

Monetizing the Industrial Internet of Things

July 2017



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Introduction

The expanding world of connected things Each new surprising application of a connected device—a car communicating with a traffic light?—serves as a reminder that, given investments and a potential market, nearly anything could become part of the Internet of Things (IoT). But should it? And, if so, why and how? This is the crux of the issue for manufacturers. With hundreds of analog products and many more thousands of still-mute touch points inside the business and throughout its networks, being smart about where next to apply IoT—the embedding of an Internet-connected, data-gathering device into a product—is not a simple task. At the same time, unease over cybersecurity risks, deployment costs, and data talent shortages, as well as the potential to add value, weigh on deliberations.

Meanwhile, IoT continues its inexorable growth spurt and is growing on two parallel tracks: consumer IoT and industrial IoT (IIoT). Consumer IoT has already become an expected and conspicuous feature in consumer products, such as wearables emitting biometric data. IIoT encapsulates applications within industrial operations (such as robots talking to one another) as well as field services (think wind turbines signaling a need for repair before a breakdown happens). One estimate places the number of all connected things globally (e.g., smart phones, embedded sensors, actuators, machinery, vehicles, cameras, radar systems, drones, to name a few) at 8.4 billion in 2017. Two-thirds of connected things are consumer IoT devices, and about one-third are business and IIoT (e.g., manufacturing equipment, smart utilities, intelligent oil fields, and smart buildings). That number is projected to exceed 20 billion by 2020. Put another way, the global population of connected things has already eclipsed the world's human population.¹

Manufacturers in hot pursuit of IoT commercialization As manufacturers ramp up operational IIoT initiatives (smart factories and connected field services) and supply chains, they are also achieving cost-cutting efficiencies. And, as IIoT-related costs of components, communications and data collection, storage, and analysis continue to decline (and functionalities increase) IIoT fence-sitters may well become adopters. 5G mobile network deployments alone are estimated to enable \$3.4 trillion in economic output by 2035 in the global manufacturing sector.² Given the tremendous changes in technology afoot, manufacturers are hunting for ways to monetize IIoT through revenue-generating products and services—or to differentiate their core product and services offerings in an increasingly converging or commoditizing marketplace.³ IoT start-ups, too, are drawing attention, with venture capital investment reaching \$2.5 billion in US companies developing IoT products and services, roughly doubling the amount invested in 2012, according to PwC/CBI Insight MoneyTree report data.⁴

At the crux of a successful IoT strategy are sustainable and scalable IoT-centric business models that can demonstrate returns on investments in time, talent, and capital. Manufacturers are finding that they need to work on numerous fronts and collaborate with a host of (often new) players to commercialize IoT through revenue-generating offerings and to improve internal productivity and collaboration. Companies need to discern what data customers want (and will pay for) to decide on which sensors or communication protocols, for example, best suit their product and their customer. IoT is prompting manufacturers to form a new mindset around servicing clients.

Key findings of the PwC/MAPI IoT survey

To get a better picture of how—and why—manufacturers are pursuing IoT initiatives to spur new sources of revenue or lead to customer retention efforts or “stickiness,” PwC and the Manufacturers Alliance for Productivity and Innovation (MAPI) surveyed US-based manufacturers. Key findings include:

- IoT deployments are accelerating: 38% of manufacturers are now offering IoT-driven products and services; an additional 48% are currently in the process of developing them
- About half of manufacturers (47%) currently offering IoT products and services are selling customer-managed IoT platforms (i.e., selling a bundling of product and IoT service, related data-gathering and analysis technology, and software)
- Over the next five years, manufacturers expect that the revenue driven by IoT-based products and services will increase by an average 10% of total company revenue
- The most common reasons manufacturers offer IoT-driven products and services are: 1) competitive pressures; 2) prospects for new revenue and return on investment; and 3) customer demand
- Only 14% of manufacturers surveyed say they have created go-to-market IoT strategies, and roughly half are in the creation process, suggesting that some companies are offering IoT products without a clear strategy to market those products

What our findings tell us

For those looking to advance their position in the IoT race, our findings inform five overarching recommendations manufacturers should consider.

- 1. Identify do-able, realistic entry points (or expansion plans) into the IoT products and services market— your competitors likely already have a strategy.***
- 2. Define and demonstrate how IoT products and services create value for your customers and your company. Be agile at proof-of-concept stage and be prepared to move swiftly past early challenges.***
- 3. Develop effective IoT go-to-market strategies to effectively support your IoT products and services offerings.***
- 4. Create scalable and future-proof IoT business models and promote an entrepreneurial culture to develop them.***
- 5. Learn from your products and your customers to improve, accelerate, and scale up your IoT products and services.***

A close-up photograph of a person's hands typing on a laptop keyboard. The person is wearing a light blue and white checkered shirt. In the background, a tablet is held up, displaying a website with a large image of a person and some text. The scene is brightly lit, suggesting an office or workspace environment.

