The Why, What, and How of IoT

50+ Examples
across 11 Industries

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Companies are going to spend almost
$5 trillion on the IoT in the next five years[1]

Understanding and applying data lies at the heart of digital business transformation. Data can reveal reason, rationale, and purpose – explaining not only who, what, when, and where regarding customer behavior and business operations, but also the why. Managed well, data can be the cornerstone for business success.

The Internet of Things (IoT) is quickly emerging as a leading source of data and business intelligence. It's broadly defined as a network of internet-connected objects that collect and exchange data using embedded sensors.

According to Business Insider, IoT is "disrupting businesses, governments, and consumers and transforming how they interact with the world. Companies are going to spend almost $5 trillion on the IoT in the next five years — and the proliferation of connected devices and massive increase in data has started an analytical revolution."[1]

In this guide, we explore:

- The current state of IoT

- Applications of IoT solutions across major industries

- A strategic process to implement IoT solutions in your organization

- Five considerations for establishing IoT solutions

Current State of IoT

Over the last few years, businesses have adopted the terms "smart" or "connected" to refer to the Internet of Things – smart cars, smart factories, and connected healthcare to name a few. This simply implies that the IoT makes these environments more intelligent than they have historically been.

What exactly makes up the Internet of Things? Essentially, nearly everything in the world can be considered a "thing" in IoT.

An IoT device is any standalone internet-connected device that can be monitored and/or controlled from a remote location.[2] Sensors (IoT devices) gather data, and a wide variety exist that measure limitless amounts of data such as temperature, vibration, force, pressure, weight, sound, acceleration, tilt, angle, optical, ambient light, electric, magnetic, flow, position, proximity, motion, velocity, humidity, movement, emotion, and presence.

All of the data collected by devices feeds into an IoT ecosystem, which are "all the components that enable businesses, governments, and consumers to connect their IoT devices, including remotes, dashboards, networks, gateways, analytics, data storage, and security."[2]

Organizations across industries are investing in IoT to improve business processes, minimize risks, and enhance customer experiences. Analysts are forecasting that companies will invest $4.8 trillion in the IoT over the next five years. The growth of IoT devices is projected to skyrocket to 22.5 billion by 2021, up from 6.6 billion in 2016.[1]

While the market opportunity for the IoT continues to grow, there's more involved than just installing sensors on products or equipment and calling it "smart." Complete IoT solutions need a supporting environment for data analysis, software applications to track/report data, and applications to track active or passive trigger events. Bottom line – **your organization will not benefit from an IoT solution unless you're thoughtful about the purpose and role that it plays.**

How Key Industries are Applying IoT

In 2016, adoption rates for IoT reached nearly 43% of enterprises worldwide.[3] However, the scope of applications for IoT solutions is still in its infancy. With a wide variety of projects classified as IoT, consider these examples of how eleven major industries are implementing this solution.

Manufacturing

IDC reports that the manufacturing sector made the largest IoT investment in 2016, spending $178 billion. Manufacturers have initially used IoT to optimize processes, monitor equipment, and conduct predictive maintenance on assets. However, the number of outward investments for using IoT is on the rise.[4] Additional manufacturing use cases include:

- Smart factories with sensors that collect data on performance of machines and systems for proactive maintenance and improving overall operational efficiency

- Using temperature, moisture, and vibration sensors on critical tools/equipment to predict failures and/or optimize schedule for preventative maintenance

- Automating inventory management, using radio-frequency identification (RFID) for product tracking through manufacturing line and/or supply chain

- Identifying bottlenecks on the operations line using sensors on carts that move the product (or on the product itself) to optimize tooling numbers and locations

- Maximizing the potential of just-in-time manufacturing

- Creating smart products that provide OEMs with operating data and enabling two-way product support

- Developing connected products that inform the supply chain about predicted demand for aftermarket parts

Transportation

The transportation industry is the second-largest segment investing in IoT, spending upwards of $78 billion in 2016.[4] A significant portion of this investment goes towards freight monitoring.

"Increasing numbers of freight and public transportation vehicles are equipped with sensors that help schedule maintenance, optimize fuel consumption, and train drivers. These vehicles can also monitor operating or driving behavior for insurance purposes," according to ZDnet.[5]

Additional use cases in the transportation industry include:

• Connecting shipping vehicles with temperature sensors to ensure goods, especially food, arrive in safe condition[6]

• Monitoring safe transport of hazardous freight with sensors that measure heat, vibration, and sound frequency[7]

