Deloitte.

Confederation of Indian Industry

Harnessing the power of Internet of Things to transform Industry in India

Contents

Foreword Deloitte

Technology is redefining the potential of everyday products. The 'Internet of Things' (IoT) is likely to make everyday life better and easier by connecting everyday products with people. Used well, connected products can boost consumer engagement and deliver substantial value for both consumers and businesses across industries.

This opportunity has never been more significant, as more and more companies find themselves in desperate need to (re) engage with consumers and stay relevant. In an increasingly competitive market with brand loyalty at its lowest point, businesses are looking for creative ways to restore the lost connection with their consumer and influence buying decisions at the point of purchase.

In this report, we define and describe the concept of smart factory and explore ways on how companies can re-imagine customer relationships in the age of IoT:

- What it is, its key features, and the trends that have contributed to its rise
- The components and technologies that comprise the smart factory, and how it fits within the digital supply network
- How the smart factory can drive value and its other benefits
- Ways organizations can begin building and enacting a true, holistic smart factory
- How companies can differentiate themselves in the market, transform relationship with consumers and create value beyond the standard factory leveraging IoT

To be globally competitive in the next five years and beyond, it's imperative that Indian manufacturing companies (both incumbents and new entrants) are well versed with emerging technology trends driving IoT, commercialise innovative ideas into sustainable businesses and product development, and leverage new business models to drive competitive and profitable growth.

CII-Deloitte report titled "Harnessing the power of Internet of Things to transform Industry in India" is an endeavor to exploring the trends and factors that will influence adoption of IoT in manufacturing and laying out steps both new entrants and incumbents can begin to take to effectively set their own path in the rapidly changing manufacturing landscape.

Partners
Rakesh Barik
Neeraj Arora
Shree Parthasarathy
Anil Talreja
Rajeev Singh

Harnessing the power of Internet of Things to transform Industry in India

Foreword CII

The digital space has witnessed major transformations in the last couple of years & the latest entrant to the digital space is the Internet of Things (IoT).

IoT technology has the potential to transform India in many ways. The demand for IoT in India is emerging across industries such as utilities, manufacturing, automotive, transportation and logistics. Everyday customers are already using IoT enabled smart devices for health and wellness, tracking devices for personal safety, and also the emerging smart home systems category. And the government, whose flagship initiatives like Digital India & Make in India feature IoT as a key enabler of public utilities and services.

Service providers have started working to maximize the gains from this emerging market. The telcos are coming up with new products and services to address this market. Moreover, India and its technology competency is driving global innovations and helping realise possibilities.

The Internet of Things is a game changer in my opinion. We should seek out the best outcomes - to benefit our businesses and the worldwide economy. In addition to connecting people, anytime and everywhere, it is connecting IoT products to humans and other IoT products, and it is putting these products at the service of humanity. This transformation has already begun; it will only continue to accelerate.

This is why there is a strong need for regulatory and policy framework, and, I am glad that the Government of India is looking at ways to lay out regulations for machine-to-machine (M2M) communications as IoT is one of the most crucial part of the broadband highway and will play a pivotal role in delivering a wide range of the e-governance and citizen services, pan India. Adoption and usage of IoT enabled solutions and devices is also now increasing in the field of public service with the aim to accomplish the Digital India vision that includes digital literacy, financial inclusion and widespread adoption of e-governance services across platforms. To this effect, 2015 saw the roll-out of a draft policy on IoT that laid down the framework, issued by Department of Electronics and Information (DeitY). The policy would be implemented through a multi pillar approach, such as capacity building and incubation, R&D, and incentives and engagements. Towards the beginning of next year, we will have a complete set of best practices for IoT. In addition, the ministries of IT and telecom are working together to bring in robust security protocols for new technologies. Security and data protection are key areas for the current government and the roll out of a "full fledged" data protection law by the Srikrishna Commission will have a significant impact on IoT.

Rishi Bhatnagar
Chairman
CII IoT Summit 2018

About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, playing a proactive role in India's development process. Founded in 1895, India's premier business association has over 8,500 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 200,000 enterprises from around 265 national and regional sectoral industry bodies.

CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water, to name a few.

As a developmental institution working towards India's overall growth with a special focus on India@75 in 2022, the CII theme for 2017-18, India@75: Inclusive. Ahead. Responsible emphasizes Industry's role in partnering Government to accelerate India's growth and development. The focus will be on key enablers such as job creation; skill development and training; affirmative action; women parity; new models of development; sustainability; corporate social responsibility, governance and transparency.

With 67 offices, including 9 Centres of Excellence, in India, and 11 overseas offices in Australia, Bahrain, China, Egypt, France, Germany, Iran, Singapore, South Africa, UK, and USA, as well as institutional partnerships with 355 counterpart organizations in 126 countries, CII serves as a reference point for Indian industry and the international business community.

CII Address
Confederation of Indian Industry
(Northern Region) – Sub-Regional Office
Plot No 249 –F, Sector-18, Udyog Vihar
Phase IV, Gurugram - 122 015.
T: +91-0124-4014073
F: +91-0124-4014070
E: ciinr@cii.in
W: www.cii.in

Harnessing the power of Internet of Things to transform Industry in India

Manufacturing and Internet of Things

The new frontier of manufacturing systems[1]

Connectivity within the manufacturing process is not new. Yet recent trends such as the rise of the fourth industrial revolution, Industry 4.0,[2] and the convergence of the digital and physical worlds—including in-formation technology (IT) and operations technology (OT)—have made the transformation of the supply chain increasingly possible. Shifting from linear, sequential supply chain operations to an interconnected, open system of supply operations—known as the digital supply network—could lay the foundation for how companies compete in the future. To fully realize the digital supply network, however, manufacturers likely need to unlock several capabilities: horizontal integration through the myriad operational systems that power the organization; vertical integration through connected manufacturing systems; and end-to-end, holistic integration through the entire value chain.[3]

In this theme paper, we explore how these capabilities integrate to enable the act of production. This integration is colloquially known as the smart factory, and signifies the opportunity to drive greater value both within the four walls of the factory and across the supply network.

The smart factory represents a leap forward from more traditional automation to a fully connected and flexible system—one that can use a constant stream of data from connected operations and production systems to learn and adapt to new demands.[4] A true smart factory can integrate data from system wide physical, operational, and human assets to drive manufacturing, maintenance, inventory tracking, and digitization of operations through the digital twin, and other types of activities across the entire manufacturing network. The result can be a more efficient and agile system, less production downtime, and a greater ability to predict and adjust to changes in the facility or broader network, possibly leading to better positioning in the competitive marketplace.

Many manufacturers are already leveraging components of a smart factory in areas such as advanced planning and scheduling using real-time production and inventory data, or augmented reality for maintenance. But a true smart factory is a more holistic endeavor, moving beyond the shop floor toward influencing the enterprise and broader ecosystem.

[1] This section has been derived from The Smart Factory- Responsive, adaptive and connected manufacturing which is a part of Deloitte series on Industry 4.0. available at https://www2.deloitte.com/insights/us/en/focus/industry-4-0/smart-factory-connected-manufacturing.html
[2] Learn about Industry 4.0 at https://dupress.deloitte.com/dup-us-en/focus/industry-4-0.html.
[3] Shiyong Wang et al., "Implementing smart factory of Industrie 4.0: An outlook," International Journal of Distributed Sensor Networks (2016), http://journals.sagepub.com/doi/pdf/10.1155/2016/3159805.
[4] Agnieszka Radziwona et al., "The smart factory: Exploring adaptive and flexible manufacturing solutions," Procedia Engineering 69 (2014): pp. 1184–90, http://www.sciencedirect.com/science/article/pii/S1877705814003543

Harnessing the power of Internet of Things to transform Industry in India

The smart factory is integral to the broader digital supply network and has multiple facets that manufacturers can leverage to adapt to the changing marketplace more effectively.

The concept of adopting and implementing a smart factory solution can feel complicated, even insurmountable. However, rapid technology changes and trends have made the shift toward a more flexible, adaptive production system almost an imperative for manufacturers who wish to either remain competitive or disrupt their competition.

