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IoT Is Enabling Enterprise Strategies for New Beginnings

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Key insights

The global pandemic pushed the focus on Internet of Things (IoT) technologies from proof-of-concept to operational necessity. In the emerging business environment, corporate leaders must deploy IoT strategically — beyond what was necessary to what's now possible — to become purpose-driven, adaptable and resilient.

- IoT is already delivering value by enabling new business models, seamless customer experiences, responsive value chains, and enhanced quality of life.

- A strategic approach to developing IoT systems: embed security from the start, connect devices and environments in a real-time context, perform predictive functions, and leverage AI and analytics to be self-correcting.

- To generate significant value from a company's IoT systems, top management must embrace a boundaryless organization, enable quick and automated actions, and create rich experiences with a clear purpose.

Out of disconnection and toward interconnection

Over the last decade, many large companies around the world invested heavily in Internet of Things technologies. By the end of 2020, Gartner projects there will be 5.8

billion IoT endpoints in use.[1] That represents a 21% increase from 2019 (and that figure was a 21.5% jump over 2018).

Companies have embedded digital sensors in their products and installed them on factory floors, in vehicles, and throughout utilities networks and retail stores. These sensors, contained in items ranging from bulldozers to electric toothbrushes, enable businesses to track their products' performance and the performance of their business processes and supply chains. They also allow them to predict when their products are ready for maintenance, repair or replacement, saving labor costs and reducing downtime while generating new revenue streams and enhancing customer loyalty.

But we are just at the beginning of the IoT story. In the post-pandemic world, a transformed business environment – and the needs of those businesses and their customers – will demand exactly those capabilities IoT technology can offer. And combined with the power of cloud computing, the ability to deliver data insights from analytics and the automation of responsiveness through artificial intelligence (AI), IoT systems will create more business opportunities in the years to come. In our vision, IoT systems don't just connect things; they bring them to life. In fact, TCS has launched the IoT business framework Bringing Life to Things™ to enable such transformation for organizations.

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There are four overarching ways by which the Internet of Things is already delivering value:

1. **Generating new digital business models.** Through the deployment of sensors, product companies can charge for post-sale services that help customers maintain and make better use of those products (a model sometimes called "servitization"). This enables companies to shift the paradigm from customer-owned products to a subscription model delivering recurring and predictable revenue.

2. **Creating seamless customer experiences.** By monitoring the performance of its products, a company can deliver superior service by guiding product usage, identifying potential problems and alerting customers to solutions.

3. **Optimizing responsive value chains.** Installed in manufacturing and distribution operations, sensors enable companies to detect and overcome internal bottlenecks and other conditions by automatically making adjustments that keep products moving or services flowing.

4. **Enhancing the quality of life.** Sensors that monitor the conditions of workplaces,

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[1] "Gartner Says 5.8 Billion Enterprise and Automotive IoT Endpoints Will Be in Use in 2020," August 29, 2019, accessed at: https://www.gartner.com/en/newsroom/press-releases/2019-08-29-gartner-says-5-8-billion-enterprise-and-automotive-io.

including factories and warehouses, can prevent accidents before they occur by alerting people to unsafe conditions. Sensors in products (like a toothbrush) can help users improve their health.

The COVID-19 pandemic shifted the economic and commercial landscape, often requiring IoT solutions merely to continue the most basic operations to stay in business at any scale. Yet those companies that have ramped up their IoT activities will be positioned to gain an immediate and perhaps enduring competitive advantage. Consider:

- *The rising demand for home deliveries.* When the world needs goods and services delivered to customers' homes, the IoT can enable companies to track them, often through channel partners, thereby improving the performance of distribution channels.

- *The surging need to check the operating state of equipment in homes,* offices, cars, plants, aircraft, construction equipment and more without having to dispatch field service technicians. IoT is essential to remote product monitoring and remote service.

- *The ability to serve people who can't meet in person.* When people are reluctant (or forbidden) to gather, IoT-related technologies, for example, can allow medical professionals to remotely monitor patients' health, and provide counseling and other services. Such remote connections are applicable to other fields, including education (inexorably moving to a post-pandemic online model) and customer service departments in retail and other industries.

> There are proven ways to pursue aggressive IoT goals while mitigating the risk of failure.

