Launch Your IoT Supply Chain Exploration Now

In the near future, the Internet of Things will create major changes in supply chain management. Get ahead of that disruption by heeding this advice on strategy, platforms and current uses.

IoT Means Radical Change for Supply Chains

THE INTERNET OF Things is growing exponentially, and that's good news for the supply chain. Still, organizations have a lot to consider before incorporating the IoT. This handbook can help you understand the issues so you can make profitable decisions.

In the first article, Ann Grackin, CEO of ChainLink Research, says companies should determine their IoT supply chain strategies now. IoT's continuing expansion requires businesses to rethink how they plan and run their supply chains. Partnerships, process design and IT infrastructure all need careful consideration. Ultimately, Grackin says you need to think boldly, plan well and get there first.

The second article, by Bill McBeath of ChainLink Research, offers advice to IoT application developers on choosing an IoT platform. This complex process involves physical products, service providers and software vendors. McBeath says it pays for companies to choose

wisely because the relationship between the IoT application developer and the platform provider is a long-term one.

Finally, technology journalist Linda Rosencrance provides real-life examples of how organizations are incorporating emerging IoT technologies to improve their supply chains in the areas of logistics, transportation management and retail. Applications include sensors that monitor the temperature of food being delivered; a smart port that tracks the location of trucks and loading bays to ensure that goods are moved efficiently; and a retailer that uses sensor tags to improve inventory efficiency.

The IoT is complex, but supply chain goals are simple: Understand where goods are, where they are going and make sure the right product arrives—without any compromise in quality. ■

—JIM O'DONNELL
News Editor, SearchManufacturingERP

Go Boldly Into the New World of IoT

THE INTERNET OF Things may not be technology's final frontier, but it's certainly offering new areas of exploration. Some of you might want to think about that in terms of expanding your business, but all of you will want to think about how the explosive growth of smart products will change your supply chain. That's why business leaders at all levels need to start addressing IoT issues today. Here's how.

Whether talking about modernizing your supply chain or creating products that meet IoT needs, think in terms of top-level ownership. The CEO's team needs to take a creative entrepreneurial approach to the business model and the products and services the company sells. Questions to confront include:

- How will we transform our products to smart products?
- What platforms are needed to harness data generated from smart products?

- Will this be an internal-only initiative?
- Are we building a new business unit or spinning out a new enterprise?
- How will our support structures—plants, logistics and service chain—change?
- What investments will be needed to adapt to this new world?
- Do we need to forge partnerships to enable these changes?
- Once you place smart products in the market, an always-on organization will possess a new level of awareness and must respond. How will internal processes and your supply chain need to change to become more agile and responsive?

Let's imagine that a new digital product with sensors and other devices will be launched into the market. Your first consideration is to get trading partners and customers involved. Often manufacturers are removed from markets and

have poor insights into the world of their customers. Distributors and logistics providers also fail to leverage their proximity and lack an understanding of customers beyond those at their back door.

An IoT-enabled supply chain encompasses a total lifecycle view of the product.

IoT will promote new partnerships collected around new kinds of devices and software, third-party platforms, integration technology and channels of distribution. All of this, along with broadened product offerings, will increase your supply chain's complexity and make you re-imagine your processes. An [IoT-enabled supply chain](#) encompasses a total lifecycle view of the product. Here are the key areas that should be addressed in the plan.

Total lifecycle management. Smarter products enable information across the lifetime value, helping product developers, sales, supply chain and service management to innovate and

improve products and quality, and to develop new sources of revenue.

Responsive fulfillment. IoT's impact is dramatic in this category. In a world where embedded products call out in real time for refills, replacements and same-day delivery, distribution networks will have to be ever-ready with the right inventory strategies.

Predictive service and maintenance. How can you analyze sensor and other data to reduce failures, avoid downtime and increase product performance and value in the eyes of the customer? Smart products will increasingly enable companies to address these issues, though that capability comes with the expectation of much-higher service levels.

Flexible manufacturing. IoT will drive richer product choices and customization with shorter lead times. The digital manufacturer will need to be more agile.

Smarter demand management. How do we develop richer data sources and learn to use

these to understand customers and consumption patterns—at an item level—by location? IoT will require us to answer that question.

NEW NEEDS IN AN IoT WORLD

Regardless of whether your organization moves into the business of producing IoT products, such products are destined to have a great effect on your supply chain information and technology management. For example, disparate systems will need to talk with one another, and the need to mine the rich and vast sources of data IoT generates will be pressing. Connectivity and streaming data also create a sense of urgency to respond—but a company's response must be accurate to make IoT profitable. That means incorporating the data and capabilities mentioned above and also developing more frequent, precise and responsive planning cycles. Supply chain managers have been clamoring for visibility, but their dated models and systems are not able to achieve this.

