# Prepare to succeed with the Internet of Things

## Your competitors are planning their success in Internet of Things (IoT) digital transformation. Here's how to leap ahead of them.

The world started moving from analog to digital in the 1950s. Since then, that change has accelerated with advancements in electronics and the Internet, followed by an exponential surge in connected personal computers and later in mobile devices. Digital transformation—the total and overall effect of digitalization on society and powered by IoT—offers tsunami-level opportunities, and challenges, in the coming decade.

In the era of mobility, we take interpersonal communication for granted because we can converse with anyone around the world whenever we wish. But now, even our cars, entertainment systems, security cameras, and home appliances are learning how to exchange data—with each other and with us—through IoT. Vast market opportunities have opened for companies that are agile enough to take advantage of this change.

Right now, leading industries are jumping into an "IoT arms race," including manufacturing, energy, utilities, mining, transportation, aerospace, process control, and many more. And they have good reasons. There are plenty of growth opportunities to go around. However, the best opportunities will go to those who start early and expand with the market.

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Market growth can be measured by the forecasted velocity of connected things, variety of industrial verticals, and volume of investment and economic value. Consider these statistics:

- IT analysis firm IDC predicts that the 12.1 billion connected units in 2015 will more than double to reach 30.3 billion in 2020. Furthermore, Cisco Executive Chairman John Chambers has predicted that 500 billion connected devices will be in use by 2025.

- According to Markets and Markets (September 2016), IoT investment is projected to grow from US$130.33 billion in 2015 to $883.55 billion by 2022, at a compound annual growth rate (CAGR) of 32.4 percent between 2016 and 2022.

- A 2013 study by the Cisco Internet Business Solutions Group (IBSG) found that associated IoT economic value will total $14.4 trillion between 2013 and 2022. The majority of $9.3 trillion will materialize in North America and Europe, while China and Japan will share the $5.1 trillion, along with the rest of the world.

### IoT economic value between 2013 and 2022

**$9.3T**
North America and Europe

**$14.4 trillion**

**$5.1T**
China, Japan and other

- Of that $14.4 trillion, $9.5 trillion will come from industry-specific use cases (for example, smart grid, connected transportation), whereas $4.9 trillion will come from cross-industry use cases.

### Source of global IoT economy

**$9.5T**
Industry-specific use case

**$14.4 trillion**

**$4.9T**
Cross-industry use case

- Four industries will constitute more than one-half the total value of the projected IoT market:

    - Manufacturing (27 percent)
    - Retail trade (11 percent)
    - Information services (9 percent)
    - Finance/insurance (9 percent)

### Industry association to IoT

| 27% | 11% | 9% | 9% |
|-----|-----|-----|-----|
| Manufacturing | Retail trade | Information services | Finance/insurance |

So, what do these numbers say about the future of IoT in manufacturing and other vertical markets? For one thing, this technological revolution will replace older equipment and processes by delivering more efficiency, precision, and accuracy—making connected facilities more effective and competitive.

The effect of IoT digital transformation on manufacturing alone is profound, and it's often referred to as the fourth industrial revolution, or Industry 4.0 (Figure 1). Car manufacturers, as an example, have benefited from advanced computing and robotics in automated factories. However, these robots have been primarily individual workstations operating in silos.

On the other hand, IoT-powered factories are a "network of networks"—robotics and other machines interconnected by hard wire and wirelessly, both inside and outside the facility. These networks extend to enterprise business intelligence, vendors, supply chains, and ultimately to customers, thus supporting faster, more efficient, just-in-time, customized production and deliveries.

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## Figure 1: The fourth industrial revolution

| Mechanization, water power, steam power | 1 | Mass production, assembly line, electricity | 2 | Computer and automation | 3 | Cyber physical systems | 4 |

## Industries are rapidly adopting IoT

The IoT World Forum was organized in 2013, with many global industry leaders at the helm. These include not only Cisco, but also AT&T, Accenture, Emerson Electric, Microsoft, Intel, Ford Motor Company, Siemens, Johnson Controls, Cubic, IBM, Salesforce, MIT, General Electric, Honeywell, and many others.