• Supply chain logistics with transportation of goods by trucks or trains

• Public transit to communicate with riders on train and/or bus schedules
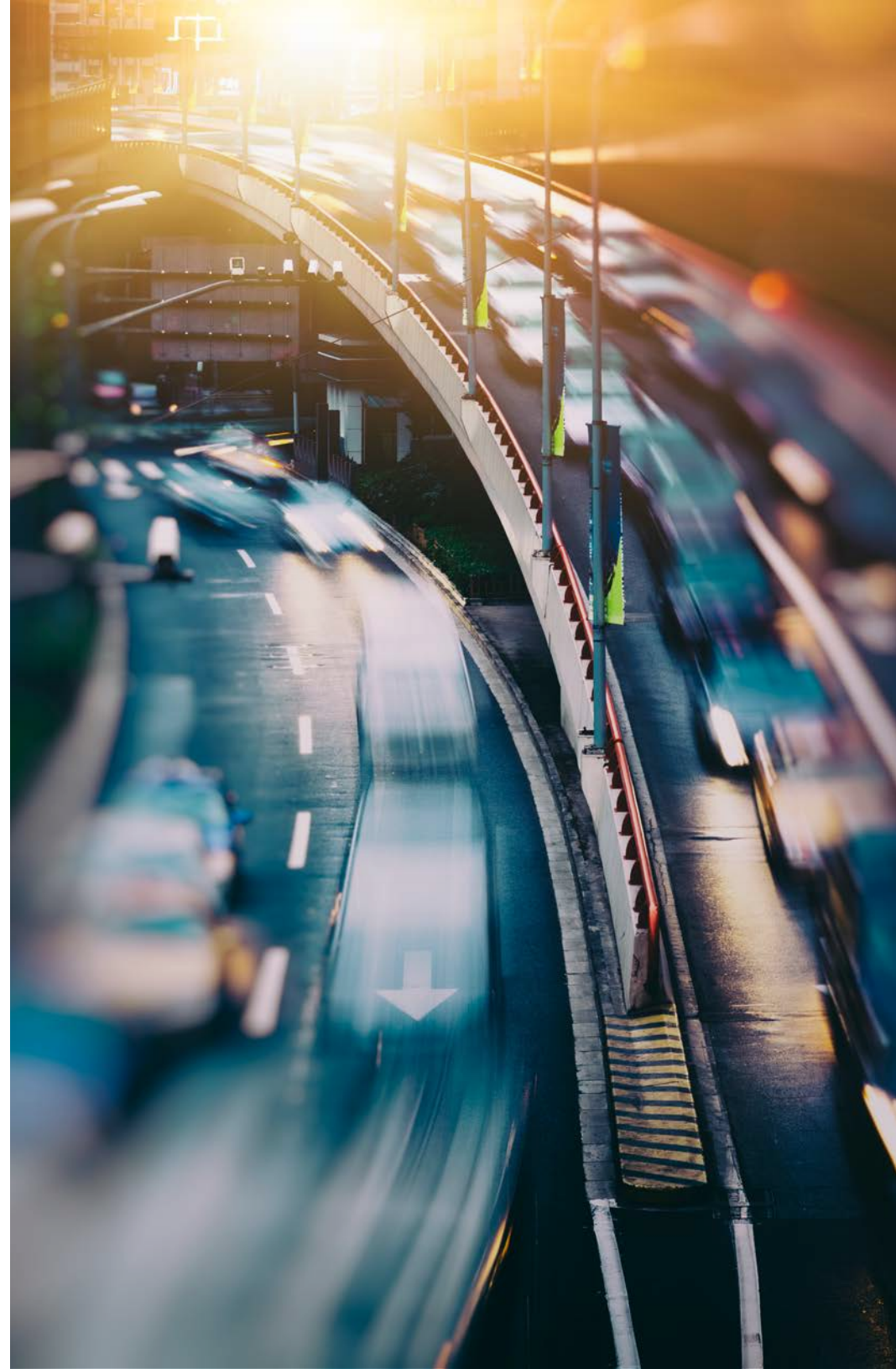
Healthcare

In the years to come, the fastest spending growth in IoT will come from the healthcare industry.[4] Connecting medical machines and devices to healthcare systems will allow patient data and images to be shared easily with providers. Real-time location sensors installed on medical equipment enables hospitals and care facilities to track resources, dispense medicine, and locate staff and patients.[6]

Additional healthcare use cases include:

- Insulin pumps that check blood sugar levels and only dispense when necessary

- Blood infusion pumps that check for drug interactions prior to dispensing new medication, or set a time limit before dispensing another dose

- RFID wristbands for patient tracking, monitoring, and permission to enter rooms while admitted to a hospital or nursing home

- Health monitors that track vitals including blood pressure, temperature, and heart rate, and send data to a tracking tool for either a patient or his/her medical provider

With more healthcare data available, artificial intelligence (AI) and machine learning technologies can analyze it to drive change in patient care. The value of healthcare data is that it will enable providers to proactively diagnose illnesses and create personalized treatment for patients.

**Learn more about connected healthcare by reading Top Five Healthcare Provider Trends for 2017.**

Utilities and Energy

Utility providers, power generation companies, and oil and gas organizations have widely adopted IoT solutions for a variety of use cases including:

- Drones to inspect exteriors of large power plants and/or power lines

- Installing temperature, vibration, moisture sensors, and tooling for preventative maintenance or predicting failures of power lines

- Sensors to monitor networks of oil/gas transport pipelines, valves, and pressure gauges to prevent leaks and contamination

- Smart grid meters for water, electricity, and gas to collect usage data and run analytics on that data to gain business intelligence

- Sensors used within power generation plants to monitor equipment over time, conduct predictive maintenance, and provide additional safety oversight[5]

- Utility providers use smart meters to track customers' energy usage and communicate that data to the company's central system, allowing companies to predict demand, spot outages, and conduct preventative maintenance[6]