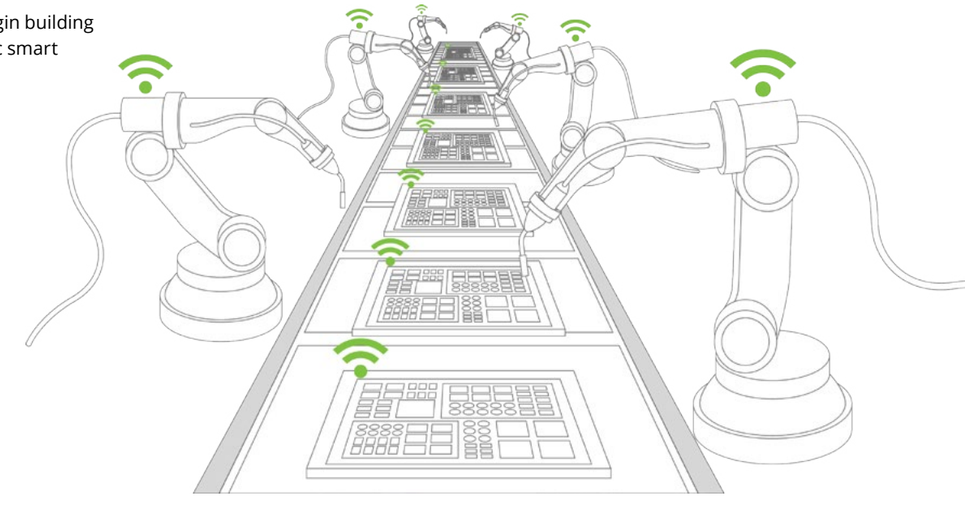
By thinking big and considering the possibilities, starting small with manageable components, and scaling quickly to grow the operations, the promise and benefits of the smart factory can be realized. In this paper, we define and describe the concept of the smart factory:

- What it is, its key features, and the trends that have contributed to its rise
- The components and technologies that comprise the smart factory, and how it fits within the digital supply network
- How the smart factory can drive value and its other benefits
- Ways organizations can begin building and enacting a true, holistic smart factory

A Brief Look at the Digital Supply Network

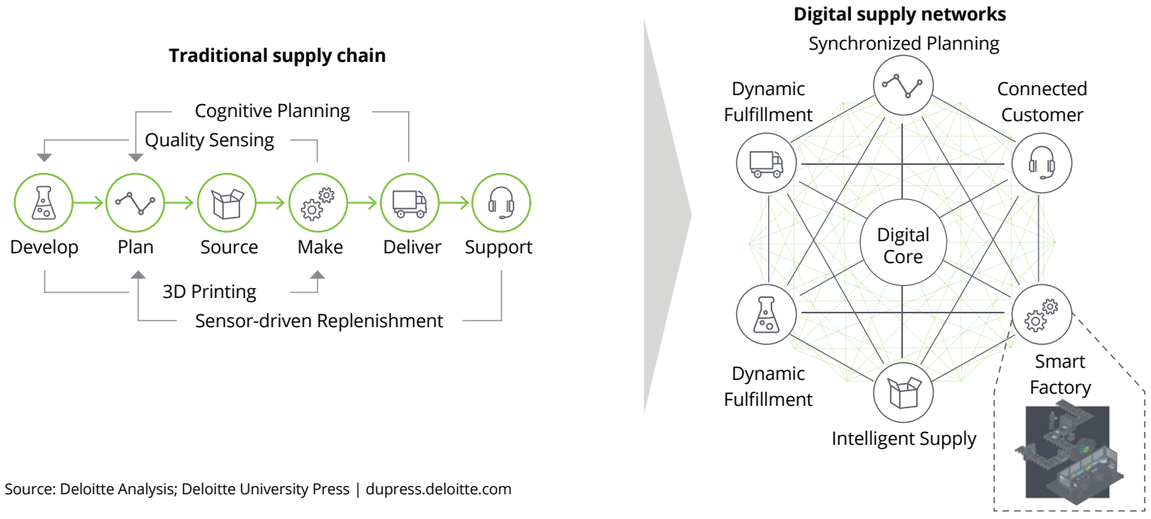
The rise of the digital supply network,[5] it was examined as to how supply chains traditionally are linear in nature, with a discrete progression of design, plan, source, make, and deliver. Today, however, many supply chains are transforming from a static sequence to a dynamic, interconnected system—the digital supply network—that can more readily incorporate ecosystem partners and evolve to a more optimal state over time. Digital supply networks integrate information from many different sources and locations to drive the physical act of production and distribution.[6]

In figure 1, the interconnected lattice of the new digital supply network model is visible, with digital at the core. There is potential for interactions from each node to every other point of the network, allowing for greater connectivity among areas that previously did not exist.
In this model, communications are multidirectional, creating connectivity among traditionally unconnected links in the supply chain.



[5] Adam Mussomeli, Stephen Laaper, and Doug Gish, The rise of the digital supply network: Industry 4.0 enables the digital transformation of supply chains, Deloitte University Press, December 1, 2016, https://dupress.deloitte.com/ dup-us-en/focus/industry-4-0/digital-transformation-in-supply-chain.html
[6] Brenna Sniderman, Monica Mahto, and Mark Cotteleer, Industry 4.0 and manufacturing ecosystems: Exploring the world of connected enterprises, Deloitte University Press, February 22, 2016, https://dupress.deloitte.com/dup-us-en/focus/industry-4-0/manufacturing-ecosystems-exploring-world-connected-enterprises.html.

Figure 1- Shift from traditional supply chain to digital supply network



Source: Deloitte Analysis; Deloitte University Press | dupress.deloitte.com

Defining the smart factory

Automation has always been a part of the factory to some degree, and even high levels of automation are nothing new. However, the term "automation" suggests the performance of a single, discrete task or process. Historically, situations in which machines have made "decisions" have been automation based and linear, such as opening a valve or turning a pump on and off based on a defined set of rules. Through the application of artificial intelligence (AI) and increasing sophistication of cyberphysical systems that can combine physical machines and business processes, automation increasingly includes complex optimization decisions that humans typically make.[7] Finally—and perhaps most crucially—the term "smart factory" also suggests an integration of shop floor decisions and insights with the rest of the supply chain and broader enterprise through an interconnected IT/OT landscape. This can fundamentally change pro-duction processes and enhance relationships with suppliers and customers.

Through this description, it becomes clear that smart factories go beyond simple automation. The smart factory is a flexible system that can self-optimize performance across a broader network, self-adapt to and learn from new conditions in real or near-real time, and autonomously run entire pro-duction processes.[8] Smart factories can operate within the four walls of the factory, but they can also connect to a global network of similar production systems, and even to the digital supply network more broadly.

It is important to note, however, that the smart factory as defined and described in this paper should not be considered the "end state," given the rapid pace of technological development. Rather, it represents an ongoing evolution, a continuous journey toward building and maintaining a flexible learning system—rather than the "one and done" factory modernization approach of the past.

[7] Ibid
[8] Germany Trade and Invest, Smart factory, https://industrie4.0.gtai.de/INDUSTRIE40/Navigation/EN/Topics/Industrie-40/smart-factory.html, accessed August 18, 2017

The true power of the smart factory lies in its ability to evolve and grow along with the changing needs of the organization—whether they be shifting customer demand, expansion into new markets, development of new products or services, more predictive and responsive approaches to operations and maintenance, incorporation of new processes or technologies, or near-real-time changes to production. Because of more powerful computing and analytical capabilities—along with broader ecosystems of smart, connected assets—smart factories can enable organizations to adapt to changes in ways that would have been difficult, if not impossible, to do so before.

Features of the smart factory: What makes it different?

As many manufacturers grapple with the myriad organizational and ecosystem-wide changes exerting pressure on their operations, the smart factory offers ways that can successfully address some of those issues. The ability to adjust to and learn from data in real time can make the smart factory more responsive, proactive, and predictive, and enables the organization to avoid operational downtime and other productivity challenges.