*Enter the IoT race
(it may no longer
be optional)*

According to our survey, nearly 90% of industrial manufacturers are either currently offering IoT-driven products and services to customers or are in the process of developing them. This compares to a 2015 PwC survey of US manufacturers which found only 69% of manufacturers had either been embedding sensors in products that enable end-users/customers to collect the data or planned to do so in the future.⁵ Arguably the greatest value may be created, however, through the analytics and insights delivered to the organization (and its customers) leveraging collected data. As with any emerging technology, some enterprises will grapple with entry timing, unsure whether they might be too late—or even too early—in their adoption strategies.

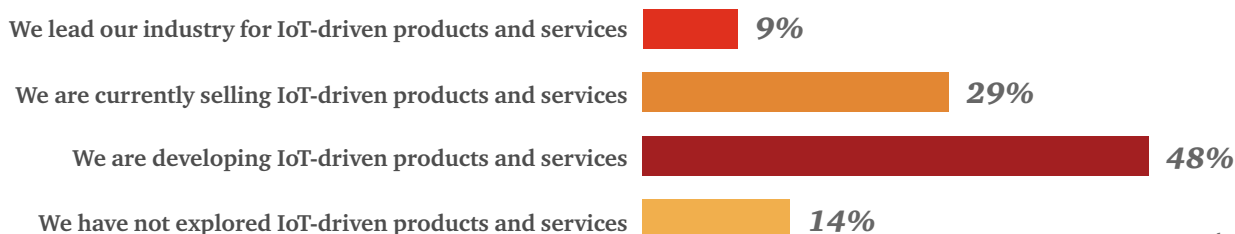
This is easy to understand. There are myriad considerations. IoT products cover a vast breadth of sophistication. Consider Rolls Royce’s IoT-driven “engine health management,” an industrial-use case that monitors

thousands of jet engines globally using sensors and live satellite feeds to gather performance data used for proactive maintenance.⁶ But IoT can smarten up simpler, consumer-case, applications, too. Take Memphis, Tennessee-based Hunter Fan Company, which updated the 103-year-old electric fan by equipping it with sensors for an automated home solution which allows control of the fan through a hand-held remote, or from anywhere in the world, via a smart-phone app.⁷

On another front, 31% of manufacturers are also implementing IoT-related enhancements to their internal operations, and 56% are exploring this path, according to our survey. They are cutting costs through IoT-driven operational and supply chain efficiencies and predictive maintenance of assets. Interestingly, 23% of manufacturers surveyed are now both deploying IoT internally and offering IoT products and services to customers.

Nearly 90% of US manufacturers developing or already offering IoT products and services

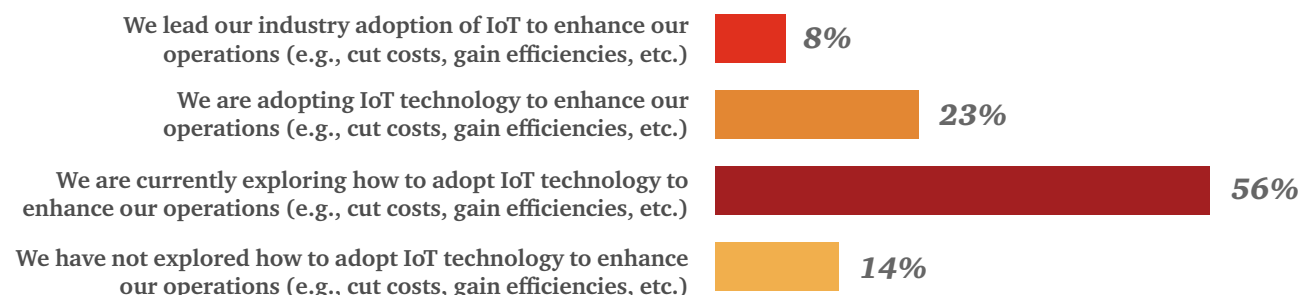
Q: Overall, how far has your company progressed in the development of IoT-driven products and services?



Respondent number: 66

Meanwhile, nearly 90% of US manufacturers are using or exploring the use of IoT tech to enhance operations

Q: Overall, how much has your company transformed your manufacturing and distribution capabilities to take advantage of digital/IoT enhancements (e.g., predictive maintenance, supply chain, etc.)?



Respondent number: 66

The heavy lifting of being IoT-product ready


Companies in the IoT space have complex needs, including considering how IoT products can create value, identifying which existing analogue products are prime candidates for connectivity retrofitting, or developing new connected products altogether.

That's just the beginning. Companies will need to create business models around their products and services. To be successful, it also means enlisting the right talent (either in-house or external) to determine key decisions to make products safe, reliable, and future proof. These decisions include: choosing the right data collection technology (e.g., sensor/actuators, automation systems), communication technology (e.g., ZigBee, Wi-Fi, Blue Tooth), data storage platforms, data analysis capabilities, app development, business culture and operating models and new customer service requirements, etc.

Find the right data While it's easy to perceive IoT as a distinct technology, it's helpful to view it, ultimately, as an integrator of all a business touches: from sales, distribution to operations, to inventory management, to supply networks, to customer service. With

many manufacturers working with a compilation of incompatible or balkanized IT systems, it's difficult to identify and leverage the right data collected across various value chains. "Collecting data from platforms such as manufacturing, inventory systems, logistics, machinery or connected products is one thing. Most manufacturers have no shortage of data," said Ed Abbo, President and Chief Technology Officer of C3 IoT, an AI and IoT application development platform provider, in an interview with PwC and MAPI.