In 2016, combined investments in Smart Grid for electricity and gas were predicted to total $57.8 billion[4]
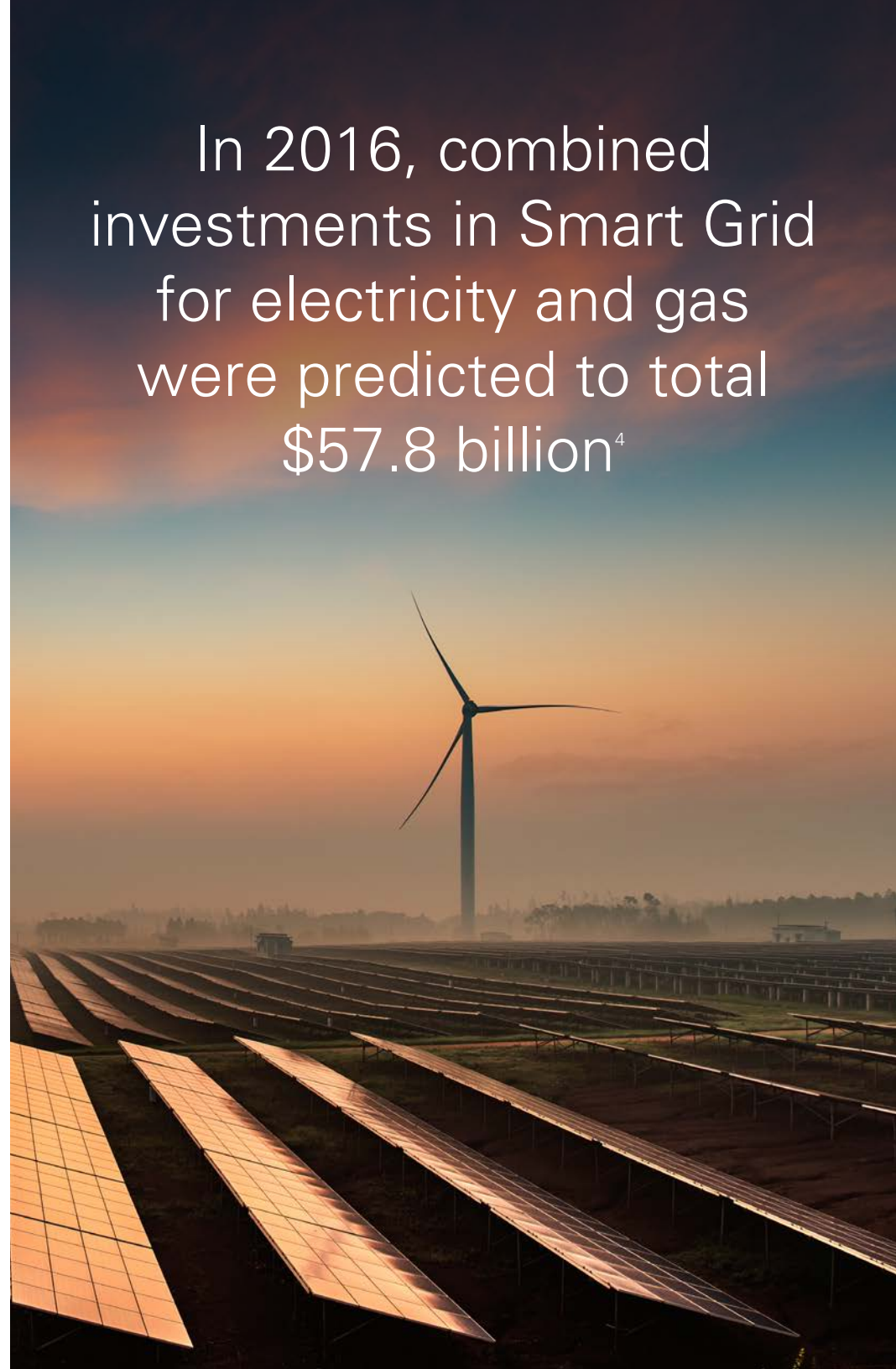
Automotive

In the consumer space, connected cars are emerging as an IoT industry leader, placing the automotive industry among the top segments for IoT adoption over the next five years.[4] In fact, it's estimated that over 380 million connected cars will be on the road by 2021.[8]

Here are a few examples of IoT you will find in today's vehicles:

- Smart cars with built-in sensors that capture information in real-time, prompting the owner with diagnostic information to stay ahead of maintenance, monitor gas/oil/fluid levels and engine temperature, guide rear-view cameras and proximity sensors for parking and aid in blind-spot detection

- Connected cars send information to manufacturers with real-time data, sharing insights on developing more accurate predictive maintenance models – speed of data allows them to respond quickly to any issues found

- Rather than relying on check-engine lights, connected cars provide an efficient way for manufacturers to communicate problems with drivers, such as sending a calendar appointment to bring the car into nearest dealer for servicing

- Predictive collision avoidance using advanced sensors, big and fast data, and car-to-car connectivity

- Testing and prototypes to develop self-driving vehicles

Explore the automotive industry's interest in and movement toward autonomous and connected cars.