As part of its efforts to implement a smart factory while producing air conditioners, a leading electronics company used a fully automated production system, three-dimensional scanners, IoT technologies, and integrated machine control. The benefits of this automation included lower lead times for customers and lower overall costs, along with production capacity improvement of 25 percent and 50 percent fewer defective products.[9]

Figure 2 depicts the smart factory and some of its major features: connectivity, optimization, transparency, proactivity, and agility. Each of these features can play a role in enabling more informed decisions and can help organizations improve the production process. It is important to note that no two smart factories will likely look the same, and manufacturers can prioritize the various areas and features most relevant to their specific needs.

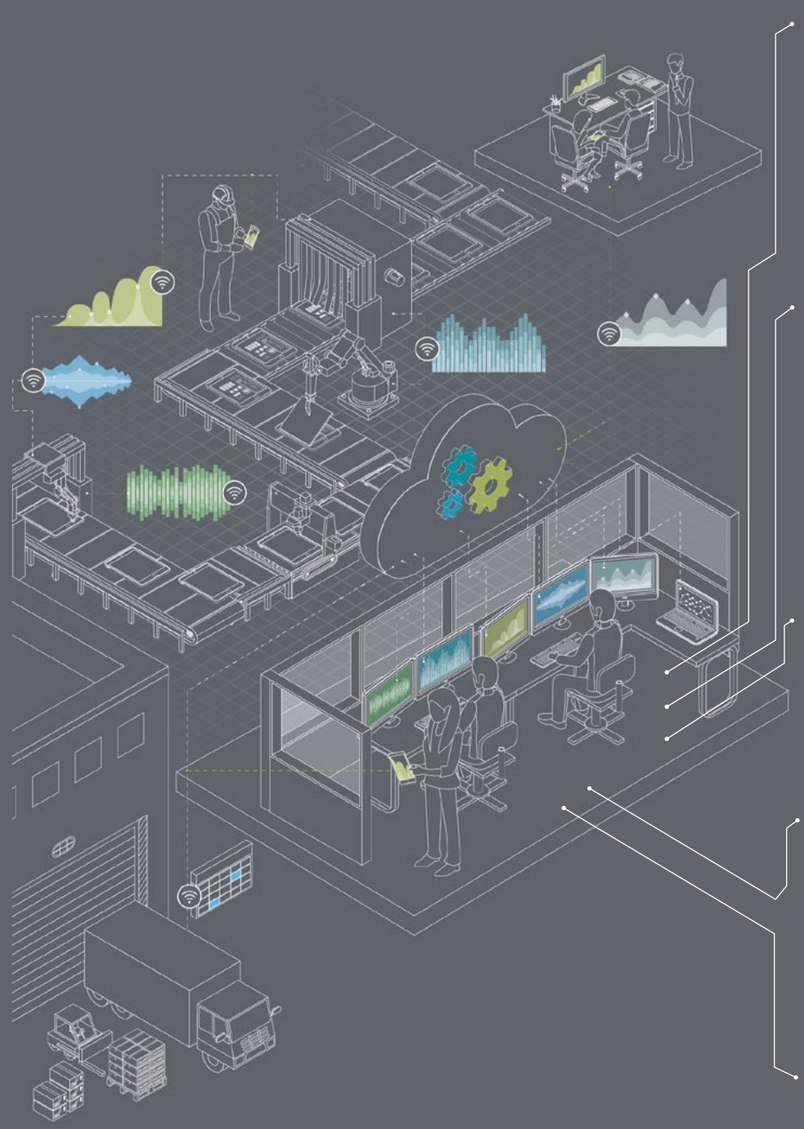
Perhaps the most important feature of the smart factory, its **connected** nature, is also one of its most crucial sources of value. Smart factories require the underlying processes and materials to be connected to generate the data necessary to make real-time decisions. In a truly smart factory, assets are fitted with smart sensors so systems can continuously pull data sets from both new and traditional sources, ensuring data is constantly updated and reflect current conditions. Integration of data from operations and business systems, as well as from suppliers and customers, enables a holistic view of upstream and downstream supply chain processes, driving greater overall supply network efficiency.

An **optimized** smart factory allows operations to be executed with minimal manual intervention and high reliability. The automated workflows, synchronization of assets, improved tracking and scheduling, and optimized energy consumption inherent in the smart factory can increase yield, uptime, and quality, as well as reduce costs and waste.

In the smart factory, the data captured is **transparent**: Real-time data visualizations can transform data captured from processes and fielded or still-in-production products and convert them into actionable insights, either for humans or autonomous decision making. A transparent network can enable greater visibility across the facility and ensure that the organization can make more accurate decisions by providing tools such as role-based views, real-time alerts and notifications, and real-time tracking and monitoring.

[9] Yoon Sung-won, "Samsung expediting smart factory for home appliances," Korea Times, April 19, 2017, http:// www.koreatimes.co.kr/www/common/vpage-pt.asp?categorycode=133&newsidx=227896.

Figure 2- Five key characteristics of smart factory



Connected
- Continuously pull traditional datasets along with new sensor and location-based datasets
- Real-time data-enabling collaboration with suppliers and customers
- Collaboration across departments (e.g., feedback from production to product development)

Optimized
- Reliable, predictable production capacity
- Increased asset uptime and production efficiency
- Highly automated production and material handling with minimal human interaction
- Minimized cost of quality and production

Transparent
- Live metrics and tools to support quick and consistent decision making
- Real-time linkages to customer demand forecasts
- Transparent customer order tracking

Proactive
- Predictive anomaly identification and resolution
- Automated restocking and replenishment
- Early identification of supplier quality issues
- Real-time safety monitoring

Agile
- Flexible and adaptable scheduling and changeovers
- Implementation of product changes to see impact in real time
- Configurable factory layouts and equipment

Source: Deloitte Analysis; Deloitte University Press | dupress.deloitte.com

In a **proactive** system, employees and systems can anticipate and act before issues or challenges arise, rather than simply reacting to them after they occur. This feature can include identifying anomalies, restocking and replenishing inventory, identifying and predictively addressing quality issues,[10] and monitoring safety and maintenance concerns. The ability of the smart factory to predict future outcomes based on historical and real-time data can improve uptime, yield, and quality, and prevent safety issues. Within the smart factory, manufacturers can enact processes such as the digital twin, enabling them to digitize an operation and move beyond automation and integration into predictive capabilities.[11]

Agile flexibility allows the smart factory to adapt to schedule and product changes with minimal intervention. Advanced smart factories can also self-configure the equipment and material flows depending on the product being built and schedule changes, and then see the impact of those changes in real time. Additionally, agility can increase factory uptime and yield by minimizing changeovers due to scheduling or product changes and enable flexible scheduling.

Impacts of the smart factory on manufacturing processes

Manufacturers can implement the smart factory in many different ways—both inside and outside the four walls of the factory—and reconfigure it to adjust as existing priorities change or new ones emerge.[12] In fact, one of the most important features of the smart factory—agility—also presents manufacturers with multiple options to leverage digital and physical technologies depending on their specific needs.

The specific impacts of the smart factory on manufacturing processes will likely be different for each organization. Deloitte has identified a set of ad-vanced technologies that typically facilitate the flows of information and movement between the physical and digital worlds.[13] These technologies power the digital supply network and, by extension, the smart factory—creating new opportunities to digitize production processes. Table 1 depicts a series of core smart factory production processes along with a series of sample opportunities for digitization enabled by various digital and physical technologies.