- *A louder call for automation.* During a pandemic, factories and distribution centers need to continue operations with fewer people to permit social distancing. This applies especially to businesses in areas where a return to full operations must of necessity be gradual, or when there's a need to adjust rapidly should a new outbreak occur. IoT-enabled systems enable employees to distance without compromising efficiency or quality. In an IoT-enabled environment, single-shift enterprises can become double- or triple-shift operations, maintaining (or even increasing) throughput and output levels.

These new conditions call for enterprises to ratchet up their IoT capabilities as their individual circumstances permit. But many companies have been moving too slowly to leverage IoT for a post-pandemic world. In our work with clients before the COVID-19 crisis emerged, we witnessed many firms engaging in proof-of-concept projects and programs aimed at making incremental improvements. Efforts like these are not suited to this moment in time. And those companies that are simply picking up where they left off before the pandemic will find themselves left behind.

However, there are proven ways to pursue aggressive IoT goals while mitigating the risk of failure. Lean and agile approaches allow companies to adjust and refine projects as they go, incorporating a feedback loop of learning, sharpening their execution.

This is the process that will allow companies to think big – which is what the post-pandemic world requires.

The strategic imperative of IoT

IoT-based systems powered by intelligent technologies create exponential value by augmenting the capabilities of physical objects with digital intelligence. They generate new customer experiences and new digital ecosystems.

Well-designed IoT systems are purpose-driven, delivering a result designed for specific benefits. They are resilient. The fact that they are distributed means that one node failure doesn't break the system. They are adaptable, expanding and contracting as business needs demand. IoT systems are integral to emerging digital ecosystems because they connect to external parties. This radical connectivity can reconfigure how industry players interact with customers, suppliers, partners, and rivals – if companies are open to the possibilities. An electric car, for example, may connect the vehicle and drivers to electric utilities, insurance companies, location-based services and other service providers, even as it provides in-vehicle WiFi.

Appreciating and understanding these benefits, companies can move beyond a proof-of-concept mindset to take a more purpose-driven, strategic approach to their IoT initiatives. With cloud-connected IoT devices, data analytics and AI, they can design and implement systems for the outcomes they want, rapidly sensing and responding to the needs of their customers, employees and partners.

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A strategic approach to developing IoT systems encompasses four elements:

1. **IoT systems that embed security from the start**. A company that deploys IoT systems that are secure and that comply with security and privacy regulations like GDPR mitigates risks across the IoT network and the applications it supports.

2. **IoT systems that connect in context**. The purpose of embedding digital sensors and related technologies into products, factories, and supply chains is to track and trace products and their performance on a continuous, real-time basis. For example, shipbuilder Damen has developed connected vessels with more than 10,000 IoT-connected sensors on board collecting data on fuel consumption, engine performance and operational efficiency. This has helped Damen become more than a

builder; thanks to the data it collects in context, it is now a maritime solutions provider.[2]

3. **IoT systems that are predictive**. These systems leverage sensor data for predictive analysis. For example, telecommunications giant Ericsson has a "smart factory" that optimizes manufacturing processes using IoT and Industry 4.0 advances.[3] The company can equip hundreds of high-precision screwdrivers with IoT sensors that make it possible to track usage and schedule maintenance before equipment breaks down, dramatically reducing maintenance costs and extending the useful life of its equipment.

4. **IoT systems that enable self-awareness**. By combining IoT with technologies such as AI and analytics, companies can make their products and operations self-correcting. For example, warehouse robots equipped with sensors and AI can avoid collisions with workers and other robots, improving workplace safety and avoiding downtime.