Success Story

HELPING CAR MANUFACTURERS MAXIMIZE DRIVER SAFETY ON THE ROAD

Delphi is a leading global supplier of technologies for the automotive and commercial vehicle market. Recognizing drivers' converging priorities – the importance of staying focused on the road while still wanting to be entertained, informed, and connected 24/7 – Delphi sought to apply its vehicle integration expertise to offer manufacturers connected systems that help maximize safety on the road. We built a cloud-based portal to bring OEMs and consumers a unique, global connectivity solution, API-governed vehicle-to-cloud communication, and a consumer-focused touch-screen application. With voice recognition, text-to-speech, touch-screens, reconfigurable displays, and workload management technology, the connected systems provide tailored information to drivers that pertain to current road, traffic, and/or weather conditions.

Consumer Electronics

Consumer electronics is estimated to become the third-largest industry segment for IoT by 2020.[4] With increasing demand for digital assistants such as Amazon Alexa and Google Home, consumers and businesses are quickly embracing IoT in their daily lives. Additional examples include:

- Smart refrigerators/pantries that use weight-based sensors and re-order food items

- Amazon Dash (Wand and Button) used to inventory items in the house and programmed to order items by integrating with AmazonFresh

- Fitness trackers (Fitbit/Garmin) include GPS devices that sync with scales and training programs as well as provide data and/or suggestions to the user

- Smart homes equipped with home automation systems, mobile apps, Nest, etc. to control lights and heat/air conditioning remotely

- Security systems for the home with facial recognition to gain entry, access personal safes, televisions, or computers

- Smart offices with sensors that detect conference room and bathroom availability, printer mapping to the nearest printer or conference room based on location within an office building

Agriculture

When it comes to IoT adoption in agriculture, the U.S. currently leads the world. According to *BI Intelligence*, "IoT device installations in agriculture are estimated to grow from 30 million in 2015 to 75 million by 2020."[9] Here are a few examples of how the farming industry is using IoT:

- Moisture sensors placed in the ground to automate irrigation systems

- Soil sensors to monitor acidity and temperature to determine the best time for planting the next crop

- Smart equipment (tractors, reapers, etc.) connected to the Internet that display information about crop yields as well as sensors to self-diagnose/predict failures and schedule preventative maintenance

- Weight sensors in silo stock to detect leaks and gather information on moisture, humidity, and temperature to ensure health of harvested crops
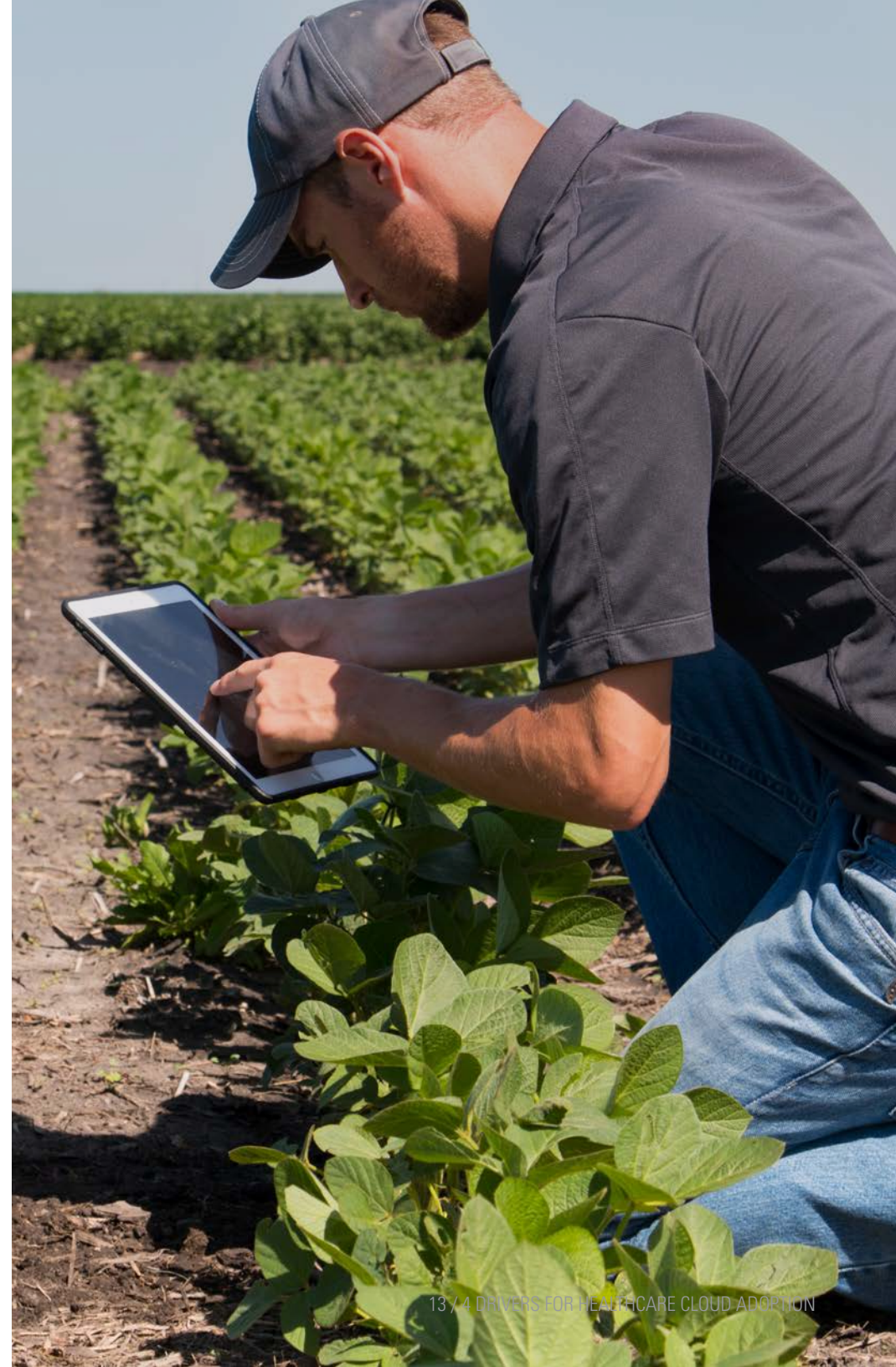
Retail and Hospitality

