence. Sensory technology is the next iteration of industrial productivity, and many firms have already earmarked budgets and talent to leverage it. They will be positioned to shape the future of this disruption, to which those late to the game will be forced to merely react.

CASE #3

Coca-Cola Reduces Stockouts and Inventory Costs with Vending Machine IoT Components

Coca-Cola has been a beverage powerhouse over the decades, but generational shifts and changing health concerns have resulted in declining vending machine sales for the Atlanta soft drink giant. To address declining revenues, the company introduced the Freestyle vending machine featuring a modern touch-screen and proprietary Pure Pour technology, capable of dispensing 165 different Coca-Cola branded beverages.

While the increased menu choices boosted sales, it also complicated inventory management, requiring Coke to closely monitor product sales in order to quickly respond to shifts in consumer tastes. The brilliance of the Pure Pour technology is that it utilizes IoT sensors to capture product consumption data and send it wirelessly to remote supply optimization algorithms. The sensors also detect potential problems with the internal blending mechanism to prevent costly outages.

Revenue has increased thanks to the new sensory technology. Beverage purchases are up an average of 6 - 8 percent, while overall traffic and servings have grown anywhere from single to double digits. The company also enjoys a 30 - 40 percent smaller inventory footprint per machine. By harnessing the power of the IoT, Coca-Cola has increased brand perception, and reduced stockouts, and decreased mura to achieve the Lean principle of flow.

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