"But committing to getting the most out of that data is another matter. It is CEO-led mandates for digital transformation initiatives that are driving the large and growing market opportunity for a new generation of enterprise software that leverages big data, AI, and IoT at industrial scale. C3 IoT serves this growing demand by enabling large industrial and commercial organizations to rapidly build and deploy next-generation software applications that leverage AI and IoT across all parts of the enterprise to address productivity improvements, new business creation, and competitive differentiation. If companies can't get this right, they will be at a competitive disadvantage," Abbo added.



*Define the IoT
value proposition:
what do you and your
customers want?*

As companies wade into IoT monetization (whether beginning at step one or dominating one's industry), they will have five basic questions:

- What do our customers want to gain from it?
- Will customers want it enough to pay for it?
- What do we want to get out of the IoT products and services space?
- Will it incentivize customer retention?
- What value can IIoT deliver internally in productivity improvement—both within the four walls and across the supply chain?

Getting these questions wrong could mean spending a considerable amount of time and capital on an IoT offering that is unneeded or unwanted. As David Burdakin of JBT Corporation, in an interview with PwC and MAPI, put it: "Take a vehicle, which could provide thousands of data points. Which ones of those are critical, and which ones are simply noise?" Consider John Deere, which has embedded agriculture machinery with sensors that can track mechanical performance as well as monitor soil conditions and the pressure used to plant seeds into fields. That data is collected via Wi-Fi or wide-area networks, sent to a cloud-based center where it is analyzed, and then offers insights such as proactive maintenance (along with ways to order parts if needed) to users through the

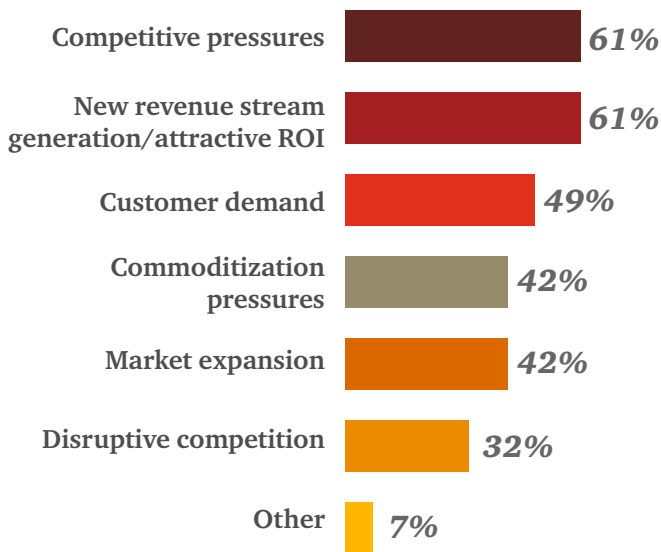
company's tablet application.⁸ Indeed, as manufacturers develop IoT offerings, they should determine what data from those offerings is critical for the consumer or business customer, not-so-critical or, possibly even frivolous?

Competitive pressures, monetization, driving manufacturers into IoT Top factors triggering manufacturers to offer IoT products and services include competitive pressures (61%), new revenue streams/return on investment (ROI) (61%), and customer demand (49%). These companies have expectations that connected products and services could provide them with a first-mover advantage and possibly new revenue opportunities assuming that customers find enough value to pay for it.

Demonstrating ROI on IoT products and services has become a sort of golden fleece. It can define a business model that can be replicated and scaled out and, most importantly, can help justify additional resources being dedicated to some companies' overall IoT strategy. "Our biggest challenges [in developing our initial IoT-enabled products] were figuring out how we could actually demonstrate how IoT-enabled products can help them [the customer], and deciding what data, specifically, customers really need and want, ensuring we provide that data to them easily, and, most important, if all of that can justify an adequate return on their incremental investment?" said David Burdakin, JBT Corporation.

Competitive pressures, new revenue streams drive IoT products and services development

Q: Please indicate which of the following factors influenced your company's decision to invest in IoT-enabled products and services. Select all that apply.



Other includes:

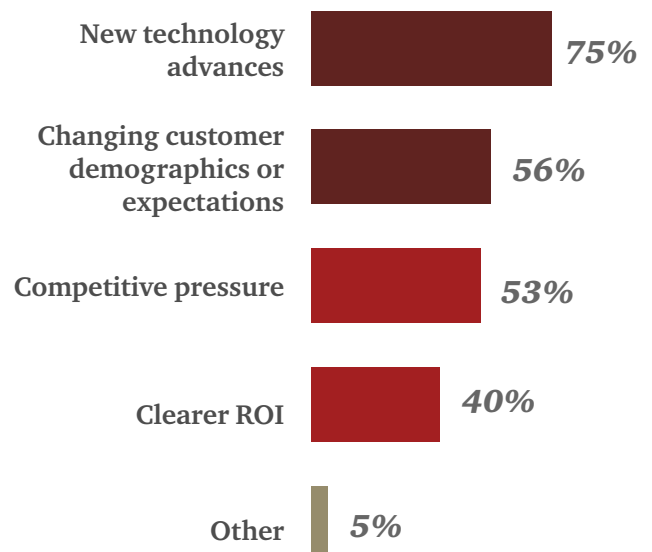
- Desired to lead our market
- Cost savings
- Lack of industry growth
- Service optimization