Retailers are still early early in the IoT adoption phase, using Bluetooth beacons inside stores to reach customers and offer personalized promotions or discounts for customers who have opted-in.[6] According to IDC, the retail industry will be among the segments with the fastest spending growth of this technology.[4] Retailers are already investing in a variety of use cases, including omni-channel operations and digital signage.

Additional uses cases in retail and hospitality include:

- Smart shelves used by CPG firms that measure customer behaviors and buying habits
- Digital vending that offer cashless payments, touchscreens, and supplying relevant products faster based on consumer preferences (i.e., Coca-Cola Freestyle)
- RFID inventory and supply chain management
- Proximity detection to stores with one-to-one marketing programs
- Facial recognition to confirm hotel and airline reservations
- Point-of-sale solutions that include options to use Venmo and mobile wallets
- Kiosks
- Digital signage within stores
- Self-check-in and check-out

Brick-and-mortar retailers and eCommerce companies have to change their business models to satisfy increasing customer expectations.

Explore three areas where you can start innovating and transform your commerce business model.

Success Story

OPTIMIZING INVENTORY MANAGEMENT FOR CPG WITH SMART SHELVES

A U.S.-based multinational food manufacturer wanted to eliminate out-of-stock items and recover lost revenue while still meeting customers' needs. To solve this challenge, we designed and built two custom IoT prototype "racks of the future," using RFID sensors to monitor product inventory on the shelf. The custom application runs on the rack and communicates, via cellular modem, to a back-end system built on an IoT suite. The custom-developed dashboard allows the CPG manufacturer to see real-time status of sensor hardware as well as inventory levels, reports on sales trends by SKU, and proactively identify times when products may run out of stock. With SKU-level reporting, the company can also approach retailers with recommendations for more profitable updates to the product mix and changes to the stocking process to minimize lost sales.
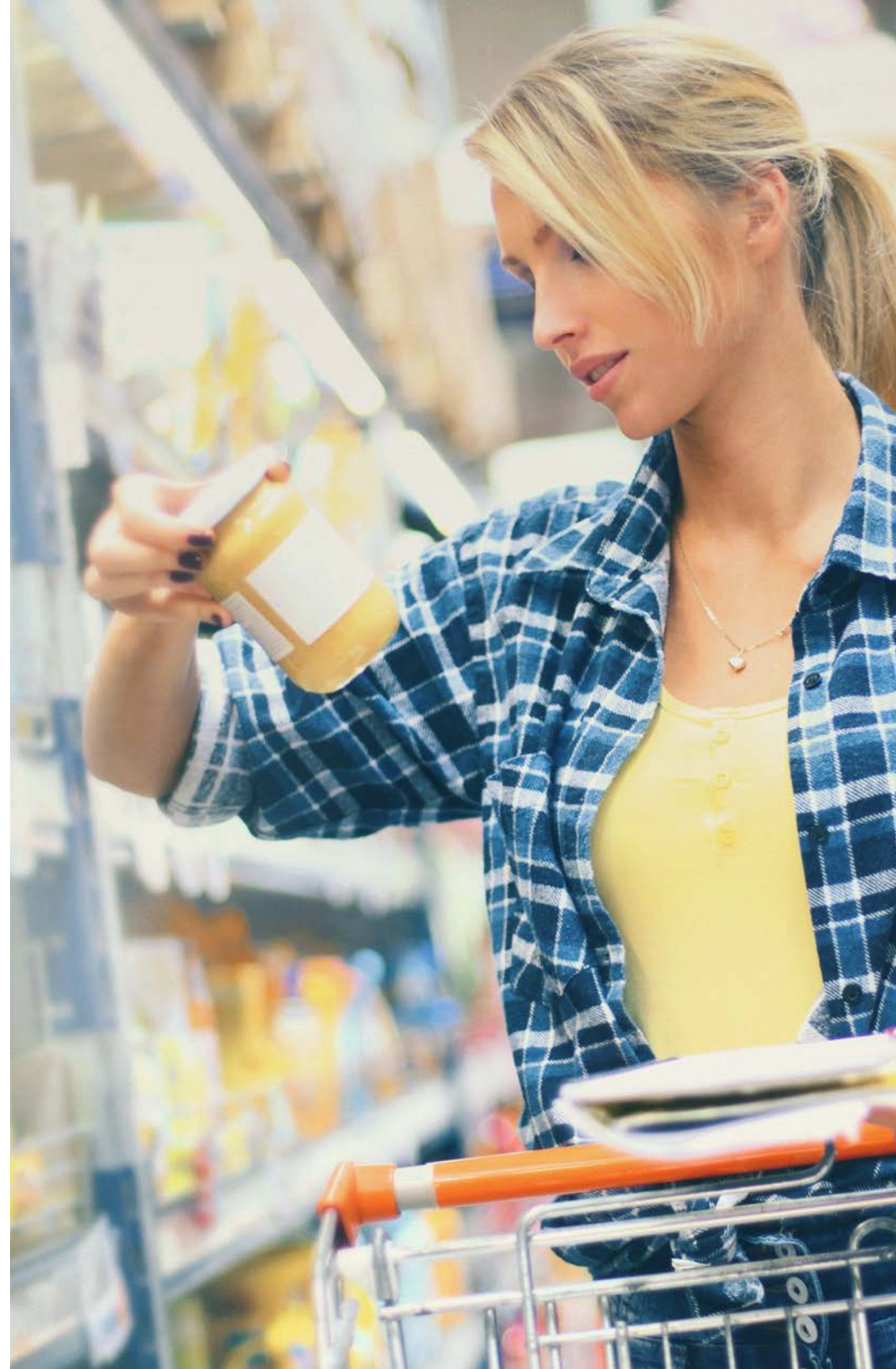
Financial Services

