BEST PRACTICES

Innovative Use Cases for the Adoption of Internet of Things in India Manufacturing

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IDC MANUFACTURING INSIGHTS OPINION

"Product innovation" continues to be a high business priority among manufacturing enterprises in India. Innovators are actively seeking new functionalities and business models in today's competitive world. The Internet of Things or IoT is emerging as one of the key tools in this journey.

IoT extends the sphere of innovation beyond designing better performing or cost-effective products to creating "connected assets" that enable new value propositions throughout the useful life of a product — from its manufacturing to shipment, to the customer's location, and to its intended performance in the field. This IDC Manufacturing Insights report is a result of our detailed study and analysis on how IoT is being adopted by manufacturing companies as a tool for innovation in the manufacturing processes, on the shop floor, within the supply chains, and for products and services. The report covers major use cases for IoT implementation and challenges faced in each of them, some case studies, and what more needs to be done keeping future requirements in perspective.

The following are the three broad categories of IoT implementation in manufacturing:

- **Smart manufacturing** — for continuous monitoring of critical assets, equipment, process, and product parameters within the factory using sensors with wired networks or WiFi
- **Connected products** — for products giving continuous feedback about their location and performance after they are put into service in the field by using telemetry for remote monitoring
- **Connected supply chain —** for keeping track of inbound and outbound shipments for location-related information and critical in-transit parameters such as temperature

IoT has reached a level of maturity in which the major challenge in its adoption is not the cost involved or the ROI, but the infrastructure constraints and scalability. IoT is becoming an affordable technology due to the investments and efforts of multiple players in the ecosystem. As all the stakeholders in the ecosystem continue to improve their offerings, this challenge will be overcome, bringing out a more impactful and wide reaching applications of IoT in the journey of product innovation. It will no longer be a buzzword but a viable technology option available for implementation if planned properly.

The identification of innovative use cases that make significant business impact becomes important in such a situation. These use cases should be sustainable from cost and scalability perspectives and for which customers see value and are willing to pay either directly by including it in the price of the product or by means of an ongoing service contract. The identification of such use cases will be as important as the implementation itself.

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This IDC Manufacturing Insights report is a continuation of the earlier report *Best Practices: Adoption of Machine to Machine in India Manufacturing* (November 2014, IDC #IN246166). This latest study, just like the previous report, offers a detailed analysis of recent developments in IoT, and how manufacturing companies are leveraging it to stay innovative. IoT, which is one of the technologies IDC terms as "Innovation Accelerators," allows organizations to leverage their latest investments in the 3rd Platform (mobility, cloud, Big Data/analytics, and social) along with their existing IT portfolio, and realize much more value matching their business requirements. IoT is maturing beyond just machine-to-machine (M2M) communication, which enables seamless communication between machines.

SITUATION OVERVIEW

Figure 1 shows the waves of evolution of information technology from the 1st Platform (legacy systems and mainframes) to the 2nd Platform (client-server based architectures), to the 3rd Platform (mobility, cloud, Big Data/analytics, and social business) and what IDC defines as "Innovation Accelerators" — IoT, robotics, 3D printing, natural interfaces, cognitive computing for self-healing systems, and security technologies.

The 3rd Platform offers better customer engagement; speed of deployment of applications; and better performance, innovation, resiliency, and reliability of IT operations. Enterprises have implemented technologies in the 3rd Platform and their mash-ups with traditional IT systems. In IoT, companies have tried proof-of-concepts (POCs) for focused areas as well as integrated applications. The challenge is not in implementing specific pieces, but in defining meaningful and impactful use cases and rolling out an end-to-end, sustainable, economically attractive and scalable applications.

Industry Overview

IoT is a key component of innovation accelerators and it cannot be ignored in the journey of innovation today. IDC defines *IoT* as a network of networks of uniquely identifiable end points (or things) that communicate without human interaction using IP connectivity — be it locally or globally. It is not an individual technology that can be implemented in isolation but it is an integral part of an "innovation platform" tying together multiple IT systems and teams within and sometimes outside an organization.

