Internet of Things: An Indian context

Digital Consulting

August 2016

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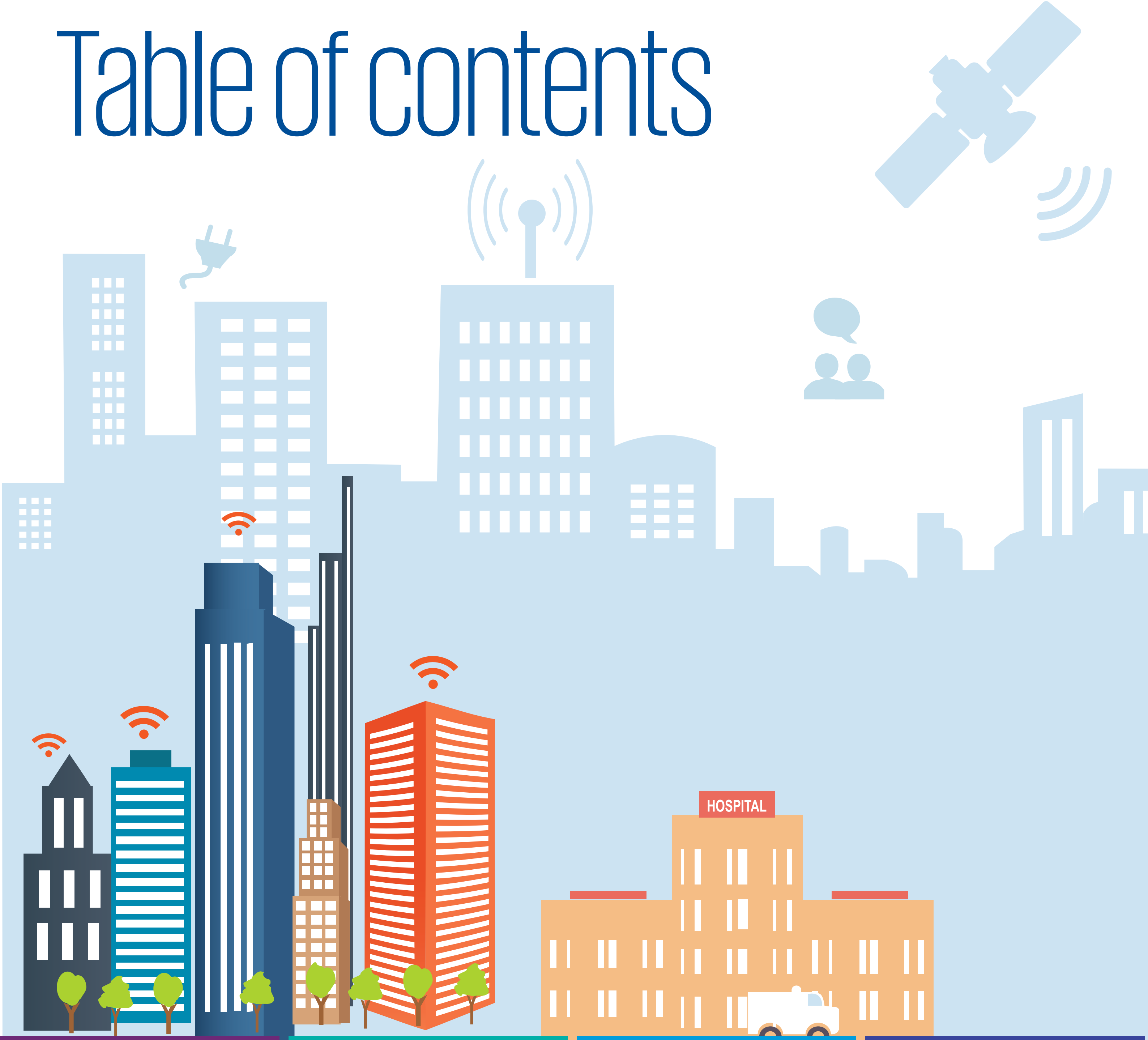
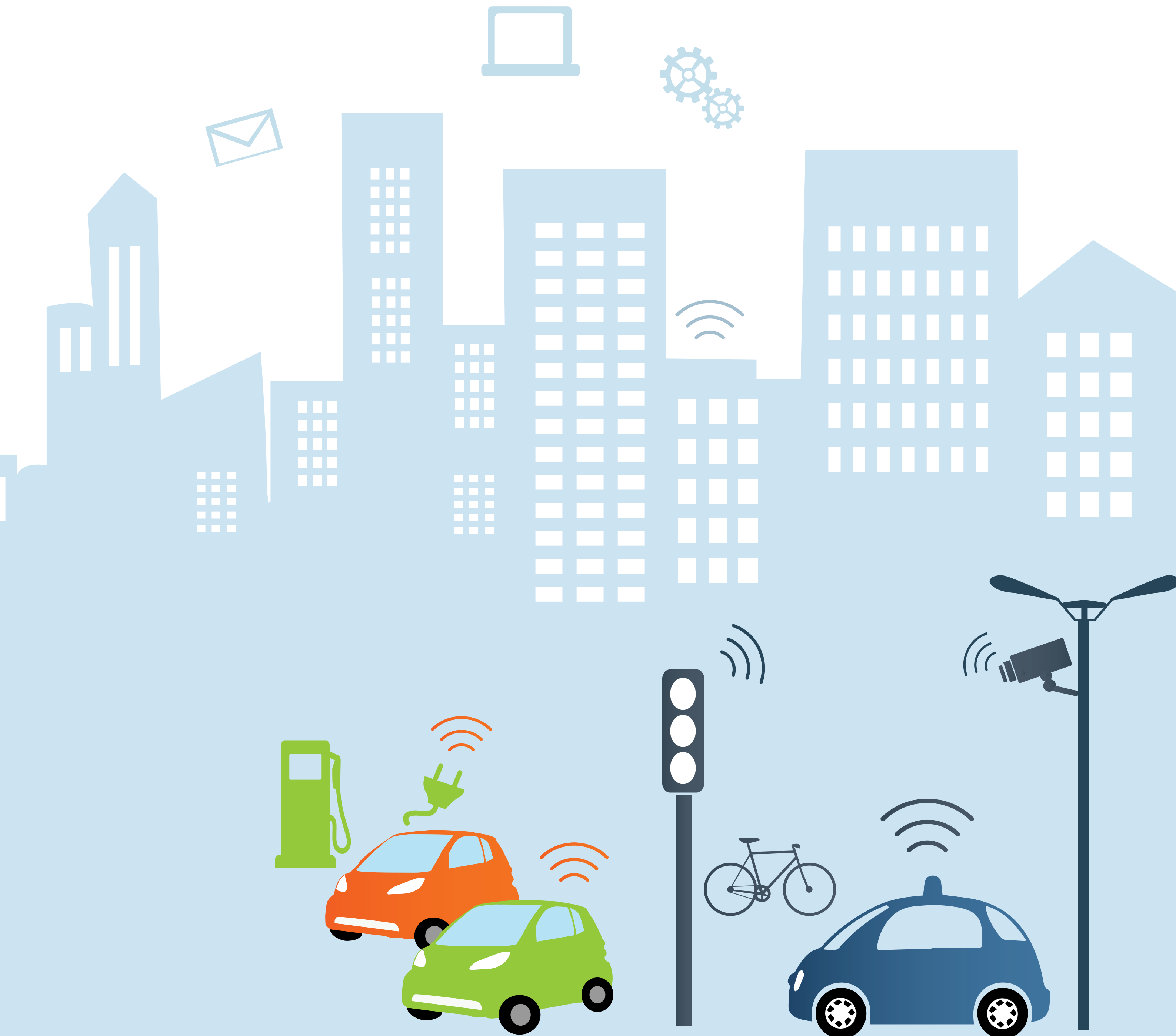
Table of contents