Cisco, Microsoft, Intel, Dell, and ARM Holdings formed the OpenFog Consortium in 2015 to promote IoT architecture and push connected analytics and intelligence to the network's edge.

These companies, and others like them, have made the leap to IoT, and it's changing their approach to doing business. For example, General Electric has evolved from a commodities company into a software-and-analytics powerhouse with its Predix platform and a target revenue of $15 billion by 2020. Amazon launched its Amazon Web Services (AWS) IoT platform in 2015, and Microsoft joined in with its Azure IoT Suite. IBM Watson provides analytics to the Watson Data Platform.

Alliances such as GE Predix and PTC ThingWorx, along with Amazon's acquisition of 2lemetry and Jasper's acquisition by Cisco, plus Cisco's alliances with Rockwell Automation, Salesforce, IBM, Ericsson, and Apple, have come as IoT leaders strive to deliver a complete package for business outcomes. As an option, they can also offer IoT as a service to their enterprise customers.

Robotics maker FANUC uses the Cisco Jasper IoT platform to connect assembly line machines worldwide, while General Motors uses it to connect 30,000 robots to the Internet for its connected factories. The Jasper platform has generated many success stories in several industries. Besides GM, users include Alamo Rent a Car, Amazon, BMW, Daimler, DHL Express, Enterprise Rent-A-Car, and many more. Cisco has also taken a tactical

investment approach in the IoT ecosystem to become focused on software and solutions with the recent acquisitions of AppDynamics and Viptela.

IDC indicates that by 2020, 60 percent of the Forbes Global 2000 companies will have doubled their productivity by transforming many human-based delivery systems to software-based delivery, and more than 20 percent of all workers will work alongside automated assistance technologies. In other words, IoT is fueling industrial automation and the coming wave of robotics.

Companies once were moving manufacturing overseas to save labor costs. A small number of companies now are reversing the trend, driven by a confluence of factors such as higher freight charges, lower domestic energy costs, federal and state incentives, and just-in-time delivery. Empowered by IoT and automation, visionary enterprises (for example, Apple) are contemplating "reshoring"—moving their manufacturing back to the United States because it's becoming affordable again.

To a certain extent, a fraction of formerly lost manufacturing jobs will be regained. However, connected factories will be primarily automated and operated by trained and certified IoT engineers. Government and enterprises will be compelled to retrain workers and assist them to move into these new careers and higher skillsets.

Besides connected factories, there are many other commercial IoT applications. As a good example, Disney World's MagicBand, a connected wristband for those staying at the resort, optimizes the facility's services per user demands. Just-in-time car services are planning to add driverless connected vehicles to their fleets. Navigant Research says that LED streetlights will grow from 13 million to 116 million worldwide by 2023. These new installations are logical IoT integration points for the delivery of energy conservation and for asset management for smart cities.

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On a grander scale, digital transformation resulting from the synergistic planning of autonomous cars and smart city technologies will be profound:

- Carbon footprint reduction
- Changes in the concept of car ownership
- Widening of roadways while eliminating much street parking
- Conversion of garages into robotic-managed service hubs

The innovations and opportunities in all industrial verticals are truly limitless for visionary enterprises.

Unfortunately, not all companies will seize the opportunity quickly enough. According to a 2015 study by TEKsystems, a provider of IT staffing, only 22 percent of polled companies had transitioned from IoT pilot programs to full implementation. Meanwhile, 42 percent were only at the "considering" stage. Finding the right staffing was a concern for 33 percent of the companies, and 37 percent were concerned about interoperability with current systems. Nevertheless, 42 percent believed that IoT would have a significant impact on their businesses by 2020.

