

Bringing Life To 'Things': A Framework for IoT

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Amazon.com has about 50 of the most highly automated warehouses in the world, centers through which flow some of the 13 million items the company ships daily.⁴⁴ In these centers, goods come to warehouse workers via robots that pick the shelves, rather than the opposite. The robots—400 to 500 of them whirling around a 125,000-square-foot warehouse at a time—are equipped with visual sensors so they don't collide with each other or have boxes fall off.⁴⁵ The robots in one Amazon center have increased the number of items a worker can pick from 100 to 300 to 400 per hour.⁴⁶

Automated warehouses are just the tip of the iceberg of how businesses, government agencies, and other institutions are using Internet of Things (IoT) technology. Digital sensors are now embedded in products ranging from aircraft engines

⁴⁴ The Verge, Jan. 2, 2018. Amazon shipped more than 5 billion items through its Prime program in 2017. Accessed Aug. 18, 2019. <https://www.theverge.com/2018/1/2/16841786/amazon-prime-2017-users-ship-five-billion>

⁴⁵ Wired magazine article, "Inside the Amazon Warehouse Where Human and Machines Become One," June 5, 2019. Accessed Aug. 13, 2019. <https://www.wired.com/story/amazon-warehouse-robots/>

⁴⁶ The New York Times, "Inside an Amazon Warehouse, Robots' Ways Rub off on Human," July 3, 2019. Accessed Aug. 12, 2019. <https://www.nytimes.com/2019/07/03/business/economy/amazon-warehouse-labor-robots.html>

and appliances to electric toothbrushes and traffic lights. (Cities will spend \$2 billion this year on ‘smart’ traffic lights that change based on traffic volumes.⁴⁷)

However, with 14 billion ‘things’ already connected to the Internet⁴⁸ (nearly three times the number in 2015⁴⁹) and another 11 billion expected by 2021, companies can easily lose their way with IoT initiatives. Their IoT strategies can quickly become tactical, fragmented, and misdirected, resulting in tens of millions of dollars spent but far less gained in return.

Companies need clear strategies to guide their IoT initiatives. The strategy development process should begin with a deep understanding of how IoT technology fundamentally changes the game: by bringing the company real-time insights on the performance of its products, processes, and people. We have seen four core sources of business value from IoT technology:

- **New digital business models**—by which product companies can charge for post-sale services that help customers maintain and make better use of those products (so-called ‘servitization’), as well as shift from ownership to subscription pricing.
- **Seamless customer experiences**—largely digital—that relieve buyers of the multitude of logistical and other headaches they often face in using a product or availing themselves to a service.
- **Optimized and responsive value chains**—i.e., production and distribution operations that detect and overcome internal bottlenecks and external conditions, making automatic adjustments that keep products moving or services flowing.
- **Enhance quality of life**—with safer operations by monitoring the condition of buildings, factories, products, and people.

⁴⁷ Juniper Research, May 20, 2019. Accessed Aug. 13, 2019. <https://www.juniperresearch.com/press/press-releases/smart-city-traffic-technology-revenues-double>

⁴⁸ Gartner, as cited in Network World article. Accessed Aug. 13, 2019. <https://www.networkworld.com/article/3322517/a-critical-look-at-gartners-top-10-iot-trends.html>

⁴⁹ Gartner, as cited in TCS 2015 IoT study. Accessed Aug. 13, 2019. <http://sites.tcs.com/internet-of-things/wp-content/uploads/Internet-of-Things-The-Complete-Reimaginative-Force.pdf>

Companies get the greatest value from IoT technologies when they view them as a new transformative force that, as we put it, ‘brings life to things.’

The ‘real’ world today, is a combination of digital and physical—it’s multi state, dynamic, and live. By adding sensor physical things and connecting to the digital ecosystem—they become responsive and closed loop—hence, can grow, evolve and adapt to the

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dynamic context. IoT brings *Life to Things*. Thus, by combining physical context and digital intelligence—a synthesis of human and AI—customers can unlock the latent, unexplored and limitless possibilities, and extract exponential value.