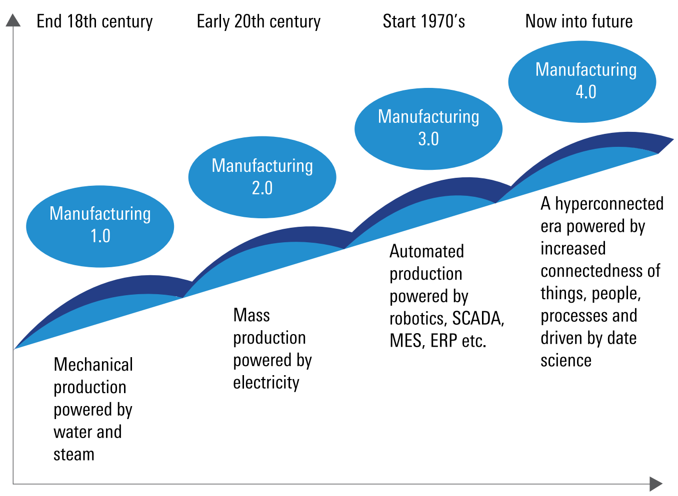




An industry in transition: Setting the context

New emerging technologies such as the Internet of Things (IoT), mobility, social, analytics, cloud, Robotic Process Automation (RPA), advanced robotics, autonomous or semi-autonomous systems, 3D printing, Artificial Intelligence (AI), advanced materials, etc. have ushered in a new era of innovation and change for the manufacturing industry. These technologies have created a new wave of digital revolution for the manufacturing industry, termed as Manufacturing 4.0. Business leaders (outside of the IT organisation) have started to evaluate the effect of these emerging technology trends on their business and operating models.