Respondent number: 57

IoT adoption speed bumps? It is important to note that companies frequently encounter pitfalls in developing and deploying IoT projects, especially at the beginning stage, when ideas are tested. A recent Cisco survey showed that among companies with completed IoT projects, one in three projects were not considered successful. Interestingly, 60% of IoT initiatives stalled at the proof-of-concept phase.⁹ This finding is telling and ought to alert companies that the early phase of IoT development (i.e., proving that it can work and be monetized) could either form a sound foundation for success or be a series of speed bumps that slows or stops the initiative. Some of these bumps could include lack of executive-level buy-in, underestimation of expertise or capital needed, lack of vision and quantification of enterprise value creation possibilities, underestimating the cultural and organizational change aspects, or overestimation of customer needs and preferences.

New technology advances, customer demand seen to accelerate IoT products and services offerings

Q: Which of the following do you think will accelerate your company's development of IoT-driven products and services? Select all that apply.



Other includes:

- Lower component cost
- Lack predictive maintenance opportunities
- An early adopter helping us pull it through

Respondent number: 57

We are at a crossroads, with a camp of manufacturers still sitting on the sidelines. Consider that more than half of those companies not yet offering IoT services cite “no customer demand” as the reason for not doing so, and nearly half cited “unclear return on investment” or “no proven solutions.” Such perceived challenges in (or reasons against) developing and selling IoT products and services suggest that assumptions about the future deployment of IoT products and services are in flux and will likely be tested over time, and through trial and error. Some companies may be overestimating customer demand and potential ROI around a given connected product or IoT service; likewise, others may be understating (or not seeing) the demand for a given product or service.

IoT revenues to gather steam in next five years

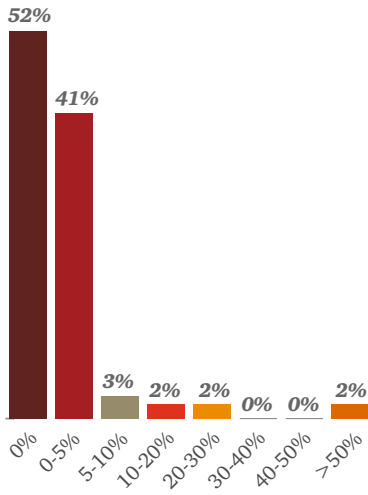
According to our survey, four in five manufacturers are already pouring investments in IoT product and services development, with 40% earmarking between 5% and 20% of their total research and development budgets to IoT development. While measuring returns on that investment can be a challenge—especially for the adoption of new and advanced technologies—nearly half

of manufacturers are already seeing returns. According to our survey, among those respondents currently offering IoT products and services, 41% experienced returns of up to 5% of their total revenue last year. Looking ahead, over the next five years, respondents expect a more promising scenario, with 42% expecting between 10% to 20% of their total revenue driven by IoT products and services.

Revenue from IoT products and services expected to rise over next five years

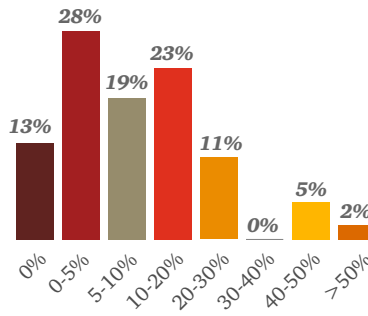
Q: Please estimate the percentage of your last fiscal year’s revenue that came from IoT-driven products and services:

IoT-related revenue as % of last year’s revenue



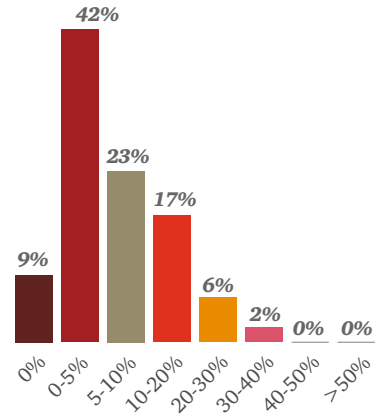
Q: Please estimate the percentage of revenue that your company anticipates will come from IoT-driven products and services 5 years from now:

IoT-related revenue as % of revenue five years from now



Q: Please estimate the percentage of your R&D budget that your company invests in the design and development of IoT-driven products and services:

Percentage of R&D in IoT development



Respondent number: 64



*Create IoT
business models
to deliver—then
capture—value*

As described earlier, there are numerous factors driving the development of IoT-enabled products, chiefly revenue generation, gaining a competitive edge, satisfying customer demand, and customer stickiness. To achieve these aims, companies are developing business models that hinge on new relationships with customers and a host of other stakeholders. These business models expand from the transactional (product sale and, in many cases, after-market parts and service) to those that offer IoT-generated data—and the services, insights, and solutions that derive from that data.