A Hotbed of Activity Around Internet of Things

The billions of digital wireless sensors that are embedded in products, attached to building walls and factory lines, resident in things we wear (digital wristbands) and inside the devices we carry (mobile phones) are testimony that we’re living in an IoT age. They have already begun to change the way companies operate in every sector.

A TCS survey this summer on how more than 1,000 North American and European companies have been digitizing their businesses found just how crucial IoT technology has been.⁵⁰ Nearly two-thirds (64%) said digital wireless sensors have had an extreme or high impact on their sector’s digital transformation this decade. A higher percentage (68%) predicted that strong impact would

⁵⁰ TCS 2020 CIO Study. Accessed Aug. 17, 2019. <https://sites.tcs.com/bts/tcs-cio-study/>

North American and European Companies: Impact of IoT Technology This Decade on the Digital Transformation of 11 Industries

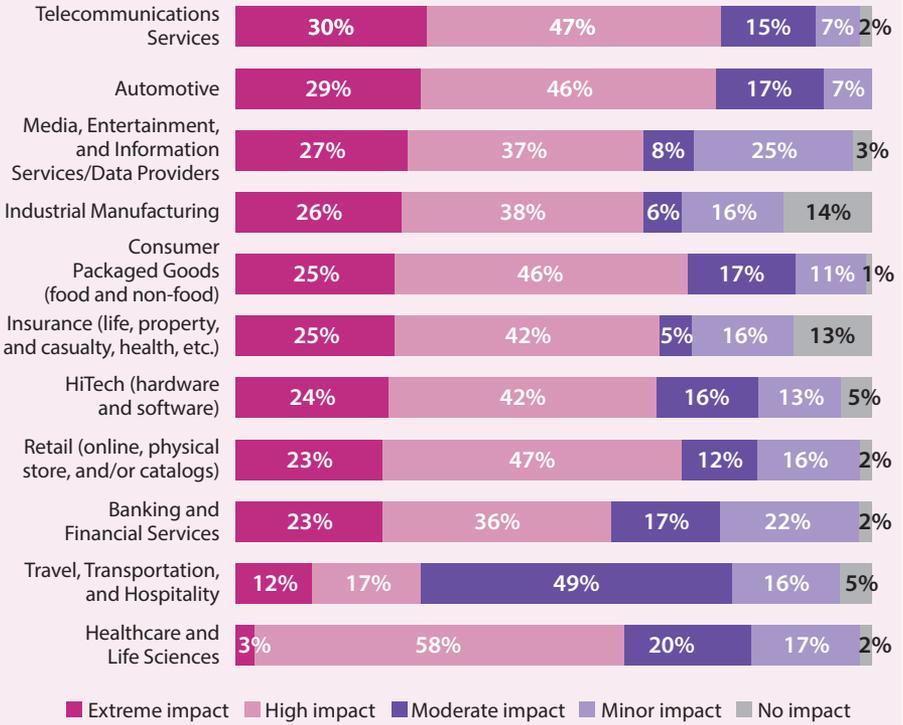


Figure 5: Impact of IoT Technology on 11 Industries

continue into the next decade. Four industries reported the highest impact from IoT: telecommunications, automotive, retailing, and consumer packaged goods. (See Figure 5.)

Yet, getting big returns on IoT technology is a challenge at many companies. In a TCS survey this spring with 516 marketing executives in North America and Europe, only

about one in five (22%) are using digital data from digital sensors in their products to personalize communications to customers in post-sale support.

Other studies also point to low overall usage of IoT technologies, and even lower returns. For example, a 2018 study by McKinsey found that less than 30% of companies with IoT initiatives had moved them past the pilot stage. And in 300 companies with large IoT programs that were long past the pilot stage, only a sixth generated improvements of at least 15% in lower cost and/or greater revenue.⁵¹

Getting Major Returns on IoT Technology

From our vast experience, generating high returns on IoT investments requires a top-down strategy whose overarching goal is a specific (and large) improvement in the business—not technology gains. We believe companies that are on the path to getting exponential value from IoT are focusing their investments in four primary ways. Let's get into each one.