Table 1. Processes within a smart factory

Process	Sample digitization opportunities
Manufacturing operations	• **Additive manufacturing** to produce rapid prototypes or low-volume spare parts • **Advanced planning and scheduling** using real-time production and inventory data to minimize waste and cycle time • **Cognitive bots and autonomous robots** to effectively execute routine processes at minimal cost with high accuracy • **Digital twin** to digitize an operation and move beyond automation and integration to predictive analyses
Warehouse operations	• **Augmented reality** to assist personnel with pick-and-place tasks • **Autonomous robots** to execute warehouse operations
Inventory tracking	• **Sensors** to track real-time movements and locations of raw materials, work-inprogress and finished goods, and high-value tooling • **Analytics** to optimize inventory on hand and automatically signal for replenishment
Quality	• In-line quality testing using **optical-based analytics** • **Real-time equipment monitoring** to predict potential quality issues
Maintenance	• **Augmented reality** to assist maintenance personnel in maintaining and repairingequipment • **Sensors** on equipment to drive predictive and cognitive maintenance analytics
Environmental, health, and safety	• **Sensors** to geofence dangerous equipment from operating in close proximity to personnel • **Sensors** on personnel to monitor environmental conditions, lack of movement, or other potential threats

Source: Deloitte Analysis; Deloitte University Press | dupress.deloitte.com

[10] Chris Coleman et al., Making maintenance smarter: Predictive maintenance and the digital supply network, Deloitte University Press, May 9, 2017, https://dupress.deloitte.com/dup-us-en/focus/industry-4-0/using-predictive-technologies-for-asset-maintenance.html
[11] Aaron Parrott and Lane Warshaw, Industry 4.0 and the digital twin: Manufacturing meets its match, Deloitte University Press, May 12, 2017, https://dupress.deloitte.com/dup-us-en/focus/industry-4-0/using-predictive-technologies-for-asset-maintenance.html
[12] H. A. El Maraghy, "Flexible and reconfigurable manufacturing systems paradigms," International Journal of Flexible Manufacturing Systems 17, no. 4 (2005): pp. 261–276.
[13] For further information and a more complete list of digital and physical technologies and their applications, see Sniderman, Mahto, and Cotteleer, Industry and manufacturing ecosystems; and Mussomeli, Laaper, and Gish, The rise of the digital supply network.

It is important to note that these opportunities are not mutually exclusive. Organizations can—and likely will—pursue multiple digitization opportunities within each production process. They may also phase capabilities in and out as needed, in keeping with the flexible and reconfigurable nature of the smart factory.

It is important for manufacturers to understand how they intend to compete and align their digitization and smart factory investments accordingly. For example, some manufacturers could decide to compete via speed, quality, and cost, and may invest in smart factory capabilities to bring new products (and product changes) to market faster, increase quality, and reduce per-unit costs. Others may choose to focus on "lot size of one" product customization and fulfillment models, and invest in other technologies to fulfil those goals.

Making the transition to the smart factory: Areas for consideration

JUST as there is no single smart factory configuration, there is likely no single path to successfully achieving a smart factory solution. Every smart factory could look different due to variations in line layouts, products, automation equipment, and other factors. However, at the same time, for all the potential differences across the facilities themselves, the components needed to enable a successful smart factory are largely universal, and each one is important: data, technology, process, people, and security. Manufacturers can consider which to prioritize for investment based on their own specific objectives.

Data and algorithms

Data is the lifeblood of the smart factory. Through the power of algorithmic analyses, data drives all processes, detects operational errors, provides user feedback, and, when gathered in enough scale and scope, can be used to predict operational and asset inefficiencies or fluctuations in sourcing and de-mand.[14] Data can take many forms and serve many purposes within the smart factory environment, such as discrete information about environmental conditions including humidity, temperature, or contaminants. How data is combined and processed, and the resulting actions, is what makes it valuable.[15] To power the smart factory, manufacturers should have the means to create and collect ongoing streams of data, manage and store the massive loads of information generated, and analyze and act upon them in varied, potentially sophisticated ways.

In order to move to higher levels of smart factory maturity, the data sets collected will likely expand over time to capture more and more processes. For example, implementing a single use case might require the capture and analysis of a single data set. Implementing further use cases or scaling an op-eration to an industrial level will typically require expanding the capture and analysis of greater and different data sets and types (structured vs. unstruc-tured), leading to considerations around analytical, storage, and management capabilities.[16]

[14] Jay Lee, Edzel Lapira, and Hung-an Kao, "Recent advances and trends in predictive manufacturing systems in big data environment," Manufacturing Letters 1, no. 1 (2013): pp. 38–41.
[15] Michael Raynor and Mark Cotteleer, "The more things change: Value creation, value capture, and the Internet of Things," Deloitte Review 17, Deloitte University Press, July 27, 2015, https://dupress.deloitte.com/dup-us-en/deloitte-review/issue-17/value-creation-value-capture-internet-of-things.html.
[16] Shen Yin and Okyay Kaynak, "Big data for modern industry: Challenges and trends," Proceedings of the IEEE 103, no. 2 (2015).

Data might also represent a digital twin, a feature of an especially sophisticated smart factory configuration. At a high level, a digital twin provides a digital representation of the past and current behavior of an object or process. The digital twin requires cumulative, real-world data measurements across an array of dimensions, including production, envi-ronmental, and product performance. The powerful processing capabilities of the digital twin may uncover insights on product or system performance that could suggest design and process changes in the physical world.[17]

Technology

For a smart factory to function, assets—defined as plant equipment such as material handling systems, tooling, pumps, and valves—should be able to communicate with each other and with a central control system. These types of control systems can take the form of a manufacturing execution system or a digital supply network stack. The latter is an integrated, layered hub that functions as a single point of entry for data from across the smart factory and the broader digital supply network, aggregating and combining information to drive decisions.[18] However, organizations will need to consider other technologies as well, including transaction and enterprise resource planning systems, IoT and analytics platforms, and requirements for edge processing and cloud storage, among others. This could require implementing the various digital and physical technologies inherent in Industry 4.0—including analytics, additive manufacturing, robotics, high-performance computing, AI and cognitive technologies, advanced materials, and augmented reality—to con-nect assets and facilities, make sense of data, and digitize business operations.[19]

People

A smart factory does not necessarily translate into a "dark" factory. People are expected to still be key to operations. However, the smart factory can cause profound changes in the operations and IT/OT organizations, resulting in a realignment of roles to support new processes and capabilities.[20] As mentioned earlier, some roles may no longer be necessary as they may be replaced by robotics (physical and logical), process automation, and AI. Other roles might be augmented with new capabilities such as virtual/ augmented reality and data visualization. New, unfamiliar roles will likely emerge. Managing changes to people and processes will require an agile, adaptive change management plan.[21] Organizational change management could play an important role in the adoption of any smart factory solution. The successful smart factory journey will require a motivated workforce that embraces the greater impact of their roles, innovative recruiting approaches, and an emphasis on cross-functional roles.[22]

[17] Parrott and Warshaw, Industry 4.0 and the digital twin.
[18] Mussomeli, Laaper, and Gish, The rise of the digital supply network.
[19] For further information about digital and physical technologies, and their role in manufacturing and the digital supply network, see Sniderman, Mahto, and Cotteleer, Industry and manufacturing ecosystems; and Mussomeli, Laaper, and Gish, The rise of the digital supply network.
[20] CRO Forum, The smart factory—Risk management perspectives, December 2015, https://www.thecroforum.org/ wp-content/uploads/2016/01/CROF-ERI-2015-The-Smart-Factory1-1.pdf.
[21] Jeff Schwartz et al., "The future of work: The augmented workforce," 2017 Global Human Capital Trends, Deloitte University Press, February 28, 2017, https://dupress.deloitte.com/dup-us-en/focus/human-capital-trends/2017/ future-workforce-changing-nature-of-work.html.
[22] Bill Pelster et al., "Careers and learning: Real time, all the time," 2017 Global Human Capital Trends, Deloitte

Consumers & Internet of Things -Reimagining Consumer Relationships in the era of smart, connected products and digital services[23]

In order to transform their relationship with consumers, consumer product businesses increasingly recognize the need to create value for their customers beyond the standard product. The Joseph Pine framework on economic value (figure 3[24]) explains it in a simple way. Companies that seek to differentiate themselves, tap into consumer needs and through that realize premium pricing, will need to create meaningful services and authentic experiences.