Innovation platform is a portfolio of multivendor, loosely coupled, but seamlessly integrated IT applications that bring together multiple functions and departments in a collaborative environment for the design, development, and management of new products throughout their life cycle. IoT provides real-time and reliable digital feedback on a product performance, in a structured manner, to get closer to customers and understand their actual usage. This helps in product enhancement and design of new versions matching customer requirements, making IoT a vital piece in the innovation platform. The integration of multiple IT applications by enabling seamless flow of information between them and handling the amount of data continues to be a challenge for enterprises, and IoT adds one more source of data generation that should be integrated with appropriate IT systems for timely generation of valuable insights and their translation into meaningful actionable items.

Technology Overview

IDC expects technology and services revenue from IoT to expand from US$2.3 trillion in 2014 to US$4.6 trillion by 2018 at a 19.0% compound annual growth rate (CAGR) globally, with discrete

manufacturing being one of the promising areas. IoT is the most adopted among the Innovation Accelerators in India followed by security. It is also a technology expected to gain significant growth in the next two years, with close to 67% of manufacturing companies across sectors expected to adopt it as per IDC Manufacturing Insights' recent study. Robotics will see most growth in adoption in the next 2 years. According to IDC's forecast, revenue from IoT technology and services for discrete and process manufacturing in India will grow from US$1.3 billion in 2014 to US$3.9 billion in 2020 at a CAGR of 20.1%.

Business Needs

The need for manufacturing companies to differentiate the products and the services they offer to customers is ever growing with the pace at which new technologies and products are rolled out.

- Automobile companies are evaluating or rolling out IoT for infotainment purposes for customers and remote vehicle management to keep track of vehicle performance. New Holland Fiat (India) launched the GPS and the GPRS technologies on its tractors under the name of "Sky Watch" in 2012, according to its media release. This technology will enable farmers to monitor and trace their tractors" health and performance for better control and maintenance, easy operations, and improved productivity. This launch can represent a new product-as-a-service business model. More than 30% of the tractor owners are projected to rent out their tractors. Besides their own usage, it is extremely important to know the hourly usage, performance parameters, and the maintenance when the tractor is rented out.
- Consumer-packaged-goods (CPG) companies are offering remote management of products such as air conditioners with mobile applications to make them "intelligent" products. Videocon recently launched WiFi enabled air-conditioners that can be controlled from anywhere through a smartphone application as part of the company's vision for connected homes. According to the press release, the device has an energy meter and uses the WiFi at home to keep track of power usage. The "away" mode tracks the user's location and accordingly switches off to conserve power.
- Companies across industries (pharmaceuticals; textiles; and process industries such as paint, oil, and gas) have already implemented remote asset management in shop floors for better yield and utilization management.

IoT helps organizations to differentiate themselves in 3 areas —

1. Productivity and efficiency in the factory to manufacture quality products at lower cost by means of proactive and predictive maintenance of the manufacturing equipment. IoT can be used to listen in real time to vital equipment and product parameters, spot specific patterns of these data that lead to specific failure modes, leading to proactive alerts before any unexpected event happens.
2. For competitive product differentiation by offering new functionalities bundled with software. Software is becoming an integral part of products from consumer goods to automobiles. IoT will be the technology to leverage this software and not keep the vital insights local to the equipment but to relay it remotely to a central command center for timely and meaningful insights and actionable items.
3. New business models such as a pay-according-to-use model, which were not possible before because of the lack of technology. IoT enables tamper-proof ways of taking a product to the market in which customers need not pay up front for the physical asset. Intermediaries such as rental companies can procure and maintain fleets of costly assets such as agriculture and