Data from IoT devices allows banks, insurers, and financial services firms to improve the customer experience, product development, and back-office performance:

- Near field communication (NFC) to enable mobile payments and banking via wearable devices (i.e., smart watches, rings, fitness bands)

- Proximity mobile payment transactions

- Facial recognition to access accounts at ATMs

- Fingerprint authentication (TouchID) to access bank accounts via mobile apps and make in-person transactions

- Plug-in sensors used by auto insurance companies to gather data about an individual's driving style (i.e., quick accelerations and hard stops) and typical drive times to determine personalized rates/discounts

- Intelligent analytics to reduce credit card fraud at fuel stations

- Mobile apps that track state-required behind-the-wheel training for teen drivers

- Smart phone cameras to capture photos from car accidents and start claims process via insurance provider's mobile app

See 100+ examples of how financial services industry leaders are digitally transforming their businesses.

Local Government and Infrastructure

With the increasing adoption of sensors and data capture, local governments are focused on improving data management and applying the information to improve services for cities and counties. Large urban areas in particular want to apply data for solving challenges related to urbanization, shifting demographics, and climate change in addition to providing daily services for citizens.[10] Here are a few examples of how local governments use IoT:

- Lamp posts with GPS controls for easier management; enable adaptive lighting and daylight harvesting, detect outages, schedule maintenance, and review power consumption

- Smart parking with multisensory videos and dashboards that provide data on parking availability, policy-based parking, and occupancy

- Lamp posts serving as shared infrastructure to provide WiFi services, surveillance, and host sensors for monitoring noise and air quality

- Smart law enforcement with patrol cars that use telematics, GPS, and dash cams as well as officers' use of body cams and mobile devices that track location and status/safety of personnel

- Smart waste management using connected sensors on trash and recycling receptacles that inform city services of waste levels and schedule collection vehicles when necessary

Life Sciences

In the life sciences industry, IoT advances medicine and improves patient health in a variety of ways including:

- Sensors on machines to facilitate efficient production and improve reliability/responsiveness of supply chain

- Sensors to proactively mitigate machine failure in the production process

- Monitor connected medical devices to anticipate required maintenance and proactively service devices

- Sensor data from devices sent to the manufacturer to improve design and quality for future models

- Wearable devices that measure patients' body traits and allow doctors to adapt therapies that align with patients' exact condition

- Motion sensors and facial recognition on mobile devices to monitor medication intake for clinical trials

Gain ideas for using digital technology at various stages of the clinical trial process, from recruiting subjects through gathering post-market data on product safety and effectiveness.

HOW TO GET STARTED

If IoT solutions are a part of your overall digital transformation, you have to go beyond digitizing your offerings and incorporate this technology – and the data it yields – into your overall business strategy. Follow this approach to understand the "why" and the "how" to implementing the IoT in your business.

01
UNDERSTAND AND DEFINE THE CRITICAL PATH

- What information are you trying to understand?
- Why are you trying to gather this information?
- What are critical steps in the process?

02
DETERMINE METRICS AND DEFINE CRITICAL MOMENTS

- What data is critical for optimizing processes or predicting failures?
- When do you need to know this information – several weeks (or hours) ahead of time?

03
CREATE AN IoT HARDWARE PROOF OF CONCEPT FOR DATA COLLECTION

- Evaluate and select sensors based on defined metrics and critical moments
- Use simple sensor software development kits (SDKs) to collect data
- Test that the sensors measure the data you want
- Confirm that the data collected is an indicator of what you need/want to know

04
BUILD CAPTURE, MONITOR, AND ACTION LAYERS FOR YOUR IoT SOLUTION

- Identify your data capture, monitor, and action needs
  - Who needs the information, and what active/passive action should be taken?
  - How will stakeholders receive the data?
  - What actions will be performed and tracked?
- Create software applications on top of SDKs
- Establish databases for data aggregation
- Develop business intelligence (BI) to create rules and triggers
- Build dashboards, toolkits, and other SW apps to track and view the data
- Build SW apps to actively and passively trigger events based on data

5 Considerations for Establishing IoT Solutions

IoT is still in its infancy, so companies are forging their own paths and using IoT devices to solve unique challenges. As you gather more information, understand your internal/external business environments, and get in front of your issues, the question becomes how to choose IoT solutions that are the best fit for your business.