In other words, traditional systems will need to modernize to provide new views. You should prepare for radical changes in two major ways:

integration and responsiveness.

When addressing integration, make sure you deal with these key areas:

Sensor networks. These provide source data about "things," including carriers and their equipment and other inventory and products; trucks and containers; machines, work-in-progress materials and other physical objects related to factories; and people. Sensor data is a new data type, which many traditional software products don't have. Thus sensor middleware or sensor networks will need to become part of the IT platform.

Big data engines and complex event processors. Complex event processors continually monitor the vast amounts of data generated by and related to IoT to discover patterns and create insights that reduce risk and boost performance.

Unified integration. Often overlooked, but critically important is integration that unifies business-to-business and application-to-application scenarios. Data needs to be shared

and incorporated into applications in real-time across the supply chain.

API libraries. Standard products and processes will be needed to connect organizations to things.

Business process extensions. The click-and-connect world of applets for sharing data and processes are like API's that are intended to be easily accessible and allow workflows into millions of endpoints.

IoT SUPPLY CHAIN REQUIREMENTS

Modern supply chain systems require the following:

- Automated demand management systems; forecasting should be at an item level by location.
- Inventory planning to capitalize on IoT data, which can provide better insights on current inventory conditions and status and, in turn, more efficient inventory polices.
- Manufacturing scheduling at a finite level to support new product launches and customization with more agility.
- Logistics that provide visibility throughout the transportation process.
- Service logistics that use devices to call for service before people are aware of failure; smart processes will equip one service call with all the right skills and parts, with the goal to make downtime obsolete.

IoT logically centers on talking about a lot of "things." However, employees—that is, people—will still be important. Be sure to encourage exploration and fresh ways of tackling old challenges via new technology and processes. These are keys to arriving early in this new world of IoT and cultivating all it has to offer.

—*Ann Grackin*

Make a Good IoT Match

IF YOU'RE A developer or business leader trying to determine which Internet of Things platform is best for your organization, you might think shopping for an IoT platform is akin to dating with the goal of choosing a spouse. That's because the relationship between the IoT application developer and IoT platform provider is much like a long-term marriage. Divorce—that is, switching platforms—can be messy, expensive, time-consuming and painful. Indeed, it pays to choose wisely.

To help you do just that, here's some advice on navigating the decision-making process. First, I'll take a bird's-eye view of interested groups. Then I'll cover hardware platforms, device management platforms and communications platforms.

THE IoT PLATFORM SEEKERS
Let's start with what kinds of developers are

interested in IoT platforms. Primarily, they come from these groups:

- Physical product companies, including a vast array of product manufacturers that are implementing and building [IoT-enabled features](#) and services.

- Service providers, such as field service, maintenance and repair, transportation and logistics services, real estate and facilities management, and hospitality and waste collection.

- Software companies that are incorporating IoT functionality into their products, from startups to established firms.

IoT platforms are critical for all of the above groups. Such platforms are instrumental to accelerating the development and reducing

the cost of products, services and applications. Without an IoT platform, the challenges of building an IoT application are enormous. Here's a look at how an IoT platform can help with those issues:

The device landscape's diversity and scope. Applications that need to work across a variety of scenarios must also be able to provide robust connectivity among myriad devices, which IoT platforms better enable.

Communications complexities. A global product must work with different carriers and provide performance monitoring and communications cost optimization. Again, IoT platforms are built with these in mind.

App development. Developing in the IoT environment presents challenges far beyond traditional application development, and integrated development platforms designed specifically for IoT greatly accelerate the process.

Developing analytics. IoT analytics must deal with numerous data challenges, including real-time streaming data, geospatial data and enormous volumes of data. Domain-specific IoT analytic platforms provide libraries of pre-built algorithms, queries, dashboards and tools.

IoT infrastructure. Infrastructure issues are a key challenge for IoT developers. Most IoT platform providers run the back-end infrastructure for you, including servers, data centers, communications, security and admin.

HARDWARE PLATFORM CANDIDATES

A highly intricate technology framework is needed to create the IoT application connectivity, and hardware is a key aspect of this. The Internet of Things requires sensors, processors, controllers, communication hardware and local communication buses. A few semiconductor companies are building comprehensive IoT platforms around their core hardware component to meet this challenge.