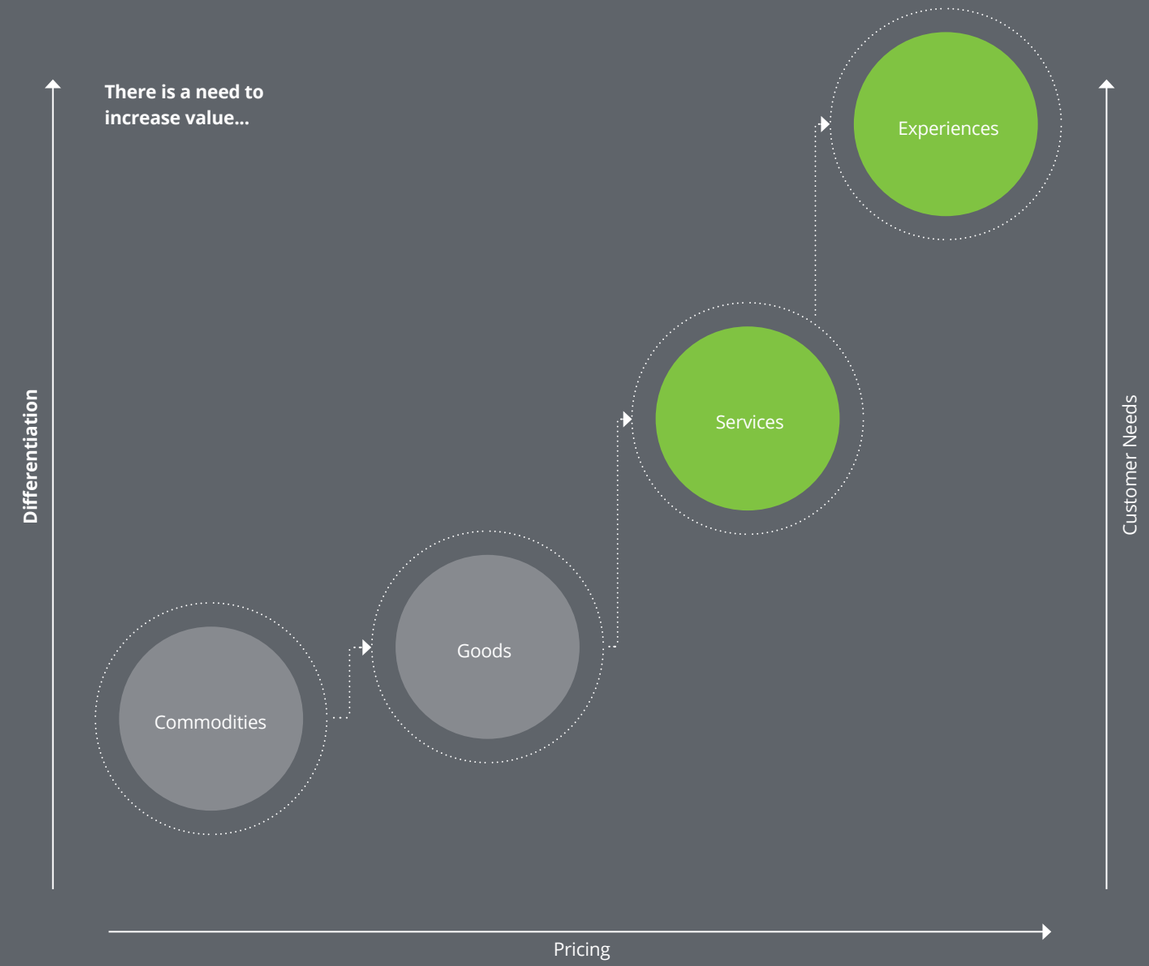
Fundamentally, IoT enables the collection of data from "things" to provide information in real time that can be meaningful to consumers. There are broadly three types of digital services and experiences that can be offered to consumer through IoT enabled connected products.

01. Convenience – notifications and alerts.
Connected products can offer efficiency and convenience for consumers by simplifying routine tasks within the patterns of daily life. Sensors and intelligent software will allow products to get to know consumer preferences, anticipate needs and respond dynamically to behavior. Simple examples of these services include communicating expiry dates or notifications when the product is running low. These could be basic notifications to your phone when your product reaches a certain minimum content limit or more sophisticated notifications triggered when you are near the product in a supermarket aisle that suggest a repurchase based on historical demand/usage. There are also products that experiment with using external data such as the weather or real-time measurement of humidity to prompt users to reapply moisturizers or creams.

[23] This section has been derived from Connected products -restoring brand value and reimagining consumer relationships part of Deloitte series on Industry 4.0
[24] The Progression of Economic Value - Welcome to the Experience Economy, B. Joseph Pine II, James H. Gilmore, Harvard Business Review, From the July – August 1998 Issue

Harnessing the power of Internet of Things to transform Industry in India

Figure 3- The Joseph Pine framework on economic value



02. Brand and product information– transparency and traceability.
Today's consumers want access to relevant information in a clear, comprehensive, and understandable way to make informed choices. The traceability and transparency generated through IoT technologies combined with connected packaging provides brands with the opportunity to meet this demand by delivering a wealth of multimedia content to consumers in a quick and easy way.

Connected products can give consumers access to additional information about the product or brand, the product's provenance, carbon footprint or to check if a product meets the ethical standards they demand. The ability to provide transparency across the value chain is becoming critical to build or regain trust.

03. Real time insights – personal advice.
Infusing products with smart capabilities can enable companies to adapt to the growing consumer trend toward purchasing personalized services and experiences rather than products.

One of the most impactful ways for a manufacturer to shape the consumer experience is by providing relevant advice that enlightens and educates consumers, and enables new ways for them to interact with the brand. We are already seeing organizations utilize connectivity, fueled by IoT technology, to communicate advice and real-time feedback within products.

IoT in products
Technology research firm Gartner[25] predicts that the number of connected products in existence (excluding smartphones and computers) will increase from five billion today to 21 billion by 2020.

The prediction of such a sharp increase in just three years indicates that the proliferation of IoT will be rapid. IoT has seen uptake in the business world –think smart supply chains– but for consumer products the hype hasn't quite translated into reality just yet. The innovations that will drive IoT technology forward and begin to weave it into our everyday lives are those that evoke the "care factor" by demonstrating real value to the consumer. The challenge is clear – how can brands capitalize on the opportunities promised by IoT in a way that matters to consumers?

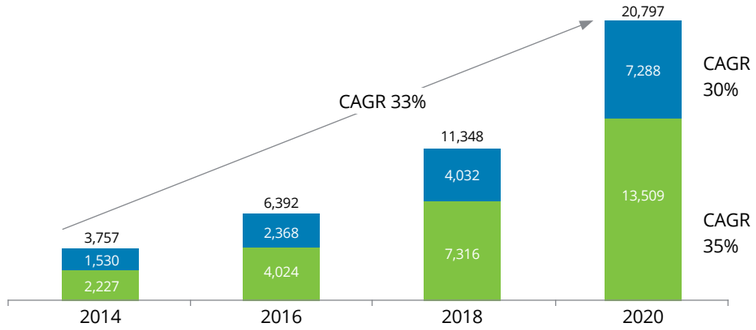
[25] Gartner - http://www.gartner.com/newsroom/id/3598917

Key Global and India Market Trends in IoT

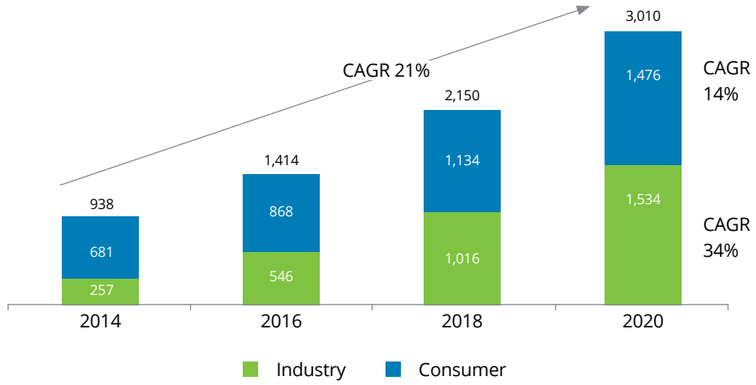
IoT is poised for exponential growth globally, with the number of connected devices expected to grow 5.5X to 20.8 billion and revenue expected to grow over 3X to $3 trillion by 2020.