Currently, plug-and-play IoT solutions and supporting software do not readily exist. Bringing IoT to life in your organization will undoubtedly mean solving your unique business challenges with custom-developed software that compiles, reacts to, and reports your data in a meaningful way.

Before going all-in with an IoT solution, here are some key considerations.

CONSIDERATION #1

LET IoT-ENABLED USE CASES GUIDE YOUR SOLUTION

Choosing the right use case in the beginning establishes a foundation for success. By doing so, you will obtain the necessary buy-in and support from the business unit(s) and executive level. It's important that all stakeholders involved understand and agree upon what success will look like. You should address questions such as:

- What specifically you are trying to measure – assets, products, processes, systems, etc.?

- Why are you trying to measure it?

- After implementation, is the solution working as it's supposed to?

- Is the solution helping you learn what you need to know?

Additionally, determining the specific use case will help you understand the scope of what you need to build. For example, an IoT-enabled industrial use case will be vastly different from developing connected products.

The use case you choose will influence:

- Software platform development/deployment

- Deployment approaches

- Process for collecting data (i.e., gathering data at the edge, need for gateway devices)

- Location for hosting collected data

FIND THE QUICK WINS

After selecting the right use case, you want to identify and pursue quick wins that fall within your overall digital transformation strategy. Tackling quick wins is important because the return on investment from an IoT implementation is not always straightforward and can be a long process. You have to gather all the data and analyze it to understand what information will be valuable to your use case.

Quick wins from a solution and data gathering perspective allow you to get the necessary buy-in – from the business unit, IT, and other stakeholders – to continue implementing IoT solutions.

If you are dipping your toe in the IoT waters, starting simple works well. You will have loads of data pouring in, and the challenge is deciphering the data. Which information is merely "noise," and which information will help you solve your problem or achieve your objective?

Success Story

CUSTOM-BUILT SMART SHELVES INCREASE REVENUES FOR A GLOBAL CPG

Mondelez International, a CPG company that produces snacks, candies, and powdered beverages, sought an IoT solution for gathering in-store data about customers that mapped to the brand's shopper journey methodology. Applying our unique problem solving, we determined how to measure customers' actions and selected a variety of sensors to create a "smart shelf" that senses behavior and dynamically interacts with shoppers. After developing a proof of concept, which fed data into our custom-built software application, we ran A/B tests, fine-tuned the solution with data analysis, and conducted an in-store pilot to demonstrate the value. The smart shelves rolled out to several international regions, helping to influence customer awareness/interest in specific snack items and ultimately, improving product sales.

FACILITATE COORDINATION ACROSS YOUR ORGANIZATION TO IDENTIFY IoT REQUIREMENTS

Because the IoT is an emerging solution, many organizations lack a designated "IoT specialist" within their IT department. Furthermore, when companies seek new platforms or technology solutions, it's often business units leading the charge and bypassing IT in the decision-making process.

Adopting an IoT solution requires cross-functional coordination between business, operations, and security colleagues to identify "critical dynamics such as scalability, security, and back-end integration with enterprise resource planning (ERP), CRM, or inventory systems, among other things."

Currently, off-the-shelf IoT solutions scarcely exist, which is why you want to consider working with an implementation partner to make this possible – one that understands IT infrastructure, line of business needs, and the technology solutions.

BUILD MANAGEMENT AND SECURITY CONSIDERATIONS INTO YOUR IoT SOLUTION

Depending on your industry or business requirements, you want to make sure your solution does not serve as an access point for critical data. The types of data collected by edge devices will vary, so data encryption is necessary for any personal data transmitted by these devices.

According to Forrester, "the fragmented array of devices, networks, and apps required to deploy IoT solutions makes it difficult to identify the source of a problem in a broader service." IoT software platform-monitoring consoles help activate, monitor, provision, and track connected devices. However, it's important to work with your security team to ensure that connected devices, apps, and data align with industry and geographic regulatory requirements.[11]