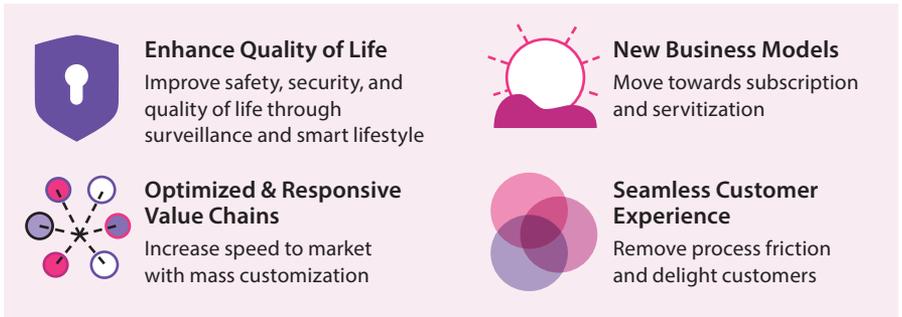


Figure 6: Four Primary Focuses of IoT Investments

⁵¹ McKinsey article, January 2019. Accessed Aug. 18, 2019. <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/what-separates-leaders-from-laggards-in-the-internet-of-things>

1. Launching New Business Models



Companies such as Rolls-Royce PLC and Caterpillar have been early adopters of IoT. They have installed wireless sensors in their products: aircraft engines for Rolls-Royce, and construction equipment for Caterpillar.

Those technologies have enabled these and other manufacturers to monitor the performance of their products in the field, and thus alert customers when they need to be maintained, repaired, or replaced. For example, Rolls-Royce uses on-board sensors in its aircraft engines and satellite communications to collect performance data for airlines. The company that creates a ‘digital twin’—a computer-based replica of its engines—and uses the data from the real engine to replicate its performance in the virtual versions. The virtual engines then use artificial intelligence-based analytics to determine how well they are operating and predict when they will require maintenance.⁵²

Caterpillar, a \$54 billion global manufacturer, counts 850,000 of its machines that are digitally connected through sensors and communications networks that receive data on their operating performance.⁵³ The company believes that tracking equipment performance through this digital capability will be key to doubling its service revenue, from \$14 billion in 2016 to \$28 billion by 2026.⁵⁴

With IoT sensors in their products, these manufacturers can change their business models—from selling equipment that customers own, to renting that equipment to customers, who then can pay depending on how much they use the products. In the future, this new business model can evolve to become a networked ecosystem model, whereby certain other players in the ecosystem can get value from a manufacturer’s database.

⁵² Rolls-Royce web page, accessed Aug. 18, 2019. <https://www.rolls-royce.com/products-and-services/civil-aerospace.aspx#/IntelligentEngine>

⁵³ Caterpillar investor presentation, accessed Aug. 18, 2019. <http://s7d2.scene7.com/is/content/Caterpillar/CM20190520-a44a6-7169d>

⁵⁴ Thomson Reuters transcript of a Caterpillar investor meeting, May 2, 2019. Accessed Aug. 19, 2019. <https://caterpillar.gcs-web.com/static-files/53563450-d7a8-412e-9349-5b378cd5c7da>

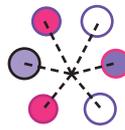
2. Creating Seamless Customer Experiences



IoT sensors give companies an unprecedented capability: the ability to monitor how their products (and their companies) are performing for customers throughout the customer lifecycle. Customers that want their products to be working continually in a frictionless manner, and with minimal downtime, view this capability as a great benefit. Caterpillar and Rolls-Royce know the performance of their digitally connected products in the field. Since the overall customer experience extends far beyond the purchase, this is a major capability.

In TCS' survey of 1,010 CIOs this summer, we found that the most successful companies in generating revenue from their digitally enabled products and services were more likely to view IoT as creating future business growth than were least digitally successful firms. Some 61% of the 'digital leaders' believe IoT is very important for growth vs. only 46% of the digital followers.