Global IoT revenue is expected to grow from $0.9 trillion in 2014 to $3 trillion in 2020. Similarly, the installed base of IoT units worldwide is expected to grow from 3.8 billion in 2014 to 20.8 billion by 2020.

IoT installed base by category (million units), 2014 – 2020



IoT revenue by category (USD billion), 2014 – 2020



Source: Deloitte Analysis, Gartner and other Industry reports

IoT applications are likely to help optimize, innovate and transform consumer products as well as business processes:

- Optimization: IoT helps reduce costs by efficient product usage while increasing efficient use of assets across business processes
- Innovation: IoT applications help create differentiated products/services and improved operations, eventually leading to better customer service
- Transformation: IoT is blurring industry boundaries by enabling disruptive business models. For example, telematics involves both automotive and insurance industries

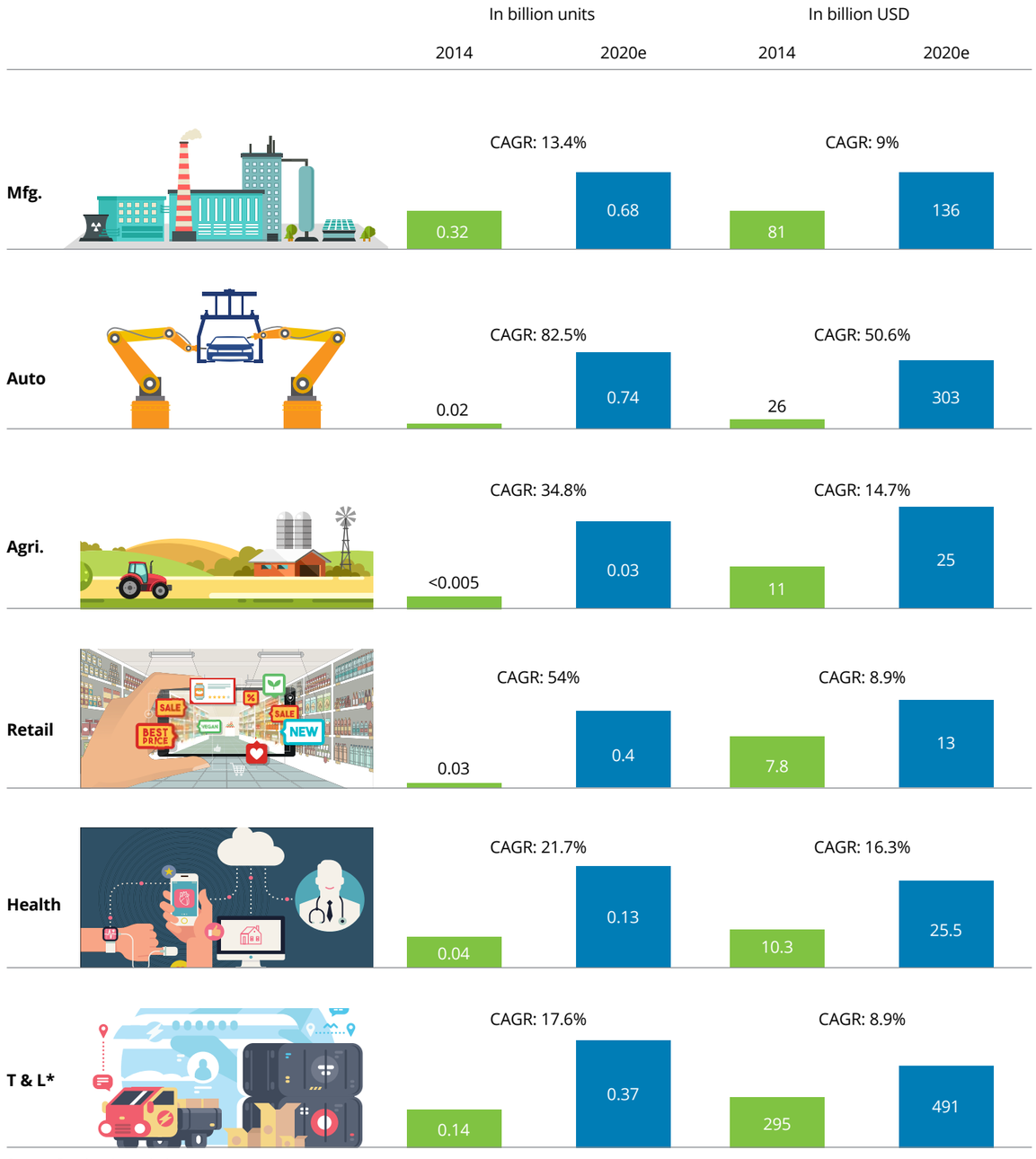
IoT is expected to add value to business processes and take value creation for industrial applications to the next level, specifically in the case of Manufacturing.

- IoT is perhaps the most crucial element of Industry 4.0, which refers to the digital transformation of the processes and systems in the Manufacturing sector
- Various connected technologies such as high-quality sensors, more reliable and powerful networks, high-performance computing, robotics, artificial intelligence and cognitive technologies, and augmented reality are changing manufacturing in profound ways

IoT market growth will be driven primarily by connected units in Manufacturing and Automotive industries, with Transportation & Logistics forming the largest share of industry-specific IoT revenue.

- While Manufacturing units are expected to grow over 2X from 0.32 billion in 2014 to 0.68 billion in 2020, the installed base for Automotive industry will grow 37X from 0.02 billion in 2014 to 0.74 billion in 2020
- In terms of revenue, automotive industry is expected to see maximum growth to reach $303 billion by 2020. On the other hand, Transportation & Logistics is expected to drive industry specific IoT revenue and will reach $491 billion by 2020

IoT Volumes and Revenues by industry



Source: Deloitte Analysis, Industry reports

Note: Manufacturing units include those from Natural Resources too, Retail units include those from Wholesale Trade, *T & L = Transportation & Logistics All numbers above include only industry specific units and not consumer units. However, units and revenue for Automotive are across industries

Brief snapshot of some of the IoT use cases/applications across industries is illustrated below:

Industry	Players	IoT Applications/ Case studies
Manufacturing	Stanley Black& Decker	RFID tags with WiFi infrastructure being used to get more visibility to track real-time line productivity
	Airbus	Smart tools being used to perform manufacturing processes such as drilling, measuring, tightening, etc. leading to improvement in production efficiency, by regular monitoring of results
	RioTinto	Sensors and GPS receivers being used on dump trucks to reduce variability of pre-set routes
	Sysmex	Remote monitoring of medical equipment to reduce downtime
	Intel	Smart factories enabling visibility into production issues for an integrated view, thereby increasing efficiency and utilization of equipment
	GE	Sensors installed on engines to reduce downtime via predictive maintenance
Automotive	BMW	Connected cars to integrate vehicle-related services
	Michelin	Tires-as-a-service offering to allow fleet managers to pay for tires on a kilometer-driven basis, thus saving costs
	Daimler	Software installed in truck fleet to send alerts and guide drivers to local dealers stocked with replacement parts
	Mahindra REVA	Secure M2M cellular connectivity to check battery, remotely control air-conditioning, lock or unlock, etc.
	Generali Insurance	Usage-Based Insurance (UBI) for automobiles based on M2M cellular connectivity
	Tesla	Autonomous driving systems based on IoT along with Cloud technology to build driverless cars
Agriculture	Semios	Sensors to monitor insects and pests and schedule release of pesticides
	John Deere	Sensors installed on farm equipment to assist farmers to manage fleet of tractors
	Clean Grow	Carbon nanotube sensors to monitor level of nutrients in crops, assisting farmers to assess the maturity of produce
	Topcon	Connected equipment with GPS, monitoring and electronic controls to help farmers
	OpenIoT	Remote sensors to help farmers monitor vitals such as humidity, air, temperature, soil, etc.
	Observant	Geo-fencing of livestock, along with irrigation scheduling and pump control
Retail	Lord & Taylor	Beacons to push notifications to consumers about a coupon or sale
	Disney	RFID tags to provide access to a variety of services, and track them later
	Amazon	WiFi enabled Amazon Dash Button for consumables to flag low volumes
	Rebeccaminkoff	Re-inventing trial rooms with virtual and smart mirrors, thus helping consumers in making a choice
	Target	Target corporation leverages beacons to make hyperlocal content accessible to shoppers
	Ralph Lauren	Polo shirts that monitor and show heart rate and calories burned if worn during work-outs
Healthcare	Pfizer	Solutions to conduct IoT enabled clinical trials in order to evaluate specific outcomes
	Diabetes Care	Sim-enabled glucometers to monitor and analyze diabetic patients
	Neuro Sky	Mobile devices with sensors to remotely monitor patients with chronic illnesses
	Proteus	Wearable sensor patches to give insights on health patterns, medication effectiveness, etc.
	mimobaby	Sensors placed around the elderly and vulnerable to give information about activity patterns, change in behavior, etc.
	Misfit	Wearable devices to track activities such as walking, biking, etc.
Transport and Logistics	DHL	Sensors to detect whether mailboxes are empty to optimize collection during last-mile delivery
	Port of Hamburg	Aggregated data of ships using sensors, GPS to collect information on traffic, possible congestion and parking spaces
	Schiphol Amsterdam Airport	RFID tags to monitor all baggage carts and ground motorized equipment
	JJ Food Service	Sensors to monitor different temperature bands and quality of the food being delivered
	Purfresh	Sensors to check on the condition of grocery and other consumables supplied
	FedEx	Tracking devices to keep tabs on temperature, location, condition of packages