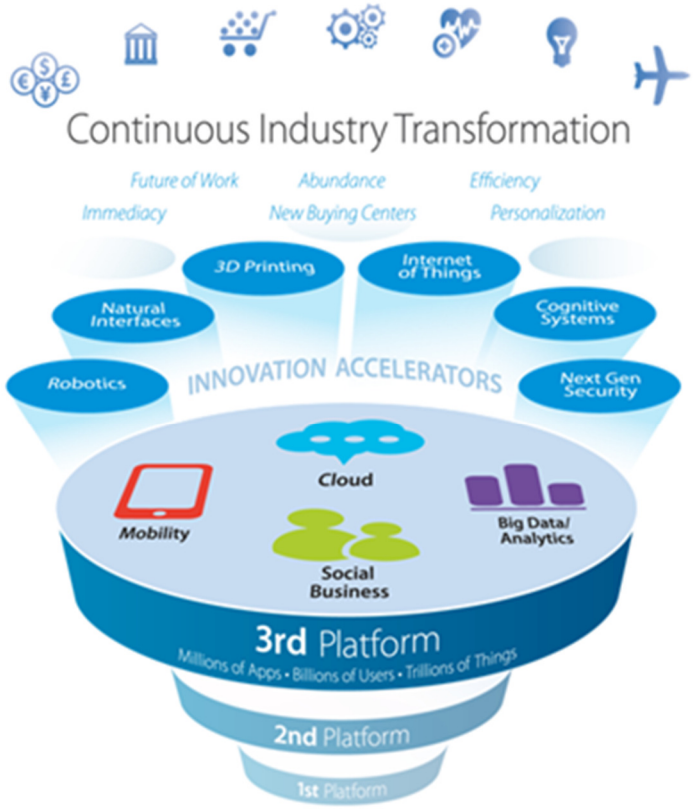
construction equipment, rent them to end consumers such as farmers, and charge them only on the basis of the actual usage.

Changing Dynamics of IoT

IDC's CIO Summit 2014 was used as a platform to check the changes in the IoT scenario in 2015. The same questions posed last year were answered by CIOs from a diverse background — automotive, CPG, chemical, energy, and services. Table 1 summarizes the key insights from the responses received in both studies. IoT is no longer just a buzzword. All the participants in the study were at some stage of evaluation or implementation.

FIGURE 1

IoT — One of the Innovation Accelerators



Source: IDC Manufacturing Insights, 2014

Areas of Application

As organizations become comfortable with IoT, there is a significant shift in focus from using it inside the enterprise for tracking manufacturing and process equipment to outside the enterprise by embedding IoT in products making them "connected," software-enabled, and intelligent. "Connected products" is the topmost option for 22% of respondents.

Table 1

Comparison of 2014 and 2015 CIO Perspectives

	Is IoT a buzzword?	Main Area of Application	Benefits of IoT
2014	Yes — (16%)	Internal — for asset management (42%)	Asset utilization (37%)
2015	No	External — connected products (22%)	New revenue streams (22%)

Source: IDC Manufacturing Insights, 2015

Remote monitoring of assets for better utilization, safety, and security monitoring and energy management are the three second highest priority areas of application with equal priority, for 19% of respondents in each category.

Business Benefits for Implementing IoT

This shift in area of focus from internal to external naturally changes the benefits expected out of IoT from a bottom-line focus for improving the utilization and eventually cost reduction to a top-line focus for improving revenue and to implement new revenue streams. The top rated benefit is "for implementing new revenue streams," by 22% of CIOs. Implementing new revenue streams by itself requires that a transformation should happen to the business and its model of working and cannot be just an incremental improvement on existing systems and processes.

Closely following this top priority are the other three benefits — revenue growth, productivity of assets, and productivity of employees. "Optimized operations" is another benefit for asset intensive industries in which the equipment need to talk to each other for an orchestrated operation balancing the load between each other.

Management Challenges

From a CIO's perspective, Figure 2 shows the challenges faced in IoT adoption, in a decreasing order of priority. Surprisingly, cost is not the topmost challenge at this stage of adoption due to the following reasons:

1. Awareness of IoT and what it can offer to the business and buy-in from multiple stakeholders in organizations from line-of-business (LOB) leaders to functional leaders across engineering,

maintenance, manufacturing, supply chain, and services leading to better funding for IoT programs.