Exhibit 1 – Manufacturing 4.0 powered by emerging technology trends

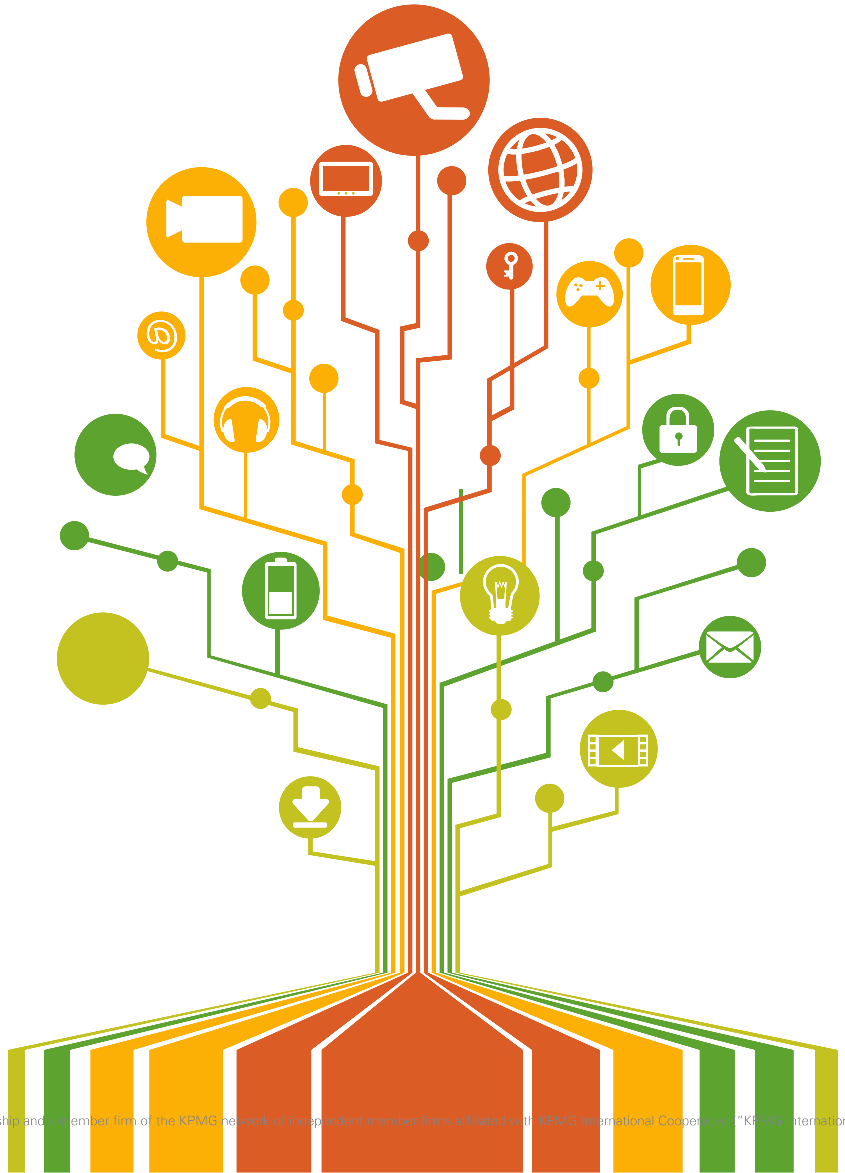


Source: H. Kagermann, W. Wahlster, and J. Helbig, "Deutschlands Zukunft als Produktionsstandort sichern. Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0. Abschlussbericht des Arbeitskreises Industrie 4.0.," acatech - Deutsche Akademie der Technikwissenschaften, DFKI und Deutsche Post, 2013

For a traditional manufacturing enterprise looking at innovating its business models or transforming its core operations, the importance of the internet in shaping its corporate strategy cannot be overlooked. Due to the emergence of IoT, the terms 'connected' and 'smart' are increasingly used for products, factories, supply chains, customers, suppliers and Research and Development (R&D). In a future which is expected to be a hyperconnected era of businesses powered by the increased connectivity between things, people, processes and is driven by data science, IoT could form an important pillar in the corporate growth strategy, especially for manufacturing enterprises looking at new sources of revenue or operations transformation. It also requires corporations to ponder over the following questions – What is IoT? What is powering this connected, smart new world? How will connected, smart products (for e.g. a car) disrupt existing industry business models as well as require a completely different operating model to design, produce and sell the product? What should a manufacturing enterprise potentially do to capture new opportunities or address the disruption caused by IoT?

This paper focusses on the Internet of Things (IoT) and strives to answer seven key questions surrounding it. The questions are as under:

1. What is IoT?
2. What is the business value of IoT?
3. What is the relevance of IoT to manufacturing?
4. What are the use cases for IoT in manufacturing?
5. How prepared are Indian enterprises which adopt as well as sell IoT?
6. How does an enterprise prepare itself for accelerating transformation through IoT adoption?
7. What is the role of the government and suppliers in accelerating IoT adoption in India?



Before we define IoT, it is important to understand the difference between the words internet and web, as these terms are often used interchangeably.

The internet is a global physical layer or a system of interconnected networks made up of switches, routers and other equipment whose primary function is to transfer information – in the form of data, voice and video – from one node to another in a reliable, quick and secure manner. The World Wide Web (WWW), is an application layer operating on top of the internet whose primary role is to provide an interface, making the information flow across the internet usable and productive.

The WWW is currently in its sixth phase of evolution. The first phase was a research phase when the web was used primarily for research purposes and called the Advanced Research Projects Agency Network (ARPANET). The second phase was when the web was used as a catalogue by companies to share information with regards to their products and services over the internet. The third phase was when the web moved away from static catalogue based information to enabling transactions in which companies could buy and sell products and services over the internet. This was the dot-com era where some of the top e-commerce companies emerged. The fourth phase of the web was one which was social and immersive, dominated by social networking. This phase was characterised by a proliferation of video traffic over the internet. The fifth phase of the web was the re-introduction of marketplaces, which were an extension of the third phase and this phase enabled the creation of new business models for e.g. marketplaces and exchanges like the top ecommerce organisations.