Laggards who aren't proactive with digital transformation will be left on the sidelines, watching their competitors succeed in Industry 4.0. Just think of the former market leaders that already have been replaced because they did not keep up with technology changes. Kodak, Nokia, Blockbuster, Borders, Sears, and others have shared this common fault—a company that once was a leader in its space lost the edge when it maintained status quo while its competitors moved on with the next industry transformation.

Having winning IoT leadership helps to ensure a positive future for many enterprises. No company wants to lose its edge, become irrelevant, and even face demise. IoT planning must transition from strategy to execution.

Companies are quickly gaining a perspective on the future impact of digital transformation, the vast market opportunity it brings, and the velocity of adoption in some industries (for example, 43 percent of manufacturing companies are already engaged in digital transformation, according to the IDC study "Digital Transformation in Manufacturing Worldwide, 2016"). And many companies are beginning to understand the peril of inaction.

Where's your company in the digital transformation journey? IoT-empowered digital transformation is complex, and it requires meticulous planning and organization just to launch a proof of concept. Now is the time to initiate engagement.

## The IoT platform is a data-centric model

In this context, the IoT platform represents system components interconnecting with one another to enable services to monitor, manage, secure, connect, and control "things." An application or middleware platform, as we know it, would be one of the components in the IoT platform. Data management and analytics are important platform attributes, and security is the top concern.

The IoT platform encompasses a suite of components in the technology stack that sit between the application and hardware layers, operating independently. The platform works with connected devices and applications by integrating them so they work together to provide consistent IoT features and functions.

The IoT World Forum Reference Model provides the following look at the technology stack (Figure 2).



Figure 2: IoT World Forum reference model

LEVEL

7 Collaboration and processes
(Involving people and business processes)

6 Application
(Reporting, analytics, control)

5 Data abstraction
(Aggregation and access)

4 Data accumulation
(Storage)

3 Edge computing
(Data element analysis and transformation)

2 Connectivity
(Communication and processing units)

1 Physical devices and controllers
(The "things" in IoT)

# Prepare to succeed with the Internet of Things

IoT has evolved from a machine-to-machine (M2M) communications and applications platform to a data-centric model with connected analytics and edge intelligence. Business processes are integrated with operations to propel data-driven business outcomes. Security spans all levels, starting with physical protection and moving to end-to-end encryption, privacy management, application identity, and access management. Business leaders and IT, driving the upper levels, must closely collaborate with operational technology (OT), managing the lower levels.

Topology and industrial application protocols may vary among industrial verticals. With manufacturing automation, IoT can help ensure quality control, radio frequency identification (RFID) inventory control, and enterprise resource planning (ERP) systems to order supplies automatically. For trucking companies, IT optimization systems can manage delivery fleets, onboard logging devices can help improve vehicle safety and maintenance schedules, and RFID sensors can verify customer deliveries.

Currently, there's no dominant IoT ecosystem platform; IT leaders must still orchestrate solutions from multiple providers. No vendor offers an end-to-end solution or a monolithic integrated solution covering connected things, connectivity and network infrastructure, devices, data and network management, analytics, and applications. However, we can continue to expect alliances and partnerships, as well as acquisitions, in the rapidly evolving IoT ecosystem. Enterprises must understand the scope and complexity and develop a plan to attract and nurture IoT infrastructure and network engineers, integrators, operations engineers, architects, project managers, analysts, developers, and other ecosystem contributors.

## Plan your IoT journey

Transforming a company into an IoT-savvy enterprise will require a well-planned roadmap. Like any other strategic process, there's a logical progression in a company's embrace of IoT:

**Unaware:** At this stage, the enterprise has very little or no knowledge of the impending IoT-enabled digital transformation.

**Aware:** The enterprise is learning more about IoT and is becoming interested in the concept.

**Educated:** Management is investigating IoT, collecting and analyzing data, and beginning to discuss the business possibilities that could result from implementing an IoT platform.

**Small trials:** Experimental IoT implementations are tried in a few smaller applications. Results are calculated and analyzed regarding their possible impact on the business.