2. Decreasing trend in hardware, software, and services cost as partners who offer this leverage the economies of scale as more enterprises adopt IoT.

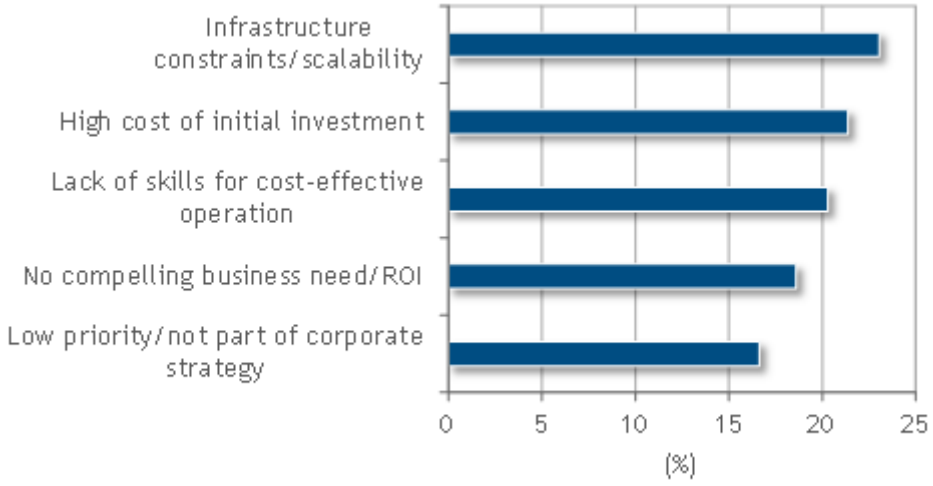
CIOs have already completed or are in the process of evaluating the up front and ongoing investments and realize that infrastructure constraints are the biggest challenge they see at this point. Infrastructure will be the biggest bottleneck as organizations move out of the pilot phase to scale up operations for larger fleets of assets. Skill sets will continue to be a challenge as the application of IoT becomes more innovative and entrenched with the business.

The lack of business case/ROI and fitment in the corporate strategy will become less of a challenge with the increasing awareness of IoT among LOB leadership in the days to come.

FIGURE 2

Challenges in implementing IoT

Q: What are the factors stopping the adoption of IoT in applicable areas?