The sixth phase of the web today is shifting to smartphones, and leading to a rise of an entirely new class of applications on mobile devices such as mobile wallets, cab hailing, etc.

The Internet of Things: A definition

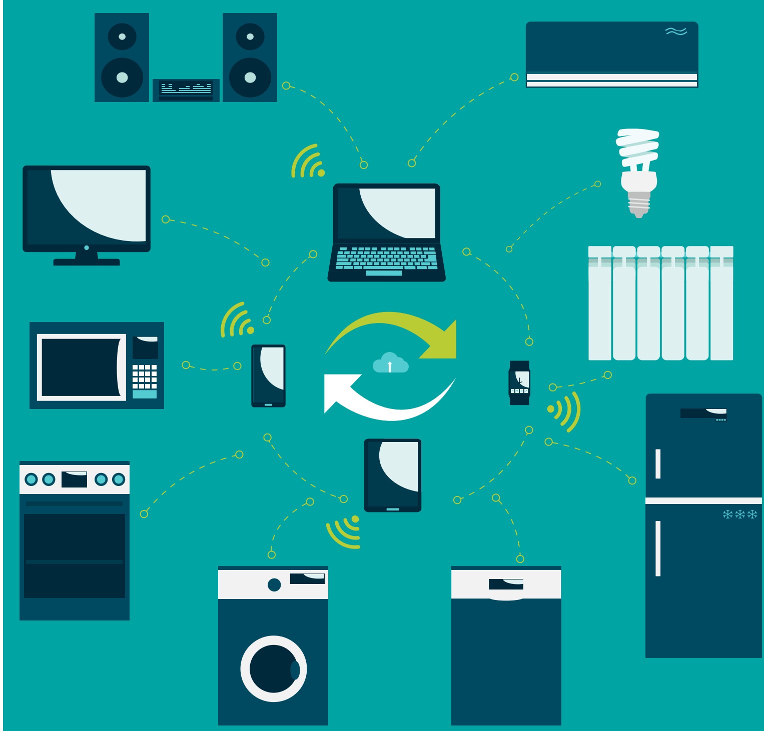
The internet on another hand has been on a steady development path and IoT is truly amongst the first few big evolutions of the internet. Three key developments in the internet are powering the transition of the manufacturing industry from a set of closed proprietary silo systems to a new open architecture, where intelligence is distributed and actions can be taken across the manufacturing ecosystem (involving a set of manufacturing plants), based on a standardised secure network and across interfaces –

Ubiquitous computing – intelligence in things at the edge i.e. fog computing

Ubiquitous use of Internet Protocol (IP) – convergence of proprietary protocols

Ubiquitous connectivity – radio (802.11n/a/g, ISA-100.11a, WirelessHART, LoRA, ZigBee, Starfish), cellular (GSM, CDMA, 4G, WiMAX) and fixed (industrial ethernet).

IoT is a leap into the future as it creates a potential for engineering a whole new set of business models that are sensory and predictive in nature. The internet is expected to become increasingly sensory due to IoT (e.g. sensing temperature, pressures, vibrations, moisture, stress, etc.) and increase its expanse by connecting previously unconnected devices to the internet. For example, connecting all the supplier machines and transportation vehicles via a shared IoT platform, an automotive Original Equipment Manufacturer (OEM) can create an entirely new model for inbound traceability of parts and components, leading to greater predictability within their inbound supply chain.