**Prototyping and proof of concept:** Management makes a larger commitment to IoT by launching prototype applications within the company and judging the results on a larger scale.

**Internal deployments:** By now, management is becoming more fully engaged, with full IoT deployments within the company. Results are further analyzed regarding their potential impact on the business.

**Market deployments:** With positive results inside the company, management now moves to external IoT deployments that may involve customers, vendors, partners, and other parties. Results and reactions are collected and further analyzed.

**Learn and refine:** Management continues to analyze data from IoT implementation, both positive and negative, and it works to solve any issues while building on successes.

**Solution evolution:** At this stage, the company is ready to transition into the next successive stages in cost reduction, performance efficiency, and new solutions and services offerings through full IoT implementation.

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## The growing IoT talent gap is alarming

But IoT is more than just platforms and machines. It must have the talent to support, operate, secure, and maintain it. This is where organizations are facing a real challenge. One might have the greatest vision in the world, but it takes skilled people to bring it to fruition. Globally, there are not nearly enough trained and certified IoT experts to fill the growing demand.

That talent gap exists for several reasons:

- IT and OT engineers don't yet understand the converged IoT network, so the relevant talent and skills aren't critical at the moment.
- The IoT platform is a new ecosystem of interconnecting technologies and collaborating actors, so trained individuals aren't yet in critical demand.
- Umbrella security still must be developed and integrated into the IoT platform, so organizations are still using legacy systems.
- IoT and business strategies aren't yet aligned, so IoT talent is viewed as unnecessary.
- Systems and solutions are not yet integrated and interoperable, so IoT talent is not fully incorporated into the enterprise.
- Modeling is still needed to provide early evaluation and optimization to allow for service refinements in the face of IoT complexity and scale.
- Cross-functional teams (project management, QA, support) still do not understand the IoT platform.

Organizations that think ahead are realizing that they must train their people now to prepare them for the coming changes. Here are some compelling statistics from a December 2015 Forbes article by Louis Columbus, "Where to Find a Job Doing Internet of Things (IoT) Work Today"?":

- During the previous two years, General Electric had advertised 2,104 jobs looking for skills needed to support their Industrial Internet initiative.

- Hiring demand for commercial and industrial designers with IoT skills had risen by 322 percent since 2014.

- Employer demand for product engineers with skills related to IoT had increased by nearly 275 percent since 2014.

- The fastest-growing IoT job positions included systems software developers (215 percent growth in 2015), information security analysts (113 percent growth), and computer systems engineers (110 percent growth).

> One might have the greatest vision in the world, but it takes skilled people to bring it to fruition.

Given the critical nature of digital transformation, competition for the short supply of certified IoT talent will be fierce. The demand will further worsen as hiring extends from the leaders (Cisco, Microsoft, Amazon, General Electric, Oracle, Honeywell, and others) to late adopters and end customers.

As illustrated earlier, the IoT platform is complex. Not only are more things becoming connected, it requires multiparty and vendor collaboration to derive value out of the massive data collected. That data traverses various networks and protocols (wired and wireless), and touches many technologies—sensors, controllers, converged networks, device and network management, gateways, security, data management, analytics, modeling, and services. These challenges can best be tackled by professionals with IoT talent, training, and certification.

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Here are some sobering facts:

- IT and OT convergence will provide competitive advantage but also will reveal skills gaps.

- Every year, 220,000 new engineers will be needed (Cisco).

- The State of IoT 2015 Global Developer Study commissioned by Progress Software found that 50 percent of developers and chief information officers surveyed said they were uncertain that they had the skills or resources to deliver on the promise of IoT.

- According to a 2014 report by VisionMobile, an analyst firm covering the developer economy, about 4.5 million IoT developers will be needed by 2020. That represents a CAGR of 54 percent over the 2014 base year. These developers need to be educated in the IoT platform, the environment in which they develop services. The same applies to other job roles such as industrial engineers, plant IT personnel, operations engineers, and others.