n = 32

Source: IDC Manufacturing Insights, 2015

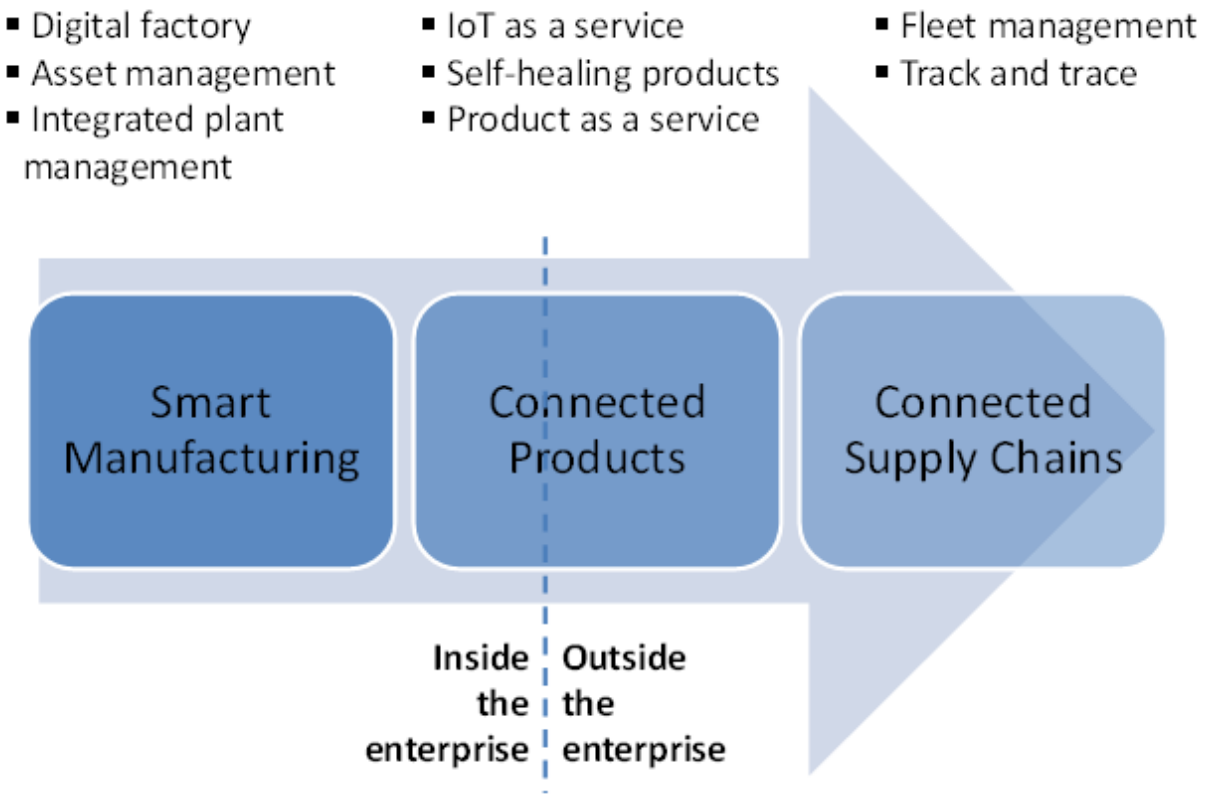
THE BEST PRACTICES

IDC Manufacturing Insights analyzes the application of IoT under three broad categories — 1) smart manufacturing for processes, 2) connected products for feedback from the customer's location, and 3) smart supply chain for inbound and outbound logistics. The following sections look at the next level of detail within these three areas with real-life examples, use cases implemented under each one, challenges faced; and analyze how these case studies have become successful implementations.

Figure 3 pictorially shows the three layers of IoT usage. Smart manufacturing for manufacturing and related equipment is the starting point given its relative use compared with connecting products outside. The scenarios that IoT can encounter inside the four walls of a factory are much more predictable and manageable. The sensors used for measuring vital parameters can be connected to the control center using wired connections or wireless communication. There is no requirement for a telemetry partner. Implementation teams can use this as starting point to have a successful IoT project and use the learnings to convince stakeholders for IoT outside the enterprise for products.

FIGURE 3

Layers of Use Cases for IoT in Manufacturing



Source: IDC Manufacturing Insights, 2015

Smart Manufacturing

IoT offers a closed loop mechanism to get real-time feedback from operations on the shop floor. This gives enterprises an opportunity to quickly check where the actual is compared with the plan, and take necessary action to keep the operations close to the necessary state based on market dynamics and unforeseen situations.

The feedback mechanism in IoT for assets including the products and the manufacturing equipment makes it a vital piece in the "Innovation Platform" explained before in this report. The data generated from IoT can be integrated with product life-cycle management (PLM), manufacturing execution system (MES), digital manufacturing, and other enterprise systems to give an accurate situation on where the enterprise is for manufacturing at any point.

Table 2

Smart Manufacturing — Challenges and Use Cases

Challenge #1
Interoperability challenges with a diverse set of equipment typically implemented in large enterprises, each with its own proprietary control system and data interchange standard
Use cases
Collect and analyze performance parameters of critical equipment leading to proactive monitoring and alerts (manufacturing output and the quality parameters of products, energy usage, vital health parameters of the equipment — wear and tear, tool and consumable usage, and unforeseen situations).