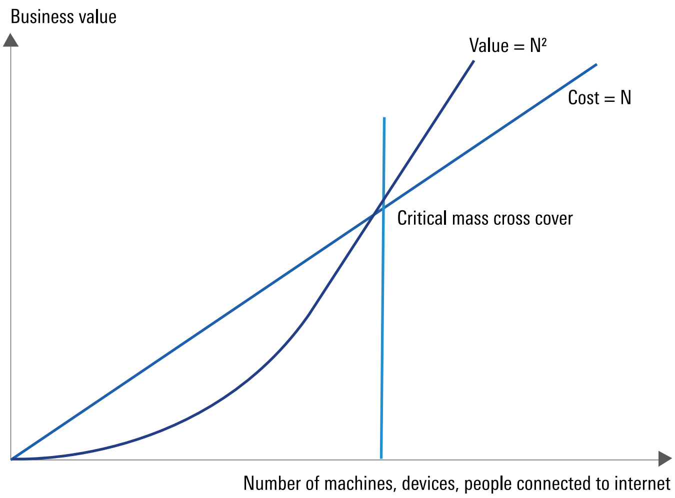


IoT and the business value of increased connectedness

By connecting more machines (systems beyond enterprise boundaries), objects (transportation vehicles) and people, a manufacturing enterprise can unlock new opportunities by leveraging data science to identify hidden trends or patterns. Eventually, this could lead to 'information automisation' creating new possibilities where machines can communicate with machines and people can collaborate between themselves in newer ways.

The business value for a manufacturing enterprise is typically directly proportional to the square number of connected machines, things and people to the system. Hence, in the context of manufacturing, the systemic value of the increased connectedness of things, people and data to the internet called 'information automisation' increases the intrinsic business value of the adoption of IoT.

Exhibit 2 – KPMG India's view on the business effect of information automisation as on July 2016



In order to understand the business value of IoT due to the increased number of devices and people connected to the internet, our research applies the concept in the context of a mining environment. At this stage, we introduce information automisation from the 'pit to a central mine command centre' (Case study 1). We then strive to extend the business value across a series of mines and introduce the concept of 'pit to boardroom.' (Case study 2).

Exhibit 3 – KPMG in India's analysis July2016 based on experience gained from conducting multiple client engagements

Connecting things

Mine machines (e.g. Linear Potentiometric Displacement Transducer (PDT), Load, Haul, Dump machine (LHD'S) and people (e.g. RFID on caplamps) connected to the internet within mine and with each other to provide real time onsights into mine operations (e.g. location of man-machine, equipment condition monitoring

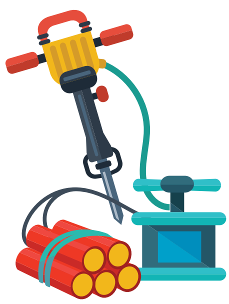
Data Science

The data from machine and mine operators is analysed to establish 'predictability' into the decision making process, business operations and creation of new operational models (e.g. integrated mine command and control centre)

Connectedness inside a mine

Transforming processes

Greater predictability and accuracy in processes by connecting the real time insights back to the devices, objects and people at the right time (e.g. short interval production control in mines)



Connecting people

Connecting data to people and people to people in building a more efficient workforce and transforming the underlying processes (e.g. asset maintenance, people safety)