3. Optimizing Value Chains



Digital sensors embedded in products are not the only source of value from IoT technologies. When companies install such sensors in their manufacturing and distribution operations, remarkable improvements in cycle time, cost, quality, and shrinkage (i.e., products disappear due to theft, etc.) are possible.

IoT makes these supply chains more flexible—that is, able to automatically change themselves due to weather, transportation bottlenecks, and other disruptions to the flow of products from factory to customer.

Product shrinkage is a major goal of a number of IoT supply chain initiatives. For example, the global pharmaceutical sector has been implementing 'track-and-trace' programs to reduce the number of counterfeit drugs. Forrester expects such initiatives to be the biggest driver of IoT spending in the supply chain by 2023, a year in which it predicts that companies around the world will spend \$435 billion on IoT⁵⁶. Researcher Gartner predicts that more than half of major global firms will have deployed IoT sensors, AI, and analytics in their supply chains by 2023.⁵⁷

⁵⁵ International Industrial Vehicle Technology article, Nov 29, 2018. Accessed Aug. 21, 2019. <https://www.iviinternational.com/news/technology/caterpillar-remote-services-improve-vehicle-effectiveness.html>

4. Improving the Quality of Life



A growing number of companies have installed IoT sensors in their factories and distribution networks to improve safety and security. There's good reason for this. In the U.S., more than 410,000 injuries and 300 deaths occurred in factories in 2016⁵⁸, while in the UK factories had 60,000 injuries and 19 deaths as a result of industrial accidents. As a result, workplace surveillance and safety have moved to the top of list of boardroom topics.

Companies are using smart technologies such as laser scanners and digital sensors in factories and warehouses to more safely operate robots and cranes, prevent collisions, and reduce other workplace accidents.

Some firms are using technology to monitor employees—i.e., truck drivers and machine operators—checking to make sure they aren't overtired.

Within IoT initiatives focused on safer operations are those focused on improving the health of customers, especially consumers. A great case in point is Procter & Gamble. The consumer packaged goods giant has been selling a digital electric toothbrush that tells consumers how well they're using the device, with sensors and AI embedded in it. P&G see such capabilities as vital to improving patients' dental hygiene—and keeping the company competitive in the \$5 billion 'brushing market'⁵⁹.

The biggest benefits of IoT technology come when companies make their 'things' self-aware.

⁵⁶ Forrester data as cited in Supply Chain Dive website. Accessed Aug. 18, 2019. <https://www.supplychaindive.com/news/track-trace-supply-chain-iot-spending/551751/>

⁵⁷ Gartner web page, Dec. 17, 2018. Accessed Aug. 18, 2019. <https://www.gartner.com/smarterwithgartner/gartner-predicts-2019-for-supply-chain-operations/>

⁵⁸ U.S. Bureau of Labor Statistics, as reported in Plant Engineering article, Feb. 13, 2019. Accessed Aug. 18, 2019. <https://www.plantengineering.com/articles/the-human-factor-of-iot-in-safety/>

⁵⁹ P&G web page, accessed Aug. 12, 2019. <https://news.pg.com/press-release/pg-corporate-announcements/oral-bs-new-ai-brush-knows-more-about-brushing-styles-anyon>

Extracting Exponential Value from IoT

The four strategic paths to IoT value (mentioned above) have major impact on a company's products, production, distribution, and customer service operations. The benefits expand, based on the degree to which a company brings 'life to things'—i.e., how much digital intelligence it implants in those products, factories, distribution operations, and customer support operations. (See Figure 7.)

Let's start with the base level of value—a stage that we call using IoT to '**connect in context**.' By this, we mean installing or embedding digital sensors or other technologies into your products, factories, and supply chains so that you can track and trace them continuously and, thus, monitor their ongoing performance.

The next level of benefits come to companies that use the digital data their IoT technologies generate to do **predictive** analysis. The example of Rolls-Royce aircraft engines discussed earlier is a great example. Its 'digital twin' virtual engines are predicting when airlines need to perform maintenance.