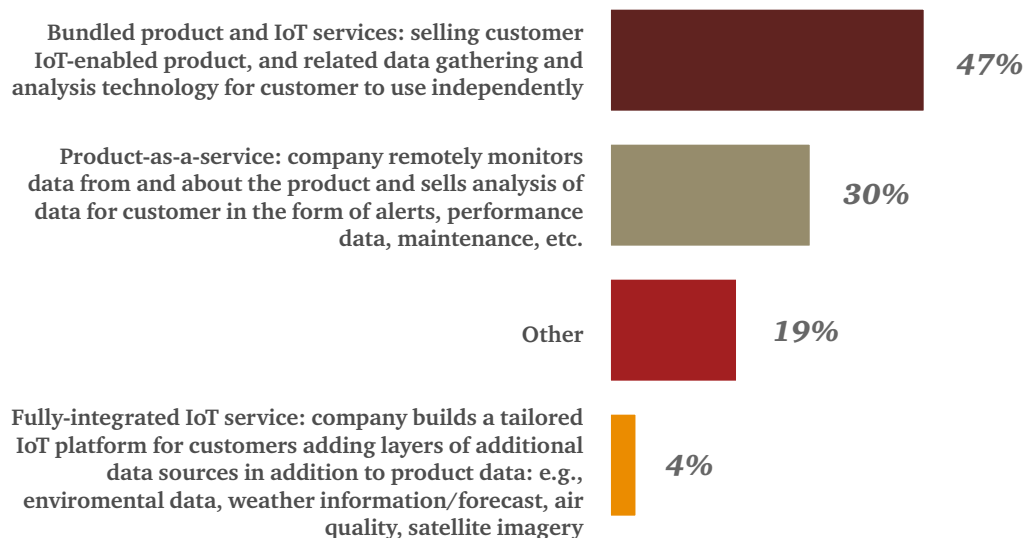
Getting the right business model Finding IoT business models that best align with and support an overall business strategy and customer base is a challenge many companies face. Manufacturers have been developing business models that are essentially designed to enhance the product and customer service in ways that will lead to new customers or the retention of existing customers and, in some cases, to monetize the IoT offerings. Some business models taking hold are described below. Business models may be best tested on a small scale to demonstrate success on several levels, including customer buy-in, ROI, gaining a competitive advantage in a company’s traditional market, or possibly capturing market share in an entirely different industry.

Gaining traction in managing customer IoT data

According to our survey, about half of the manufacturers (47%) currently offering IoT products and services are selling customer-managed IoT platforms (i.e., selling a bundling of product and IoT service, related data-gathering and analysis technology and software). Yet 30% of manufacturers have gone beyond that, selling IoT product-as-a-service offerings (e.g., the manufacturer remotely captures customer IoT data and sells data analytics and services including alerts on performance and maintenance needs). Just 4% of manufacturers are selling fully integrated multi-sourced IoT platforms, which includes not only analysis and services built onto IoT data from the customer’s asset but also folds in external data from other nodes or sources, such as environmental data, weather information, traffic, or satellite imagery, for example. “We’re definitely seeing companies starting to think about how they can move from simply selling a product to selling a service. For example, in the mining industry, instead of selling earth moving equipment, the model could be selling tons of earth moved. That way, there’s a lot less that a customer has to worry about, such as high capital expenditures and maintenance, for example. Some customers might really favor that model,” Abbo added.

Nearly one in three manufacturers is deploying products-as-a-service IoT business model

Q: Which IoT-driven business models is your company currently deploying?



Other includes:

- Just additional feature - enable IoT
- Added functionality to product
- Free
- Selling performance guarantees and extended maintenance contracts based on condition based monitoring
- Just starting to consider
- Still exploring
- Efficiency of product development
- None, but bundled would be the likely path

Respondent number: 57

IoT business models: stacking services upon products

The foundation of IoT is the gathering of data and putting that data to work. The big question for manufacturers is: how can they monetize the data? Some business models and their potential for monetization are:

- **Product performance monitoring** Customer accesses data from connected asset independently for real-time, periodic “check-ups” on an asset’s performance and efficiency of use and signals for predictive maintenance.
Potential monetization Charge a separate premium for apps or web-based tools, cybersecurity, data storage, software updates, or charge an upfront premium for the IoT-enabled asset at the point of sale.
- **Data analysis/diagnostics from manufacturer** Manufacturer (or third-party vendor) provides predictive maintenance alerts and prescriptive insights, including push alerts on service/maintenance, security alerts, and software upgrades. Manufacturer owns and remotely manages the data.
Potential monetization Charge, on a subscription basis, for some, or a complete suite of these products and services. Alternatively, can charge on an outcome basis (e.g., improvements in asset uptime or unplanned downtime) and can include bonus incentive or a penalty, based on the outcome. Or, a hybrid of the two.
- **IoT-driven field services** Manufacturer extends service by offering enterprise-wide solutions, leveraging an asset’s product performance data and analysis via alerts to the customer of needed actions/insights (e.g., identifying the part required to prevent a malfunction, identifying the most qualified field technician, or determining a software update to address an issue, manufacturer owns and remotely manages data.
Potential monetization Charge, a subscription basis, or a complete suite of, IoT products and services. Alternatively, can charge on an outcome basis (e.g., improvements in asset uptime or unplanned downtime) and can include bonus incentive or a penalty, based on the outcome. Or, a hybrid of the two.