Business value of hyper-connectivity

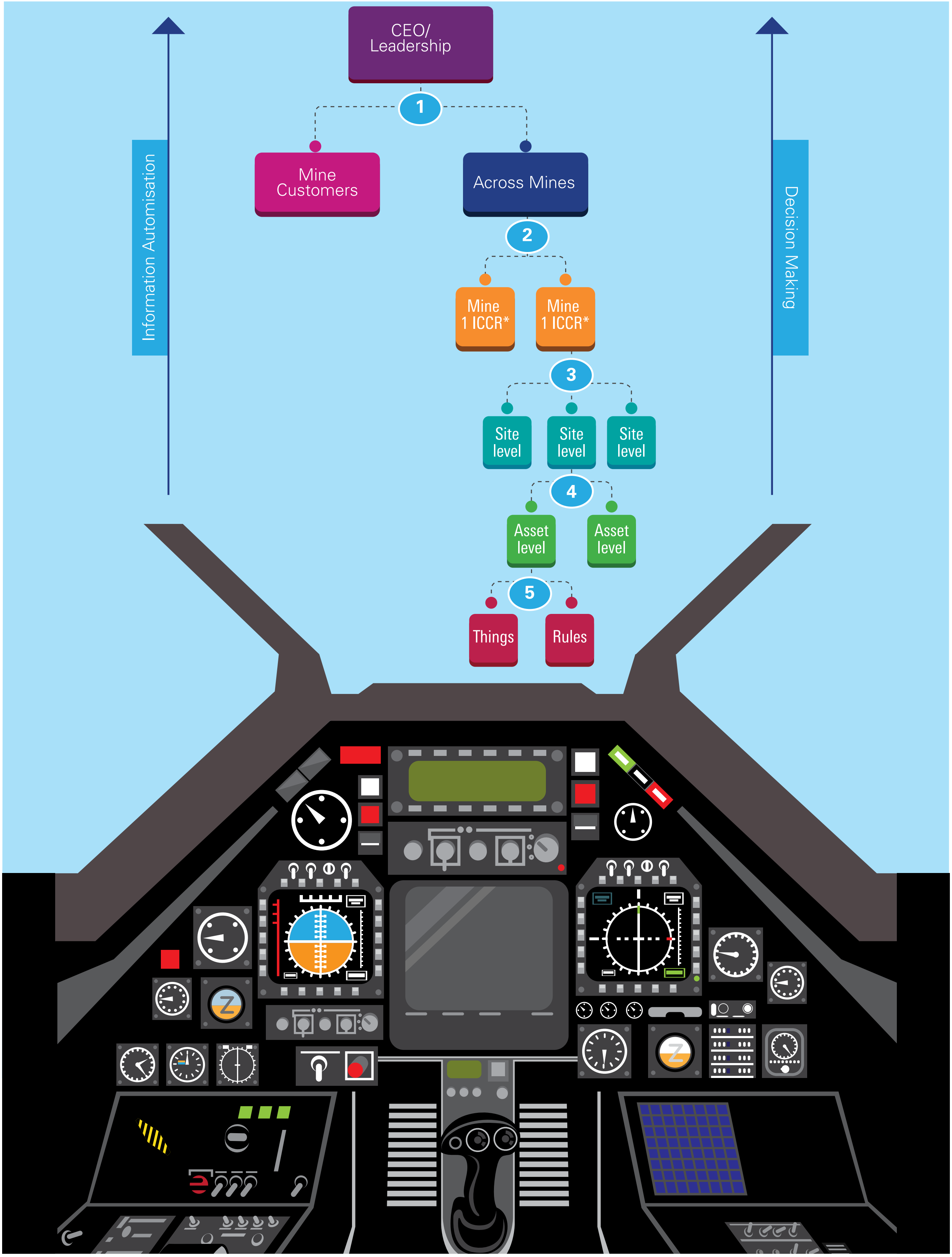
Case study 1: Illustration of hyperconnected operations in an underground mine

Hyperconnectivity i.e. connecting machines/things/people to the internet could result in corporations creating and executing distinctive and innovative models by leveraging new forms of digital engineering. This is enhanced due to real time connectedness of business resources across the value chain (people and machines) and the customers. For example, within an underground mine, increased connectivity of the mining equipment (low profile dump trucks, load haul dumper, drilling machines etc.) and objects on people (e.g. Radio-frequency identification (RFID) on cap lamps) to the internet and their interactions (machine to machine, machine to people and people to people) with each other provides real time insights (e.g. equipment's condition and location along with location of the mining staff) and enables faster decision-making (for e.g. man-machine allocation or maintenance). The data from things (for instance tyre pressure, fuel, equipment operating modes, etc.) is analysed to establish predictability into the planning and the decision making process across mine operations (such as enabling better servicing and allocation of mining equipment, etc.). Connecting the data to people and increased people to people connections leads to building a more efficient and safer mine workforce and transformation of the underlying processes (for e.g. asset maintenance, people safety, etc.). The greater predictability and accuracy in business processes by connecting real time decisions (e.g. integrated command and control mine control rooms) back to devices, objects and people inside the mine at the right time leads to transformation of business processes (for e.g. short interval production control, reliability centric maintenance operations, etc.). The business impact of IoT in a single mine can lead to more than 85 per cent predictability around equipment availability, increased efficiency and productivity of mine equipment (fuel costs, number of trips, load per trip, etc.). The increased safety and productivity of mine operators eventually impacts the ultimate Key Performance Indicators (KPI's) such as production increase and reduced cash cost per tonne.