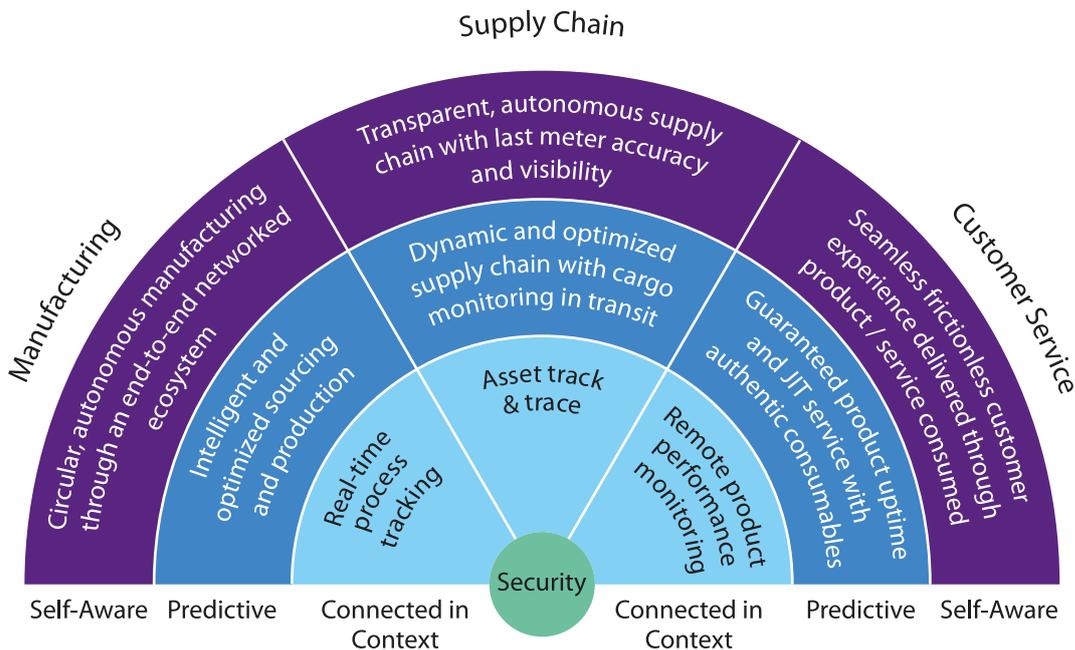Figure 1: **IoT systems in a product/production context**

Figure 1 shows how the Bringing Life to Things™ framework might play out in three areas for a product-focused business: manufacturing, supply chain, and customer service. For manufacturers, IoT can create an end-to-end networked ecosystem that includes suppliers, partners, and customers, along with real-time processes that point the manufacturer to the best sourcing leads. In the supply chain function, IoT systems can

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[2] "Setting a new standard for the maritime industry with Damen Shipyards," YouTube video, October 14, 2019, accessed at https://youtu.be/NhuAlOgHfbg.

[3] Ericsson case study, "The world's first cellular IoT-based smart factory," accessed at https://www.ericsson.com/en/networks/cases/cellular-iot/cellular-iot-enables-smart-factories/industry-4-0.

provide transparent, autonomous asset tracking that leads to the optimized monitoring of cargo in transit. In customer service, remote product performance monitoring allows companies to offer product uptime service guarantees and just-in-time service, creating a frictionless customer experience delivered through the product or service itself.

Donaldson Company's evolution from only a maker of products to a service provider is a case in point. Founded in 1915, the Minnesota-based company has produced state-of-the-art filters for engines and industrial units for more than a century, now operating 45 plants and more than 100 labs across the 50-plus countries where it does business. Since the 1970s, the company has been using embedded sensors of indicators like heat, motion and pressure to guide product design.[4] In 2015,[5] it acquired Filter Minder®, which supplies wireless sensors and service indicators for heavy-equipment vehicle filters. These connected devices track system performance and predict maintenance needs, using the vehicle's own telematics system to send filter sensor data to the cloud for analysis.[6]

Today, Donaldson is becoming a one-stop shop for "smart filter" services offering real-time monitoring and more predictive operations for customers — which is generating new subscription-based revenue for Donaldson.[7] A flagship offering for Donaldson's Connected Solutions business is the Donaldson iCue™ service, which is built on IoT technologies for dust collection maintenance and management and is even compatible with other major dust and fume collector brands. The iCue Gateway — operating independently from a customer's own internal network — sends dust collector data to a secure cloud, which feeds a dashboard view giving insight into the performance of equipment at multiple sites, alarm history across the operation, real-time alerts depending on configurable thresholds, weekly status reports, and data export for compliance tracking.[8] Dedicated sensors provide simple and accurate measures of such important measures as differential pressure, particulate trends, and relative airflow (plus optional sensors for hopper plugs, bin levels, compressed air feeds, and humidity) for a manifold improvement in how environmental health and safety leaders manage safety risks in the workplace.[9]

[4] "What Is the Internet of Things (IoT) and How Can It Help Filtration?" accessed at:
https://www.donaldson.com/en-us/connected-solutions/technical-articles/what-is-iot/

[5] "Donaldson Acquires Engineered Products Company, Maker of Filter Minder Indicators and Sensors," accessed at:
https://ir.donaldson.com/press-releases/press-release-details/2015/Donaldson-Acquires-Engineered-Products-Company-Maker-of-Filter-Minder-Indicators-and-Sensors/