Source: IDC Manufacturing Insights, 2015

Connected Products

Enterprises design, manufacture, install, and service products with certain outcomes expected out of them benefitting the customer, with a set of controllable and independent input factors. Feedback of how a product is performing with details of the circumstances in which it is working is a vital piece of information that can help companies fine-tune the performance of their installed base and for future design of products and services. This is a key use case of IoT.

Mahindra Reva's electric car is an example of a connected product, in which the business has to save on repair shop investments drove the need to have the product performance monitored remotely. The implementation was documented in IDC Manufacturing Insights case study (IDC #IN246212).

Table 3

Connected Products — Challenges and Use cases

Challenge #2
High up front cost of hardware as a % of product cost and ongoing operating cost
IoT may not be affordable for all products, not just looking at the absolute cost of the equipment, but as a fraction of the product cost and who will pay for it (customer, OEM, IoT service providers). This is a challenge stopping adoption of IoT in several product categories and the situation keeps changing as hardware becomes affordable with each passing day.
Use cases

Table 3

Connected Products — Challenges and Use cases

Challenge #2
Collect and analyze detailed product performance parameters under specific operating conditions before the products are sold to customers as part of quality assurance/quality control (QA/QC) cycle for quality purposes
Collect and analyze specific product performance feedback during the actual performance at the customer location for aftermarket services and proactive maintenance
Collect health parameters for the quality inspection of devices to ensure their regular maintenance and calibration; and to maintain their history for audit readiness

Source: IDC Manufacturing Insights, 2015

Product as a Service

The high cost of capital required up front for complex products and the cost of ongoing operations/maintenance, including the skilled resources, force companies to adopt the "product as a service" model. In this paradigm, the assets need not be owned by the consumers. They need only the services offered and the payment is only for the actual usage of the product. Consumers can entered into a contract with OEMs leading to a better sharing of risks. IoT as a technology becomes an enabler for this model.

Table 4

Product as a Service — Challenges and Use Cases

Challenge #3
Implementation of a tamper-proof, fool-proof business model that ensures equal sharing of risk and reward for the equipment manufacturing company and the consumer using IoT.
Use cases
Collect and analyze actual usage of the product in a secure, fool-proof manner leading to a business model in which the user can be charged only for usage of the equipment.
Monitor the location of an asset and raise an alert when the location moves outside a defined area.

Source: IDC Manufacturing Insights, 2015

Case Study: JCB India

JCB India is a leader in earthmoving and construction equipment manufacturing in India with five manufacturing facilities.

Business need: In 2012, JCB launched the "LiveLink" IoT program for its customers to be in constant touch with their machine by sending out real-time data and keeping them informed all the time. The telematics-based technology helps the users to collect the vital parameters of machine performance and its location using sensors on three fronts:

1. Service — to collect important parameters for health monitoring and service alerts.
2. Operation — for monitoring equipment usage, status and health, fuel consumption, and idle time. This helps in implementing product-as-a-service business models with no revenue leakage.
3. Security — geo-fencing for marking the secure boundaries of operation and ongoing monitoring of location with alerts when the machine goes outside the defined boundary conditions.

Technology implemented: Per JCB design and architecture requirements, Wipro implemented IoT as an end-to-end application. JCB, Wipro, and the LiveLink Control Unit (LCU) manufacturer worked closely during the evolution of its design and all throughout its testing. Wipro also brought in partners such as Vodafone and Google for handling of communication and map services. Wipro deployed its own homegrown cloud-based platform built using open source technologies as the backbone for data capture, storage, and analysis in Wipro's datacenter. At the beginning of 2015, the platform handled 60,000 transactions per day for a fleet of 1,300 machines, with plans to add 2,000 new machines each month.

Benefits realized: From a customer perspective, the target for the IoT system was to ensure prompt service for all issues to be resolved within 72 hours of reporting. In the current business model, LiveLink is bundled as a value-added service along with the machine. Wipro has minimized the up-front capital investment for JCB and provided the services on a subscription model (per machine per month or PMPM). JCB and Wipro worked together to overcome challenges such as building and scaling up of the business case, achieving critical adoption rate in the market, establishing robust governance, and creating mechanisms for ongoing support and continuous improvement. The system is now gaining wide acceptance in the field and is expected to grow further. It will be further enhanced and deployed across more models and geographies soon.