Source: Deloitte analysis, Deloitte Insights

Harnessing the power of Internet of Things to transform Industry in India

India is a rapidly growing hub for IoT solutions with market value expected| to be $9 billion, and an installed unit base of 1.9 billion by 2020.[26]

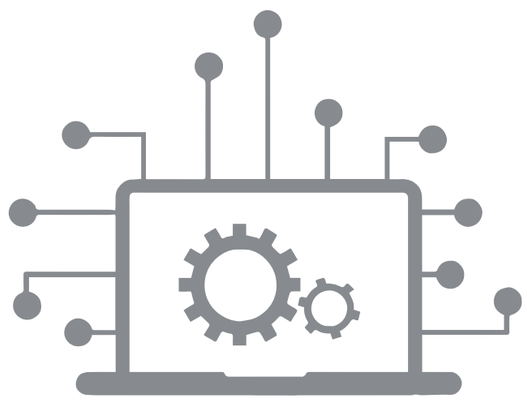
- Although India began its IoT journey much later than developed economies, the installed base of connected units is expected to grow at a rate much faster than them. IoT units in India are expected to see a rapid growth of ~32X to reach 1.9 billion units by 2020, from its current base of 60 million. As a result, India IoT market is expected to grow ~7X to move from $1.3 billion in 2016 to $9 billion by 2020[27]
- Rise of the tech-savvy consumer along with increasing smartphone and mobile internet penetration is driving consumer IoT applications in the Indian market. However, consumer IoT adoption is expected to be slower than its industrial counterpart due to cost of IoT devices and security as well as privacy concerns of consumers

The Indian IoT ecosystem has a diverse set of players including Hardware Vendors, Application Vendors, Network Operators and System Integrators; 60-65% of these players are start-ups.

- IoT presents opportunities for players across the value chain, with Application Vendors expected to garner 50% share of the India IoT market[28]
- Application vendors are focusing on both vertical and horizontal solutions including Consumer and Industrial IoT. In addition to catering to a large segment of consumers, they are looking to offer customized solutions for niche consumer groups
- Hardware vendors are increasing investments in R&D to develop and expand their product portfolio in IoT and enhancing market share through acquisitions
- Telecom firms are increasing investments in networks such as SigFox to increase connectivity revenues
- System integrators are investing heavily in their IoT consultancy and implementation services while focusing on building digital capabilities and solutions for IoT by acquiring niche companies and platforms
- Start-ups offering innovative solutions, are playing a significant role in driving the growth of IoT in India

IoT adoption in India is expected to grow across industries

- By 2020, industries such as Utilities, Manufacturing, Automotive and Transportation & Logistics are expected to see highest adoption levels in India. Government of India's planned investment worth $1 billion for 100 Smart Cities, over the next 5 years[29], is expected to be a key enabler for IoT adoption across these industries
- Industries such as Healthcare, Retail and Agriculture are also expected to make significant progress in IoT adoption



[26] Deloitte –NASSCOM report on Internet of Things, November 2017
[27] Deloitte –NASSCOM report on Internet of Things, November 2017
[28] Deloitte –NASSCOM report on Internet of Things, November 2017
[29] Make in India, Website accessed on 13 March 2018, http://www.makeinindia.com/article/-/v/internet-of-things

Key Technologies Enabling IoT

Technology	Definition	Examples
Sensors	A device that generates an electronic signal from a physical condition or event	Small, robust, and inexpensive sensors create information from conditions in the surroundings
Networks	A mechanism for communicating an electronic signal	Wireless networks with ubiquitous coverage such as cellular connectivity, WiFi, or LPWA networks
Standards	Commonly accepted prohibitions or prescriptions for process framework	Technical standards enable processing of data and also interoperability among different devices
Augmented Intelligence	Analytical tools that improve the ability to describe, predict, and exploit relationships among phenomena	Databases with unstructured information are searched and analyzed for corrective future actions
Augmented Behavior	Technologies and techniques that improve compliance with prescribed action	Several machine-to-machine interfaces remove fallible human intervention

Source: Deloitte Analysis, Industry reports

Key Challenges Impeding IoT Growth and Adoption

Despite the presence of numerous enablers, various challenges are currently impeding global IoT growth:

Source: Deloitte Analysis, Industry reports

Where is the win-win?

Fundamentally, IoT enables the collection of data across the product lifecycle and enables companies to stay more connected, leading to two-way and real-time communication with consumers. Importantly, this brings an opportunity to translate data to create value for both consumers and businesses – the win-win.

Connected products enabled by IoT have the potential to profoundly change the relationship between consumers, the product and the brand. For brands there are five key areas of value to be gained from successful connected offerings:

01. Influencing at the point of purchase – IoT technologies are likely to enable companies to strengthen engagement and retention across the shopper journey. For consumer products companies, the potential to influence shoppers "in the moment" through the provision of information, services and experiences in line with their brand values will be critical in the fight for attention.
02. Precision Marketing- The IoT enabled connected products are likely to allow companies to tailor the interactions offered to different audiences, and providing rewards and offers on an individual basis in the moment (for example, receiving offers whilst walking near the product in the supermarket aisle). By leveraging real-time data, brands will be able to drive precision marketing designed for their individual consumers and informed by their behavior.
03. Targeted innovation – The advent of IoT within everyday products are likely to allow for an unprecedented wealth of granular usage data to be collected. Brands will be able to collect information about how consumers are using their products and expanding the traditional view of consumer from the point of purchase all the way through to the point of consumption. This data can then be transformed into insights, delivered when and where it's needed to drive innovation, inform better strategic and operational decisions and in many cases, to gain competitive advantage.
04. Reconnecting on shared values – There is significant opportunity for brands to reposition and align with shifting consumer values of wellness and sustainability in an authentic manner. For example, the ability to quickly and effectively share brand narratives about social impact and human sustainability with consumers through connected packaging can enable a business to change its brand perception and reconnect on shared values.
05. Unlocking the end-to-end value chain – This is the Holy Grail when all parties along the value chain share data and connect. IoT devices and sensors create a digital identity enabling physical products to be identified, communicated with and tracked - giving insights into parts of their physical operations that haven't been measurable in the past. Transparency of the full end-to-end value chain is an area which is currently in the early stages of development, and has yet to be commercialized.