How many certified IoT professionals do you have in your organization today? As it takes time to recruit and nurture IoT talent, there's no better time than now to address the talent gap issue.

## Your workforce must be transformed

Just as prior industrial revolutions changed the workforce, digital transformation touches on all industrial verticals and enterprises. As a company's profitability and industry position depend on vision and execution, smart management teams are being proactive and tactical in their approaches to acquire the essential talent to properly manage all facets of IoT.

Many enterprises will find themselves creating a separate business unit to drive the IoT-supported enterprise. This business unit will likely be led by a business-savvy chief IoT officer, and the team will consist of multidisciplinary contributors in infrastructure networks, smart devices, and operations intelligence. Solutions and technology architects and analysts, security operations engineers, service developers, consultants, system integrators, third-party vendors, and cross-functional teams will also contribute. No more silos. Whether the team members are product or project managers or current IT or OT professionals, they must be educated and certified in IoT skillsets.

The immediate challenge is that employers are competing to draw from the same limited talent pool. A shortage of certified professionals makes the task even more difficult. The situation will worsen as more "things" are connected to the Internet, requiring even more talent acquisition.

How can your company keep pace when changes are happening so quickly? And, how can a company address that shortage of skilled workers so it can remain competitive in the IoT marketplace?

## Get your workforce ready for IoT now

One solution is to train the people already in place. These IT and OT personnel already know the company strategy and products, and they should become a high-priority investment. As they train together, they can even collaborate on solving problems and building a solid foundation for the IoT functions within the organization.

In addition, people who come into a company already trained and certified for these positions can help support that company's growth potential. Look for those with certification in IoT or industrial networking or similar. If candidates lack certification, companies may wish to hire promising candidates and enroll them in the proper certification training. They'll need to energize the "in-place" talent with additional new talent for innovative projects.

To upskill the workforce, employers are advised to look for leading training organizations offering a full range of courses for IT and OT professionals. There are compelling reasons why companies and their teams might want to consider Cisco for this purpose:

- Cisco is an industrial IoT (IIoT) leader, and its certifications are well established and globally recognized. Its IoT training and certification is an extension of its global-leading certifications for security, as well as for routing and switching.

- Cisco-certified skillsets are hands-on and transferrable because the course content is vendor-agnostic.

- Cisco is a founding member of the IoT Talent Consortium, launched in 2015 as an outgrowth of the IoT World Forum (of which Cisco is also a founding member). Its focus is on accelerating preparation of first generation of IoT-ready talent to manage the first wave of IoT installations.

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Broadly speaking, Cisco has identified the top job roles in eight categories (Figure 3), and many subcategory jobs also exist. Job roles appropriate for IoT training include the following:

- IT and OT (now IoT) network engineers
- Business process and industrial operations and support engineers
- Service developers
- Data engineers
- Analysts
- Security operations personnel
- Executives
- Project leads and managers
- Business and solutions architects
- Cross-functional team leads

As a first step, a company's OT professionals, for example, must learn IP network technology and use their industrial backgrounds to earn career certifications as industrial networking specialists. As part of achieving a Cisco Certified Network Associate (CCNA) Industrial certification, professionals learn advanced topics, such as troubleshooting, wireless, and security.

IT professionals already certified in networking fundamentals can learn the industrial application protocols and fast-track to become IoT professionals by earning the CCNA Industrial certification. Certified IoT professionals can help their companies remain competitive and integrate various IoT projects in multiple industrial verticals, such as manufacturing, utilities, energy, oil and gas, connected transportation, and more.