- **“The Pay-Per” model** Just as some manufacturers are already charging on an asset usage basis, or on the service that an asset is providing (e.g., *Asset Pay-Per*), IoT enabled products also lend themselves to similar “pay-per” offerings, including pay-per-hour of output, pay-per-alert, pay-per-insight, pay-per-warning, and pay-per-solution, which can be described as *IoT Software Pay-Per*. Manufacturer owns and remotely manages data.
Potential monetization Manufacturer charges only when a customer uses products, and only when it receives insight or warnings on performance, maintenance, or insights on gaining efficiencies such as power consumption.

Building the right team Manufacturers exploring IoT products, business models, and go-to-market strategies might well heed the following advice: you don’t need to go it alone. It is revealing that three of four manufacturers “leveraged internal resources” to build their IoT products and services strategy. At the same time, they also looked elsewhere for help, with 26% doing so through partnerships and acquisitions or hiring an IoT specialist vendor, and 25% purchased an industrial IoT platform developed by a third-party provider. Convening a diverse group of leaders at the outset helps integrate IoT product development through the business. “I don’t see IoT as a separate business, but rather as an enhancement of our product lines,” said David Burdakin, JBT Corporation. “We created an IoT team about two years ago from different business units across JBT—including engineering managers, technical experts in software and machines and the sales team—to leverage IoT across the organization, with each unit responsible for how to apply it. We are developing solutions with a focus on enhancing customer profitability through the use of real-time data analytics, predictive maintenance, and fleet management capabilities,” noted Burdakin. Thus, a robust IoT initiative would ideally need to include business, user experience and technology expertise joining efforts on what would be multi-functional teams.

Finding new stakeholders and markets for collected data As enterprises capture value from data gathered by their products, they may well find other, often incongruous suitors, for that data. For example, the driving habits measured by an automobile and captured

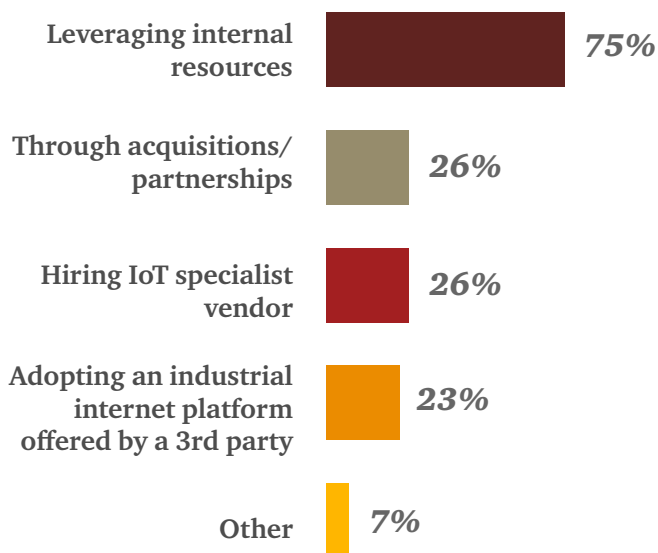
by automakers hold obvious intrinsic value to automakers (e.g., predictive maintenance, research and development advancements). But what about other sectors which might also find that data valuable—for example, insurance companies—yet for entirely different reasons? While acquiring, sharing, or selling data could well benefit manufacturers and their customers, doing so also clearly comes with challenges, including data privacy and ownership issues, which, if not well managed, could potentially erode digital trust with customers.

As manufacturers expand their data offerings stacked upon their products, they will also benefit by partnering not only with other enterprises, but also with the public sector, non-profit, and academia to deliver data that can enhance IoT products (such as real-time data on weather, crime statistics, transportation traffic, data on energy use from public utilities, to name a few).

Learn from your products Another way businesses

Most manufacturers still looking inward to develop IoT product and services strategies

Q: How has your company executed on your IoT-driven products and service strategy? Select all that apply.



Respondent number: 57

can capture value from IoT products is to use data as a feedback loop to unveil how their products are being used, which functionalities are most utilized and, just as important, least popular. To future-proof a connected product, manufacturers need to have the capability to remotely update the apps customers use to access the data as well as to update or add next-generation software (for greater functionality or cybersecurity). Take the battery and electric carmaker Tesla, for example, which was able to remotely repair a charging plug software glitch on about 30,000 of its cars.¹⁰