Getting started: Taking steps toward the smart factory & smart products

As IoT develops, brands should be looking to employ connected devices to develop service driven relationships with consumers, deliver personalized engagement and conversation and provide clear and comprehensive information on products. The benefits for brands are profound - transparency allows businesses to restore trust, meaningful engagement helps build loyalty and information about product usage and needs of the consumer will enable precision marketing and informed product innovations and improvements.

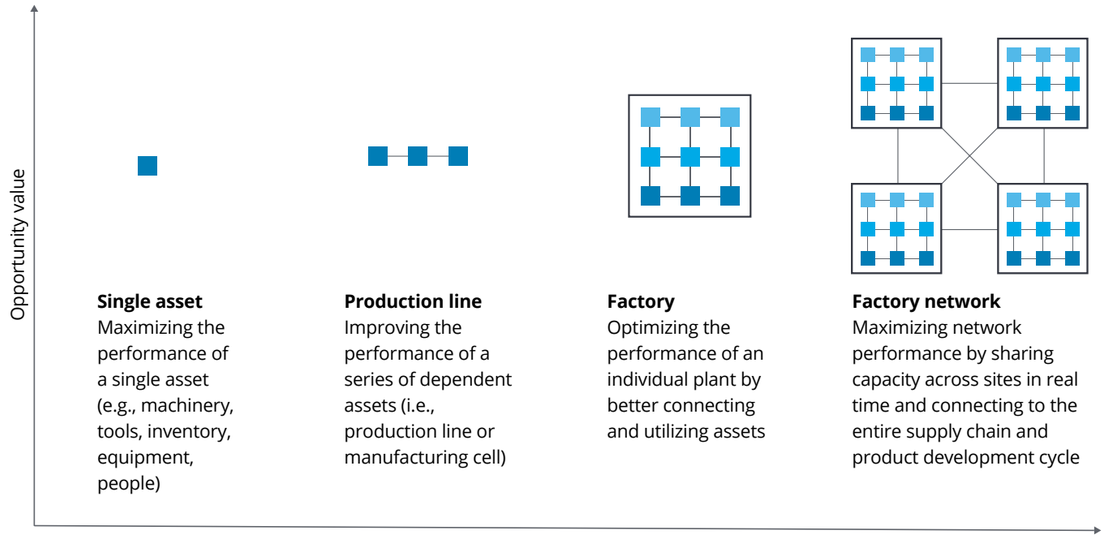
The development of connected products is slowly starting to emerge on the agenda of consumer product executives and is likely to rapidly gather pace as technology and consumer expectations evolve. The opportunity is now and India is ideally placed to capitalize on it - we have some of the highest smartphone penetration in the world, enabling people to interact with digital products and services with ease. In addition, the availability and falling costs of technology mean a connected ecosystem is emerging with which we can deliver these experiences. If IoT is going to grow as fast as is projected, the industry will need to act now to develop a value proposition in line with the following considerations:

Think big, start small, and scale fast

Smart factory investments often start with a focus on specific opportunities. Once identified, digitization and insight generation fuel actions that can drive new value. Building and scaling the smart factory, however, can be as agile and flexible as the concept itself. Manufacturers can get started down the path to a true smart factory at any level of their network—value creation can begin with and scale from a single asset, and use an agile approach to iterate and grow.

In fact, it can be more effective to start small, test out concepts in a manageable environment, and then scale once lessons have been learned. Once a "win" is achieved, the solution can scale to additional assets, production lines, and factories, thus creating a potentially exponential value creation opportunity (figure 4).

Figure 4



Exponential value can be unlocked for manufacturers by implementing a complete smart factory or network of smart factories across the enterprise

Source: Deloitte Analysis; Deloitte University Press | dupress.deloitte.com

Don't just begin and end with the technologies

The smart factory journey requires more than just a set of connected assets. Manufacturers would need a way to store, manage, make sense of, and act upon the data gathered. Moreover, companies would need the right talent to drive the journey and the right processes in place. Each smart factory journey would require transformation support across solution design, technology, and change management dimensions.

Human-centric design – Interaction must be quick and easy. If the effort of interaction begins to outweigh the perceived benefit, this will serve as a strong barrier to engagement. The process must be as intuitive as possible – for instance, near field communication is easy and frictionless, as consumers are only required to hold their mobile phones near to a product's packaging to be presented with all of the information and services available for that product, compared to quick response codes which require more user input and initiation. In addition to making the interaction easy the service need to be valued and focused on the moments and attributes that matter to consumers (the care factor). Consumer research and co-design of the product and service proposition is therefore essential.

Authenticity is key – The challenge for businesses is to find the right value proposition for the brand and make sure the IoT enabled connected product can enhance the offering and add value. Companies will need to consider how the brand's values, mission, vision, and character inform the consumer experience. Propositions should be authentic and tie directly back to brand values, and faithfully express brand personality. Building trust is crucial to a brand, therefore IoT interactions should be authentic and consistently demonstrate to a customer what a brand considers to be important and worthwhile. Without consistent interactions, customers won't know what to expect and will question authenticity.

Data privacy and cyber security – As networks of connected devices are integrated and additional data becomes more accessible, new security and privacy concerns are likely to arise. Consumers are increasingly data savvy and understand IoT devices can transfer data to places they may not know about. Consumers care when misuse of information directly affects them – resulting in lost trust and potentially negative press. Consumer expectations will need to be considered and, where appropriate, organizations should notify them upfront about when and where their data will be used if they are to build and maintain trust from the first interaction.

Another critical point to consider is cyber security. Interconnected devices are vulnerable to attack because they lack fundamental security safeguards, and breaches could pose risks to individuals and companies alike. However, the benefits of embracing the growth of IoT outweigh the risks as long as a company treads carefully and methodically. Organizations will have to determine what information is appropriate for IoT, and how they can ensure solutions are secure, vigilant, and resilient.

Think outside the four walls

As mentioned earlier, the smart factory solution is a holistic solution, joining what happens within the four walls with what happens across the entire digital supply network. Therefore, in order to achieve a truly successful outcome, any organization embarking on the smart factory journey should consider the full array of supply chain partners and customers from the start. Actions in one node, or for one stakeholder, can impact the others.

Far from being an "end state," the smart factory is an evolving solution—one that taps into multiple features such as agility, connectedness, and trans-parency. At a high level, the dynamic nature of the smart factory speaks to an unending call for creative thinking: imagining the possibilities of the nearly endless configurations that a smart factory solution makes plausible. Investing in a smart factory capability can enable manufacturers to differentiate themselves and function more effectively and efficiently in an ever-more complex and rapidly shifting ecosystem.

Harnessing the power of Internet of Things to transform Industry in India

Acknowledgement

Deepak Sidha
Deputy Director
deepak.sidha@cii.in
9810307114

Contacts

Vanessa Matthijssen
Partner
Consumer Products Leader
Deloitte Touche Tohmatsu
Tel:+61 404 371 235
E-mail: vmatthijssen@deloitte.com.au

Marty Hartigan
Principal
Strategy and Operations
Deloitte Consulting LLP
Tel: +1 213 688 5578
E-mail: mhartigan@deloitte.com

Adam Mussomeli
Principal
Supply Chain and Manufacturing Operations
Deloitte Consulting LLP
Tel: +1 203 253 5101
E-mail: amussomeli@deloitte.com

Shree Parthasarathy
Partner
National Leader, India
Deloitte Touche Tohmatsu India LLP
Phone +91 124 679 2000
E-mail:sparthasarathy@deloitte.com

Rakesh Barik
Partner
Technology Leader, India
Deloitte Touche Tohmatsu India LLP
Phone +91 124 679 2000
E-mail:rakeshbarik@deloitte.com

Rajeev Singh
Partner
Automotive Sector Leader, India
Deloitte Touche Tohmatsu India LLP
Phone +91 124 679 2000
E-mail:rpsingh@deloitte.com

Neeraj Arora
Partner
Deloitte Touche Tohmatsu India LLP
Phone +91 124 679 2000
E-mail:neerajarora@deloitte.com

Confederation of Indian Industry

Deloitte.