One example is ARM's mbed IoT device platform. ARM is by far the most popular embedded microprocessor architecture (it has produced more than 50 billion ARM

processors). Its IoT platform consists of the mbed OS for the ARM processor, a device server, a Web-based IDE and reference applications. In addition, ARM has assembled an ecosystem of partners including cloud partners, original equipment manufacturers, original design manufacturers, systems integrators and hardware component providers.

Intel describes its IoT Platform as "an end-to-end reference model and family of products from Intel—that works with third-party solutions…." Intel's product brief lists six IoT components including Intel's IoT gateway, analytics services, enhanced privacy identity, Wind River edge management system, Mashery API management and McAfee secure fabric platform.

According to various forecasts, 25 billion to 75 billion IoT devices will exist by the end of this decade. The sheer volume of devices, combined with their daunting variety, places heavy demands on deploying, commissioning, managing, updating and maintaining all these devices. No IoT administrator wants to deal with hundreds of different administrative interfaces (one for each device type). That's why there's such a great the need for an underlying device management platform.

Developers of IoT applications also need software code that can discover, connect to, receive data from, send commands to and manage these devices in a secure and normalized way. They need abstraction and normalization of the interfaces at various levels in the IoT technology stack, from the physical wire interface to the analytics interface, so the code can talk to all devices of a specific class in the same way. For example, there must be a standard—or shared—way to query any thermostat for the current temperature, regardless of the make or model.

DEVICE MANAGEMENT PLATFORM OPTIONS

To some extent, you can solve connectivity issues of the kind mentioned above with current IoT device protocol standards, such as data distribution service, message queue telemetry transport and constrained application protocol. Another helpful standard is Advanced Message Queuing Protocol, which is a queuing system for message-oriented middleware.

Yet standards alone cannot solve the

problem, at least not in the near future, because there are so many legacy devices. For this reason, many IoT platforms include device interface services that provide the needed abstraction and normalization. Examples of IoT device management platforms include those from Zatar, Etherios, DCN, Wind River Edge Management, RacoWireless, Cumulocity, Eurotech and Xively.

COMMUNICATIONS PLATFORM POTENTIALS

Some IoT platforms provide the machine-to-machine communications services needed to make it all work. This is a natural area for wireless carriers to jump in, so we see IoT communications platforms such as Vodafone M2M, AT&T M2X, Verizon M2M, T-Mobile M2M, Sprint M2M and Singtel M2M. Carrier-independent providers include Aeris, Arkessa, Jasper and RacoWireless. Common functions include cellular communications services, cellular device management, cost and rate management, global SIM, cloud services and diagnostics. Carriers have varying strategies and some offer quite a bit of functionality beyond the services listed here.

Each platform provider has its unique vision. They all want to leverage the underlying technologies and assets they have, while taking into consideration their business model and current customers. So when you evaluate IoT platforms, don't think speed dating. Instead, take the time to understand what each provider offers; you'll be in this partnership for the long haul. —*Bill McBeath*

Driving Faster Supply Chains Through IoT Logistics

THE CONNECTED INFRASTRUCTURE that forms much of the Internet of Things foundation has been around a lot longer than many people realize. Manufacturers and supply chain service providers have been putting sensors on things for ages, and now some have implemented IoT logistics technology to save time and money. U.K. food distributor JJ Food Service is one of them.

To ensure that product temperatures complied with regulations, the London-based company entrusted its drivers with recording temperatures inside their vehicles each time they made deliveries. Unfortunately, drivers weren't always doing that.

"If the drivers were rushing, they would forget to log the temperatures," COO Mushtaque Ahmed said. "There were manual temperature probes in the vehicles that they were supposed to use at the point of delivery, but half the time the drivers couldn't be bothered."

Those oversights created a "nightmare" for logistics and transportation teams charged with maintaining records for 60,000 orders a month. In turn, customer-service teams were unable to answer questions. So, about a year ago, the company, whose eight distribution centers serve more than 30,000 businesses, went live on an automated IoT logistics system that monitors the temperature of goods carried in delivery vehicles. Ahmed said that now Bluetooth-enabled sensors in each refrigerated truck send temperature readings to an app on the driver's IoT-connected smartphone. Drivers and dispatchers are alerted if temperatures fall below certain levels.

The company is using IoT logistics technology to make its business processes more efficient and intelligent and improve its service offerings, Ahmed said. "In terms of legal compliance, customer service, recordkeeping, stock reconciliation, everything is happening behind

the scenes without the drivers or delivery person worrying about it."