[6] "Filter Minder® Indicators & Switches," accessed at:
https://www.donaldson.com/en-us/engine/filters/products/air-intake/accessories/filter-service-indicators/filter-minder-indicators-switches/

[7] "Donaldson Introduces iCue™ Connected Filtration Service to Monitor Industrial Dust Collectors Using IoT," accessed at:
https://ir.donaldson.com/press-releases/press-release-details/2019/Donaldson-Introduces-iCue-Connected-Filtration-Service-to-Monitor-Industrial-Dust-Collectors-Using-IoT/

[8] iCue Connected Filtration Service from Donaldson Connected Solutions, accessed at:
https://www.donaldson.com/en-us/connected-solutions/

[9] "Three Things a Connected Dust Collector Can Tell Environmental Health & Safety Leaders," accessed at:
https://www.donaldson.com/en-us/connected-solutions/technical-articles/three-things-connected-dust-collector-can-tell-environmental-health-safety-leaders/

The three principles of building IoT systems to generate value

To build IoT systems that generate significant business value, top management needs to adopt three principles.

1. **Embrace a boundaryless organization**. Embedding sensors in a company's products will provide some digital capabilities to serve customers, like alerts for service or order replenishments. But taking full advantage of IoT's potential requires removing constraints imposed by traditional corporate boundaries and internal functional data silos.

   This means that companies should use multiple data sources to amplify the benefits of their IoT systems, including data from suppliers, from field technicians on repair calls and from customers using their products or services. Also important, internal data must be accessible across corporate functions.

   For example, in a crisis such as the COVID-19 pandemic, communications within an enterprise became challenging as units, or plants, shut down suddenly and unpredictably. However, merging sensor data from the supply chain with data from ERP, CRM, logistics and real-time events enables a company to maintain an integrated view of its operations. This is critical to resilience and business continuity and optimizes the use of resources while keeping customers satisfied and loyal.

2. **Deliver quick, automated actions**. The data companies collect from IoT systems is of limited value unless it can be acted upon rapidly. Doing so means delivering the right information to the right stakeholders at the right time.

   For example, in the post-pandemic world, the immediate status of an individual's health will be (for the foreseeable future) of critical importance. Wearables, connected to IoT systems that can analyze a host of inputs, can automate that determination, helping keep workplaces productive and, more important, safe.[10]

3. **Create rich experiences with a clear purpose**. For enterprises selling products and services, the purpose of IoT technology is to dramatically improve the way these firms make, distribute, and support their offerings.

   Customers and companies don't buy products just to own them; they buy them with a purpose in mind: to improve their lives at work or at home, to reach a destination, dig a hole faster, or make a repair quickly.

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[10] "Reimagining Life Sciences Value Chain Using Internet of Things," TCS White Paper, accessed at:
https://www.tcs.com/content/dam/tcs/pdf/Industries/life-sciences-and-healthcare/Reimagining-the-Life-Sciences-Value-Chain-using-Internet-of-Things.pdf

The products and services companies provide today must have the ability to improve continuously, offering customers a better experience next time. Ride-sharing companies like Uber and Lyft are oft-cited examples of using IoT technology to create a frictionless system that allows people to find rides and pay for them without reaching for their wallets. But IoT capabilities are remaking all areas of transportation, both public and private: from reducing wait times for buses and trains and improving route choices for commuters; to enabling redistribution of fleet resources to optimize service levels;[11] to showing availability and providing asset security for "shared micromobility" — dockless and dock-station rentals of pedal bikes, e-bikes and e-scooters from providers like Lime, Bird and Spin — which rose from 35 million such trips in the U.S. in 2017 to 84 million in 2018.[12]

How the pandemic highlighted the need for IoT systems

As a result of the COVID-19 pandemic and the ensuing economic crisis, many industries and service categories around the world immediately needed to find new ways to function to continue providing goods and services in a very different world. For example, IoT systems supported a wide range of health-related services at a moment of surging need, including:

- *Telehealth consultations*. The Stanford Children's Health Hospital quickly increased its capacity to perform about 620 digital visits per day (up from just 20 pre-pandemic)[13] and the insurance industry increasingly is reimbursing and even encouraging such remote consultations.