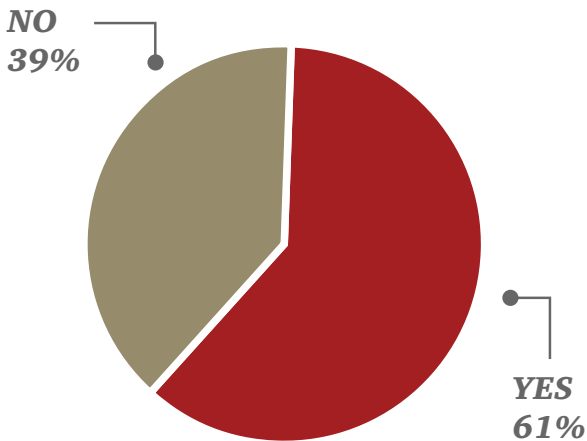
Or, perhaps customers are not optimizing the products as much as expected; this can prompt a real-time, virtual feedback loop with customers to inform—and accelerate—product design, development improvements, and new product introductions. Presently, about three of five manufacturers selling IoT products are using data collected from those products to improve product development. Using predictive analytics enables manufacturers to enhance the customer experience. “Manufacturers that have product data can also better predict that an issue with one customer could trigger a red flag or potential claim by another customer with similar circumstances,” said Ed Abbo, President and CTO of C3 IoT. For example, C3 IoT worked with one manufacturer that was gathering data on 2,300 of its products in the field, with each product emitting data from hundreds of sensors. Once their data was properly integrated and correlated with other data sets (such as data on inventory, sales, repair service, etc.), the company was able to anticipate, for example, whether proactive repairs were required to avoid potential warranty claims, and whether design or manufacturing changes were needed based on the experiences of other customers.

Keep a vigilant eye on cybersecurity Manufacturers using IoT-connected equipment and supply chain tracking realize the importance of keeping data secure and incorporating enterprise-wide cybersecurity risk management. Large manufacturers building out IoT throughout their operations, especially those in critical infrastructure sectors (including energy, chemicals, and industrial defense) are already aware of the importance of investing in strong operational technology security.

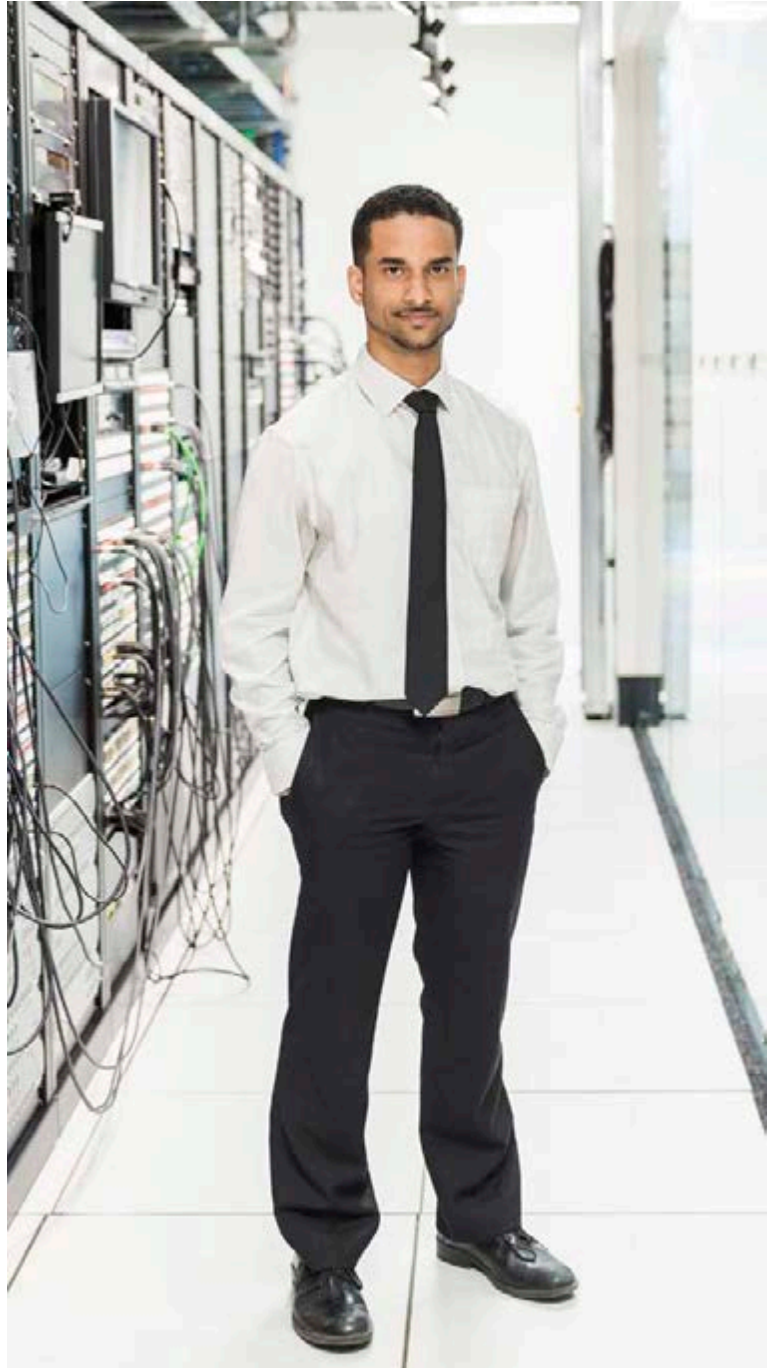
But securing customer products from attacks requires an extra dose of vigilance. Consider that, in PwC's 2017 Global State of Information Security Survey®, 46% of respondents said they plan to invest in IoT security over the next year, 35% of respondents had an IoT security strategy in place, and 28% said they were in the process implementing an IoT security strategy.¹¹ Adding extra security to help safeguard products from being hacked can also be another opportunity to charge a premium. In a recent PwC survey, “enhanced security features” topped the list (75% of respondents) of add-on features that respondents would pay extra for, after purchasing a smart home device.¹²

6 of 10 manufacturers gather data from their IoT products to inform product improvements, R&D

Q: Does your company collect information from your IoT-based products and use it to drive efficiency or performance improvements (e.g., to product development, product quality, reliability, etc.)?