But the biggest benefits of IoT technology come when companies make their 'things' **self-aware**. By this, we mean IoT-infused products or operations that can correct their own performance, sometimes without human intervention. Automobiles with sensors of vehicles in front of them and automatically brake are an excellent example. A warehouse (like that of Amazon) whose robots avoid crashing into other robots and people is another. So is an autonomous factory, whose automated assembly lines take on arduous and unsafe work, and leave the rest to factory workers and plant management.

This is truly about bringing life—human capabilities—to things. It is a path on which a company can achieve exponential value, where 'things' are brought to life and combine AI and human intelligence to make right decisions and optimize people, processes, and products.

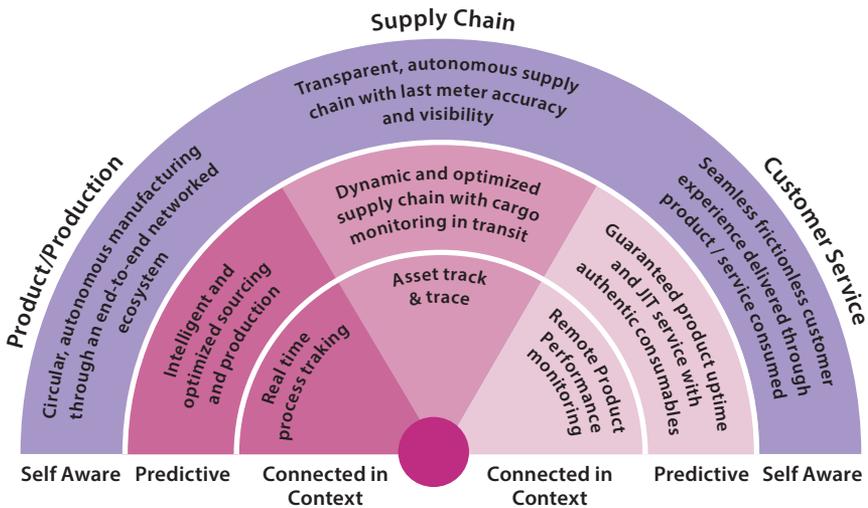


Figure 7: Path to Exponential Value

How do you make sure your company is on the path of unlocking the huge hidden value of IoT in its value chain? Three overarching principles must be in place:

- Being boundary-less:** Simply embedding sensors in your products will give you only some of the digital capabilities you need to keep them in tip-top shape for customers. You'll also need supplier data, field repair data, and customer data, at a minimum. If the digital sensors in the tires of a truck flag low pressure and a pending flat, that truck maker will have to alert its closest dealer (and possibly the tire maker) that the driver will be there very soon for a repair or replacement. You'll also need to break down the data 'silos' in your company. Using the same example, the low-tire-pressure incident will force the truck maker to automatically check its finance and customer service records to see if the tire is still under warranty. All to say that lots of data is required to solve the customer problem that your IoT sensors have identified. Your operations cannot be constrained by internal or external organizational boundaries, other than regulations.

- **Being pervasive:** By this, we mean the data, the analysis of that data, and the actions that are triggered automatically all must happen quickly—even in real-time. All parties need to be able to make the right decisions on behalf of the customer. That, in turn, means they must trust that they all have the right information, and that it is available to the right stakeholders at the right time. This makes decision-making more democratic, and even moves some decisions to be made by the devices.
- **Being experience-rich:** The whole purpose of IoT technology is to dramatically improve the way a company makes, distributes, and supports its products—and tracks and improves how the product performs in the field. Customers don't buy tires, cars, construction equipment, or air compressors for the thrill of owning those products. They buy them to have better experiences: getting from point A to point B; digging a hole faster; or making a repair quickly. Uber is a classic example of a company that has made it effortless for people to find rides quickly and pay for them easily. It has taken the friction out of getting from point A to point B. Such experience-rich systems must have the ability to continually improve and offer customers a better experience the next time.

A Perfect Time to Bring Life to Things

As we've illustrated with these examples, the time is now for companies to seize the bountiful opportunities of implanting digital intelligence in their products, production operations, and distribution channels. Companies that have done so and brought life to things with a clear, strategic path are becoming entities that their customers can't do without.

The framework in this article points the way companies need to gain substantial and ever-improving value from their IoT investments.