TRACEABILITY IMPROVEMENTS

While connected sensors are not new, technological advances are making IoT logistics more affordable and practical, said Guy Courtin, principal analyst at San Francisco-based Constellation Research. Companies are better able to connect people, processes, and data via devices and sensors to improve their supply chains, especially in the areas of logistics, transportation management and retail. "The concept of track and trace and understanding where things are, where they're going, and ensuring the quality of a product and that the product is what [it's] supposed to be—in logistics, that's a huge area where we're seeing IoT playing a big role," Courtin said.

When it comes to IoT logistics for sensitive processes in the life sciences—transporting drugs and pharmaceuticals, for instance—companies have to ensure that what left the factory or the warehouse is what is arriving at the destination. "Traceability is a big aspect," Courtin

noted. "There is a lot more movement toward putting more RFID [radio frequency identification] and sensors on pallets [and] on trucks and being able to monitor everything in real time, so you know the truck left the warehouse at 7 p.m. and got where it needs to be three hours later."

> **Companies have to ensure that what left the factory or the warehouse is what is arriving at the destination.**

Now that IoT logistics technology is becoming more mature, companies can use it to keep track of temperatures inside vehicles to ensure that perishable products are safe, he added.

Mark Wheeler, director of supply chain solutions at Zebra Technologies, based in Lincolnshire, Ill., agreed. IoT offers a new way outside the traditional control-system architectures to connect sensors and assets and, by inference, people to enterprise systems. "With the right tools, we can connect the sensor or an asset like a lift truck or an over-the-road truck

directly to an IoT platform and potentially enable application development and visibility to those sensors and those platforms at a much lower cost than we had with previous solutions," Wheeler said. Cold chain monitoring in the warehouse, plant, truck and all the way out to the retail shelf is one application, he said.

Advances in IoT logistics technology make it possible to monitor produce—which is highly sensitive to the integrity of the cold chain—at a much lower cost than ever before. JJ Food is a good example.

IoT logistics capabilities also allow companies to have a keener eye into what's happening with their vehicles. A company can determine if a connected vehicle has been idling on the side of the road for too long, which could mean it broke down or someone is tampering with it or its contents, Courtin noted.

JJ Food is using IoT logistics technology in this way to know where vehicles are at all times so it can provide top-notch customer service, Ahmed said. "We track the locations of the drivers and vehicles by taking GPS coordinates from their handheld devices," he explained. When customer service gets an inquiry about a

delivery, it can determine the driver's location by looking at a dashboard showing the geographic coordinates.

"We can also see what the temperature of the vehicle and ... products were at delivery, so if we have any product complaints we can match that back to the data," Ahmed said.

The Port of Hamburg, Germany, has deployed geofencing—virtual GPS boundaries—so employees can track where trucks are and which bays are open. That enables the port to optimize loading and unloading of vessels and ensure that vehicles are at the right places at the right times, said Richard Howells, vice president of supply chain solution management at SAP. "If there's a delay, there's no point in having a truck sitting and waiting there a half hour early," Howells said. "They can tell the driver to go get a cup of coffee to save the driver's frustration and to optimize the process."

BETTER LOGISTICS

The next evolutionary step in IoT logistics is transportation management, although it's still early days, Courtin said. Some transportation

management teams already use IoT data in business applications for dynamic routing and real-time traffic analysis.

The combination of IoT logistics technology, such as GPS on trucks, and prescriptive analytics—which is focused on finding the best way to do something for a certain situation—helps companies route their vehicles better, said Lora Cecere, analyst and founder of Philadelphia-based Supply Chain Insights. That can keep the supply chain moving by ensuring that big trucks stay out of traffic snarls and possibly improve safety as well, she explained.

Companies can also use IoT logistics data to tie the warehouse into transportation management to track individual pallets. Some are even talking about tracking the individual stock-keeping units (SKUs) on the pallets from inception to delivery, Courtin said. Because there are so many different SKUs in the retail supply chain, retailers are often hard-pressed to know the exact locations of their inventory. Retailers, therefore, can use IoT logistics to better track the flow of inventory, he said.

But retail has lagged in using IoT, mainly because prices have always been too high. Now that they have come down, retailers are beginning to attach RFID tags to garments and other items.

There's significant movement toward using IoT in stores to better understand what products shoppers are looking at or buying so retailers can decide which ones to order, Courtin explained. Fashion company Tory Burch is putting tags on products and installing RFID readers in fitting rooms to track which items are picked from shelves, brought to the fitting room and purchased so the company can determine conversion rates, he said.

SAP's Howells said such retailers want to drive their business processes based on real-time demand signals gathered from connected devices. "The smart vending machine can have IoT technology built in to make sure that it's working all of the time, but also to trigger reorder of inventory." —*Linda Rosencrance*

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