Respondent number: 57



IoT products and services development and deployment: Questions to consider

Have you created a culture of entrepreneurship to promote innovation—where teams have the time and resources to develop IoT products and services and are encouraged to “fail fast” and learn?

Have you defined and quantified the enterprise value levers and KPIs for your IIoT initiative, both in productivity improvements and in revenue opportunities?

Are you building IoT into existing products (or retrofitting legacy products already in the field) or developing new IoT-based products—or are both on parallel tracks?

Have you defined what value you are creating with your connected products and services for your customers and for your company?

Are you co-creating IoT products with your customers (for example, if you supply to a Tier 1 OEM)?

Are you satisfied that your products are as well-protected as possible from cyber-attacks?

Do any products in your portfolio that are IP-enabled potentially lend themselves to a value-added service attached to that product?

If you can track performance data on products, can you use that data towards product improvements or even to altogether new product development?

Are there more data and analyses you can share with others outside your organization (e.g., from suppliers, distributors to end users) to improve operations and strengthen customer relationships?

Which elements of your IoT strategy ought to be done in-house, versus collaborating with a third-party vendor?

Is your organization mulling one or multiple hiring candidates with specialized skills in data science and analytics to help carry out your IoT strategy?

Do you have a contingency plan at the ready if your customer’s IoT-enabled products are cyber-attacked?

Can you quickly and easily update cyber-protection software (and even hardware) to your customers’ IoT infrastructure as it becomes available?

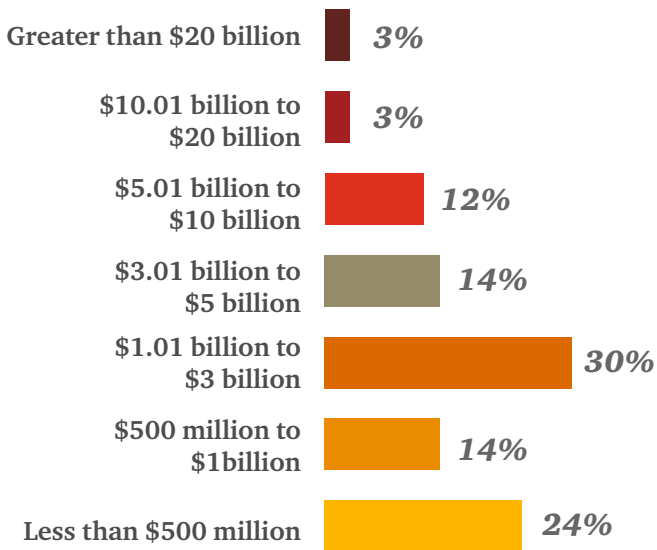
Are you able to add enhanced cyber-protection products and services, and have you considered charging a premium for that?

About the “PwC/MAPI Creating New Business Models for the Industrial Internet of Things Survey”

The majority of our survey respondents were original equipment manufacturers (62%) and roughly one-third were tier-1 suppliers (32%). Nearly two-thirds of respondents were companies with annual revenues of between \$1 and \$5 billion. The 56 publicly held companies that took part in this survey had a combined \$287 billion in annual revenue.

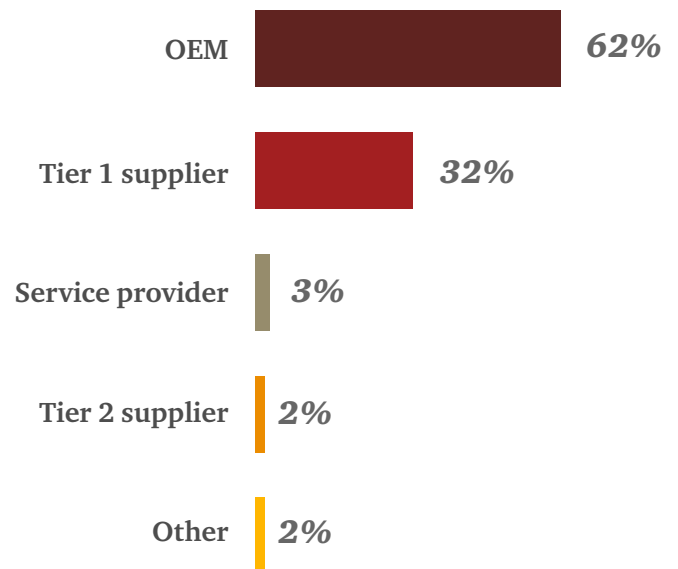
Please note that only respondents who specified they were “very” or “somewhat” familiar with the specifics of their business efforts to develop IoT-driven products and services were permitted to complete the survey.

Q: Please estimate your business’ annual revenue in US dollars for the most recent fiscal year.



Respondent number: 66

Q: Which of the following best describes your company?



Respondent number: 66

Acknowledgments

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Endnote

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