Additionally, you can be proactive with securing your solution by setting up edge and gateway devices to send data securely to the cloud. If the solution you plan to implement provides an individual or group access to your entire infrastructure and environment, then it needs to be protected.
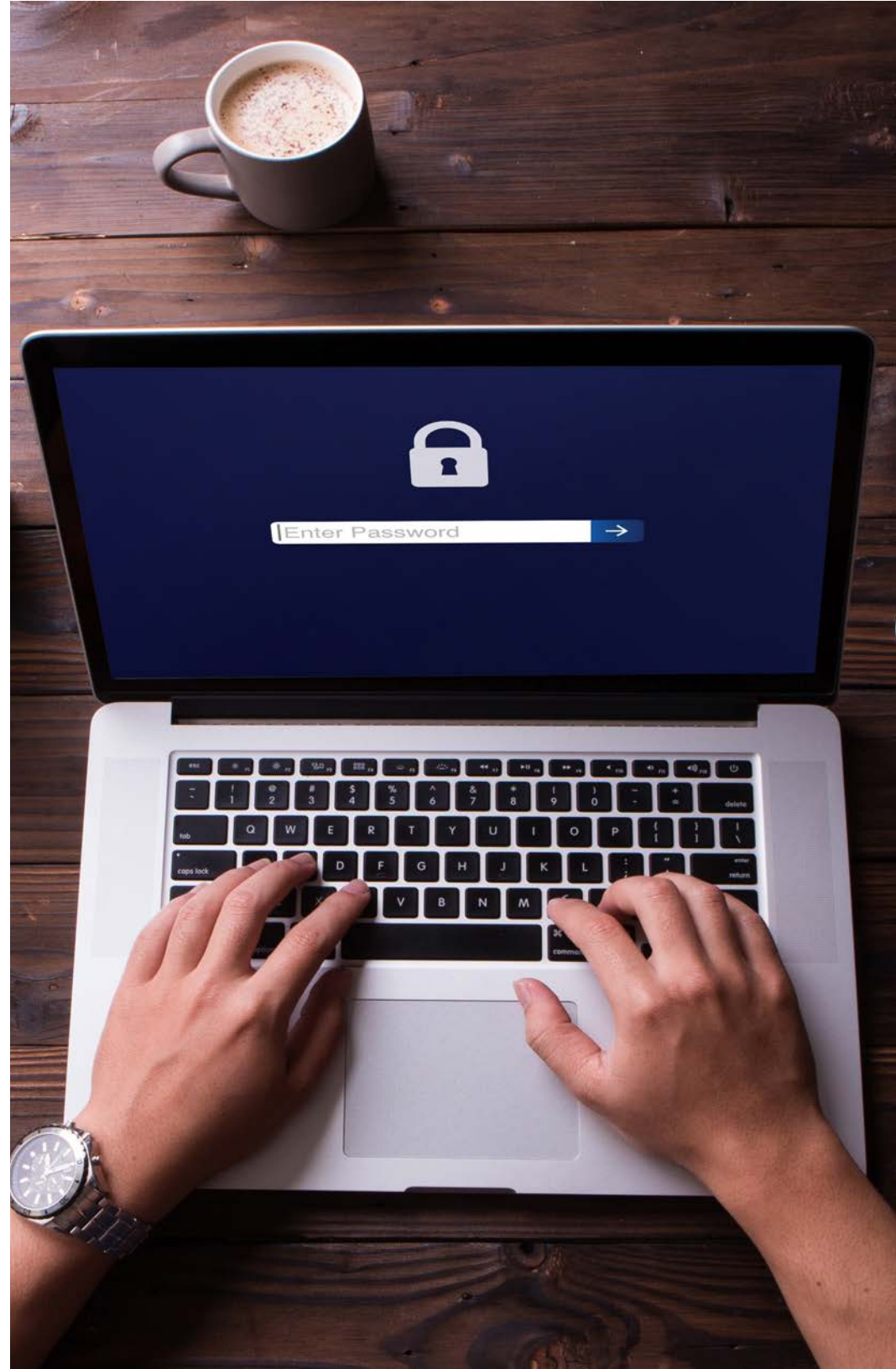
PLAN FOR LONG-TERM SCALABILITY AND GLOBAL REQUIREMENTS

As IoT solutions evolve, you will want to make sure that what you implement today can scale for the future. One way to do this is to make the most of your existing infrastructure. For example, if you're building a data lake in Azure, then the data gathered by your IoT devices should also go into this environment.

If your business prefers on-premises over cloud-hosted solutions, then you will want to take advantage of infrastructure that already supports other areas of your business. Or, if an isolated environment is necessary for security reasons, then replicate operating systems and other technical aspects of your existing environment.

By re-using internal intelligence, you are not creating a specialty area within your organization that creates complexities for IT support. For example, a hosted services specialist should understand how your business hosts data and apps and can then create a similar hosting environment for your IoT solution.

Adopting IoT solutions are not the silver bullet – or an absolute necessity – for success. However, when you apply these solutions, the data you gather will be valuable for understanding your environment, staying ahead of any potential business challenges, improving operations, and enhancing the customer experience.

Why Perficient?

Competitive companies are using the IoT to transform their businesses. However, digital business transformation involves more than investing in technology. It means organizations must think strategically about advancing new digital ecosystems to manage data effectively and in ways that seed and cultivate business innovation.

To implement IoT solutions that align with your digital transformation strategy, you need to be thoughtful about the purpose and role these solutions play. Avoid a do-it-yourself approach, and consider an implementation partner with a breadth and depth of experience.

We bring unparalleled digital transformation expertise to the table with capabilities that include:

- Business strategy development

- Systems integration

- Experience design and software deployment

- Digital design for web and mobile applications

- Prototyping IoT solutions and software development to connect devices and systems

As an implementation partner, we will ensure you consider the big picture so your IoT implementation meets the functional requirements and goals of the business and still conforms to the existing IT environment. Our experts are poised to drive these conversations, educate you on IoT solutions, help identify your use cases, and create a strategy and implementation road map to bring these solutions to life.

We help you make the right technology choices to build a strong foundation that transforms your business. **Let us help you create an exceptional experience.**

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