- *Diagnostics*. Connected digital devices can help determine early warning signs of disease symptoms. Kinsa, for example, a digital thermometer that connects to a smart phone app enabling the storage and sharing of health data, saw a spike in usage as the pandemic spread in the U.S.[14]

- *Remote patient monitoring*. With the increased risk to healthcare workers, the U.S. Food and Drug Administration issued new guidance for manufacturers of vital sign-measuring devices to expand their use to include the remote monitoring of patients.[15]

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[11] "Intelligent Urban Exchange Intelligent Transportation," TCS offering brochure, accessed at:
https://dss.tcs.com/wp-content/uploads/2019/12/tcs_iux_transportation_br-1200-01.pdf

[12] "Shared Micromobility in the U.S.: 2018," National Association of City Transportation Officials, accessed at:
https://nacto.org/shared-micromobility-2018/

[13] Knud Lasse Lueth, "The impact of Covid-19 on the Internet of Things – now and beyond the Great Lockdown: Part 1," IoT Analytics, April 16, 2020, accessed at:
https://iot-analytics.com/the-impact-of-covid-19-on-the-internet-of-things/

[14] Lueth, ibid.

[15] FDA news release, "Coronavirus (COVID-19) Update: FDA allows expanded use of devices to monitor patients' vital signs remotely," March 20, 2020, accessed at:
https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-allows-expanded-use-devices-monitor-patients-vital-signs-remotely.

■ *Cleaning robots*. Particularly in China, robots have been used to disinfect and clean hospitals and perform medicine delivery.[16]

IoT applications related to the pandemic were hardly confined to healthcare, however. Across industries and in a variety of business scenarios, our experience shows three immediate priorities requiring solutions involving IoT initiatives — workforce safety and enablement, operational continuity, and supply chain resilience — each with further implications for reimagining how business could be run more efficiently and more profitably, pandemics or no. (See Figure 2.)

Figure 2: **Internet of Things interventions to enable business in the near, intermediate and longer term**

	Necessary for essential work (1-2 months)	**Sufficient for full-range functionality (3-6 months)**	**Transformation to purpose-driven, resilient, adaptable business (6-12 months)**
Workforce safety & enablement	• Monitoring social distancing between workers; alarms/ notifications for violations • Real-time automated CCTV screening to ensure proper use of personal protective equipment (PPE) • AR/VR-based immersive, guided workforce training (self-training or instructor-led)	• Facility monitoring; implementing safety precautions, air quality, etc. • Image analytics to ensure safety compliance and to avoid accidents • Contactless shift turnovers: exchange of updates, alerts and recommendations across shifts by remote monitoring and online logging	• Collaborative robots ("cobots") work alongside employees to perform the more "dirty, dull, difficult and dangerous" work
Continuity in operations	• Remote data acquisition from readily available edge computing components • Remote monitoring of operations and assets, via the cloud, with advanced visualizations, alerts and alarms • Strengthened IT-OT layer to mitigate cybersecurity risks	• Smart factory enablement for end-to-end visibility of plant operations through horizontal integrations • Operational faults and asset anomalies diagnosed with analytical models and machine learning algorithms • Monitoring real-time plant conditions and guideline adherence	• Prescriptive maintenance, remaining useful life and inventory optimization enabled through digital control tower and decision support analytics • Automation of repetitive tasks through industrial robotics
Resilient supply chain	• Unified visibility of integrated supply chain via information hub updated with real-time events data • Integration of data from ERP, CRM, logistics and real-time events	• AI-enabled supply chain operations based on past data, on-time delivery, ratings and other supply chain constraints • Dynamic forecasting, scheduling, resource and route planning	• Regular evolution of AI-driven forecasting with increasing accuracy and system collaboration to remove buffers across the value chain

[16] Lueth, ibid.

IoT possibilities await your business

The descriptions of IoT systems in action presented in this article are, of course, incomplete. The promise of IoT systems – the possibilities presented when sensor data, analytics, AI, and the prodigious computing power of the cloud are combined – is limited only by resource constraints and imagination. Everywhere a sensor can go, everywhere it can collect data, represents another set of opportunities and new sources of value – to improve operations, create new digital business models, to discover new ways to turn products into services.

As we have seen, the Internet of Things can answer many of the questions posed by urgent situations like a public health crisis. But even as each crisis passes, like an ocean wave it leaves a reshaped shore after it recedes. Those enterprises that understand that their business and competitive environment have been unalterably changed — and have had the foresight to examine their operations for the reasons and ways to bring life to things — will be far better equipped to thrive in that reshaped world.

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