Generalists and cross-functional teams can join the IoT career track by following the Cisco learning map, so they can become certified, take advantage of the career potential, and help organizations advance. IoT training and certification can benefit these individuals:

- Business unit leaders
- Solutions architects
- Systems architects
- Business and technology analysts
- Systems integrators
- Project and product managers
- Account managers
- Vendor relations personnel
- Typical cross-functional team members in development, QA, and support



Figure 3: IoT job roles fall into eight categories
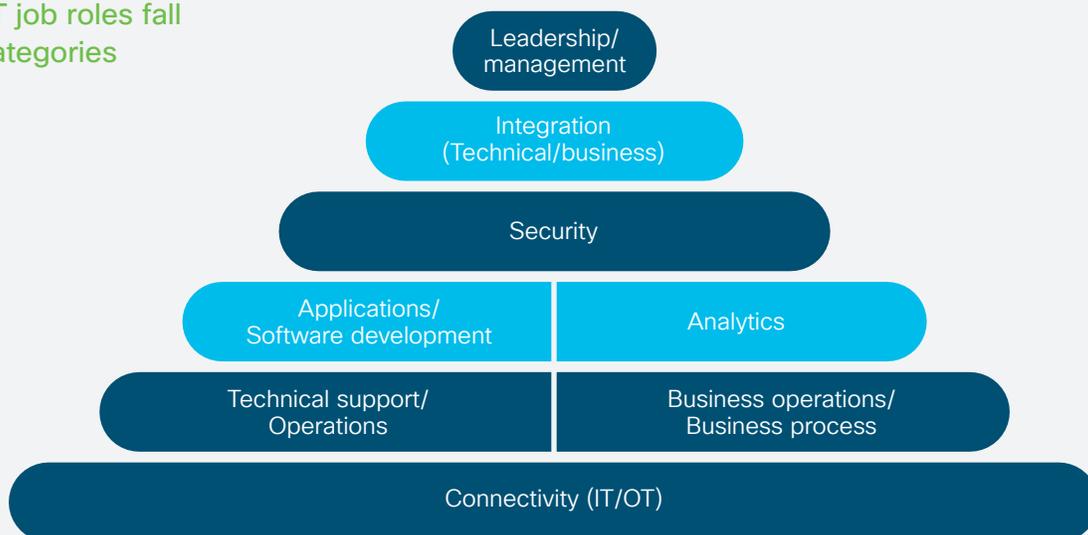
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## The training investment has a large return

One major benefit to this type of training is that certification holders become fluent in converging multiplatform industrial environments using the most popular industry standard protocols. These professionals will also be making sure that the current infrastructure is optimized, while developing a flexible platform to support future business outcomes.

In fact, a Cisco survey of 202 networking managers has shown that Cisco-certified employees are much more valuable to their employers than noncertified employees. They're faster and more effective at resolving technical problems, they're faster and more successful at completing network-related IT projects, and they get up to speed more quickly (Figure 4).

### Figure 4: Average improvement on job performance

| How much... are Cisco certified employees? | Total n=202 |
|---|---|
| Faster at resolving technical problems | 43% |
| More effective at resolving technical problems | 42% |
| More successful at completing network-related IT projects | 40% |
| Quicker at coming up to speed | 40% |
| Faster at completing network-related IT projects | 37% |

\* Cisco certified employees score at least 37% average improvement rating in all areas.

Remember that IoT is a journey. The formula for success for companies and organizations is to recruit—and cultivate—existing OT and IT staff to become IoT experts. In an ideal setting, these experts collaborate and guide cross-functional teams, consultants, third-party developers, vendors, and strategic technology partners to jointly deliver a common business goal.

Recognize that the IoT talent gap is widening, and industrial verticals will be competing with your organization for certified IoT skilled professionals.

It's paramount for executives to help enable the workforce to function effectively as a unit to support flexibility, growth, and competitive advantage. An organization's business goals can be realized only through a skilled staff.

Today's workforce must prepare for tomorrow's evolving job roles. Act now because tomorrow is quickly approaching.

## Leaping ahead with training and certification

To become better grounded in IoT networking technology and industrial verticals, consider the Cisco Industrial Networking Specialist certification.

To become an IIoT professional in manufacturing, review the Cisco CCNA Industrial certification.

If you'd like to have team training on your site, email ask-edu-pm-dcv@cisco.com.