Wipro, through its manufacturing and hi-tech business unit provided the end-to-end system integration services and managed services for this project.

Self-Healing Products

Products with two-way communication with the remote command center is another stage in the IoT journey. A farm of wind turbines is an example in which power generation can be optimized based on the demand for power at a particular hour of the day and the wind conditions, as implemented by Bharat Light & Power (IDC #IN246166).

IoT as a Service

Internet of Things is reaching levels of maturity in which it is not limited to product differentiation or aftermarket revenue streams. It can be a source of revenue by itself if offered as a plug & play service

for the installed base fleet. Manufacturing companies would not want to move out of their core area to implement the telemetry, storage, analytics, and alerts required for IoT products. Instead, they would prefer to partner with specialists in this area and consume the services offered on a pay-per-use model. Some OEMs that have the scale of operations with a diverse product portfolio such as General Electric offer IoT as a service.

Table 5

IoT as a Service — Challenges and Use Cases

Challenge #4
Ownership of data generated and security for the same to avoid wrong usage
Use cases
Offer as a plug & play service in which any asset conforming to the required standards can be connected to the service for ongoing monitoring of defined parameters

Source: IDC Manufacturing Insights, 2015

Connected Supply Chains

On time and accurate delivery of inbound and outbound products or parts into a factory and to the customer has become a critical factory in today's ecosystem. Omni-channel shopping experience in the retail and CPG industry have created new challenges for supply chains. Consumers can use any channel of communication (PCs, smart phones, digital stores, and brick & mortar shops) and request a delivery in any location (home, nearby store, or locker). Supply chains are gearing up to cater to such demanding models and IoT can be the supporting technology for ongoing monitoring of the location and other conditions of products and the shipment.

Table 6

Connected Supply Chains — Challenges and Use Cases

Challenge #5
Lack of good quality physical infrastructure and data connectivity leading to unpredictability in shipment delivery
Use cases
Ongoing monitoring of the location and status of a fleet of vehicles used for logistics
Dynamic route planning based on real-time location and logistic requirements

Source: IDC Manufacturing Insights, 2015

FUTURE OUTLOOK

IoT as one of the "Innovation Accelerators" has gained rapid adoption in the past 12 months. Manufacturing companies have realized the value it can offer beyond hype. Service providers from telecom players to system integrators, software providers, and hardware vendors have ramped up their plans to offer their value-add in the overall IoT value proposition. Partnerships between these players are being forged to leverage the solution for tech buyers and end users. IoT can become a core technology that manufacturing companies would want to develop in-house. It can lead to the creation of valuable intellectual property on the product, process, and technology sides, creating the need to have in-house teams for this developing area. IoT will be an area of focus across business leadership beyond IT.

ESSENTIAL GUIDANCE

Actions to Consider

Manufacturing organizations need to keep the following points as they evaluate and start the IoT journey and as it becomes part of the core product strategy:

- **Cost dynamics** for hardware, software, and services are ever changing in a dynamic market. Companies need to keep a close watch on this aspect. As the reach of IoT and its associated technologies keeps growing, what was once an out of reach price point can become feasible and profitable to adopt. With an ever-increasing scale of IoT adoption, the cost of hardware is on a downward trend. Software and platforms can also benefit from economies of scale and get affordable. Service cost can vary based on the level of expertise required and the domain.
- **Interoperability**. Procurement of hardware, software, control systems, and tools done in isolation without looking at the overall impact on the organization can lead to siloed deployments in which one system cannot talk to another. Implementation of IoT can be a catalyst to push organizations to centralize the choice of technology that ensures standards of interoperability and make it possible for systems and applications to talk to one another seamlessly.
- **Security** and ownership of data generated. IoT generates a vast amount of data. It will be important to decide at the beginning of the implementation on who owns the raw data and makes use of it in whatever fashion to draw insights out of it.
- **Physical security**. Sometimes, the cost of hardware required to implement IoT can become a security threat to the entire system if it is an expensive equipment. The product should be designed in such a way that it is secured when deployed on the field with necessary alarms and tracking systems in place if stolen or subjected to harsh weather conditions.
- **Scalability**. Most of the IoT applications implemented so far are smaller in scale for selected products, geographies, or services. When scaled up across the entire portfolio of products or across the country and even between countries, new unforeseen challenges can be thrown up due to the high volume of data and unforeseen situations.
- **Skill sets** to implement, manage, and consume. The skill sets needed for implementation and operation of IoT applications are not the usual IT skills required but vary across a wide spectrum from networking to Big Data to data interchanges standards knowing the assets and their nature of operation. This would need a multidisciplinary team to manage IoT, with outside partners in some areas beyond an enterprise's core area such as telemetry.

- **Required sound business model**. Even if the technology pieces fit together well to implement a well-orchestrated IoT setup, the need for an economically attractive business model will be a must to get funding and for effective operations post implementation. The model should be capable of self-sustaining from a funding perspective for the implementing organization and not be a drain on the CIO or other department budgets.
- **Complicated system with multiple moving parts**. IoT will need several subsystems — from the sensors on the assets to their connectivity to the local server, to the remote central command center, to the database where it is stored — which is the analytical engine and the last mile delivery model with technologies such as mobility. Any one of these pieces not working can make the IoT implementation ineffective needing root cause analysis to locate the problem and fix it. Fool proofing of the implementation needs to be well thought of. It is important to build reliability and redundancy into the system so that even if one part does not work, the whole system does not stop functioning.
- **Lack of good infrastructure.** By its nature, IoT will not stop within the enterprise but extend beyond its four wall to the remotest corner of a country where a product can be installed for performance. A robust implementation that can work in a scenario where the connectivity is poor becomes important. Data can be stored locally and transferred when the connectivity improves in such a scenario.
- **Defining a connected business model.** With multiple partners involved in implementing IoT, it becomes important to clearly outline the roles and responsibilities with well-defined metrics for each partner. Based on the motivation level of each partner, an economic model with incentives should be crafted to make the business model work in the long run.

LEARN MORE

Related Research

- Perspective: What Is the Impact of Connected Products on Product Innovation? (IDC #MI254962, March 2015)
- Perspective: The Internet of Things Gains Momentum in Manufacturing in 2015 (IDC #MI253743, January 2015)
- Best Practices: Adoption of Machine to Machine in India Manufacturing (IDC #IN246166, November 2014)
- Buyer Case Study: Mahindra Reva: M2M for Electric Vehicles (IDC #IN246212, August 2014)
- Worldwide Internet of Things Spending by Vertical Market 2014-2018 Forecast (IDC #249631, June 2014)

Synopsis

Product innovation, a top-ranking business priority today from boardrooms to the drawing boards, is not limited only to the design of new products in today's competitive environment. Innovation today does not stop with new and improved products, but can be extended across the entire life cycle of a product from the day it is conceptualized, designed, manufactured, installed, put into service, up to its end-of-life and safe disposal or remanufactured stage.

IoT is becoming a vital technology in this spectrum of innovation and has rapid adoption from multiple manufacturing organizations and service providers in India compared with other 3rd Platform technologies. "Innovative companies will realize the value of IoT and start including it in their technology and product road map. Companies that make it collaborative in nature, cutting across

departments, and embed it as part of the product and not a technology implemented on its own, will realize the value it offers better and faster," says Ramachandran S, principal research manager, IDC Manufacturing Insights. Process research and development groups can be a way of forming such collaborative groups that do not limit their research to products or technologies in isolation but also include process and organizational transformation that enterprises need to undergo in order to adopt IoT.

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