Integrated value across the entire network

1. Smart things (e.g. autonomous trucks) within an underground mine (over 100 machines and 1000 employees with RFID on cap lamps) communicate data parameters (over 10 per equipment or a thing) leveraging same network technology as the internet i.e. internet protocols.
2. Near real time data from things (approximately 11,000 parameters collected per shift, about 33,000 per day) serves as a catalyst for better understanding of complex mining processes (e.g. maintenance, machine allocation, production control, safety, etc.) and allows for faster adaptation i.e. smart operations.
3. Smart things can be remotely controlled at a site level through an integrated mine command and control room, thereby increasing the overall mine efficiency i.e. smart mine operations e.g. improvement in asset availability and utilisation, better worker safety, energy efficiency, near real time production monitoring, etc.
4. Optimisation across a network of mines can lead to enterprise-wide benefits e.g. the value of equipment condition data across a network of mines (100 equipments in a single mine versus 100 x equipments across 'x' mines can significantly improve the equipment maintenance costs and maintenance practices through commercial contracting with OEMs and contractors).
5. By establishing a 'digital cockpit' (like a real time dashboard showing a visual representations of an organisations key KPIs) across a network of mines, at the CEO level-based on information automisation, can lead to the better mine planning, faster time to market, sustainability, customer relationship management and people safety.

Exhibit 4: KPMG in India's research and analysis, value of information automisation across a network of mines



There are six areas and an estimated 40 use cases for IoT in manufacturing. The relevance of these use cases for a manufacturing enterprise depends on a number of factors, which are addressed in a forthcoming section. The six high impact areas where IoT has high significance and can add value to a manufacturing enterprise are:

I. Connected products and new business models based on sensor enabled products

II. Innovative customer experiences

III. Smart intelligent assets and operations

IV. Smart supply chains

V. Health, safety and environmental compliances

VI. Integrated command and control operations.

Connected products and new business models based on sensor-enabled products

- New business models
- Utility models based on the usage or life of the product e.g. tyres, car sharing
- Shared models as against ownership e.g. heavy equipment, farm equipment
- Industrial level exchanges e.g. freight exchange, logistics exchange
- Outcome based e.g. heavy industrial equipment, healthcare
- Services e.g. healthcare for the elderly, cab hailing, port community services, etc.
- Remote healthcare and insurance services based on smart wearables
- Improved customer experience based on real time product data e.g. smart transportation, analytics based predictive maintenance services, tracking and tracing of shipments
- Refined product developments based on collection of real time product performance data e.g. sensors (skin sensors), smart cameras (facial recognition) or remote video to deepen customer insights and expand reach to new constituents.

Innovative customer experiences

- Real time, micro targeted, location and context aware customer offerings e.g. smart shopping, smart vending machines, etc.
- Omni-channel customer experience e.g. virtual automotive experience, smart ATMs, etc.
- Adaptive product decisions based on predictive analytics applied to customer behaviour e.g. provisioning Maintenance, Repair and Overhaul (MRO) for industrial equipment

Smart intelligent assets and operations

- Enterprise wide asset management e.g. asset tracking, real time condition monitoring, predictive asset maintenance, Overall Equipment Effectiveness (OEE), spares management.
- Energy efficiency improvement e.g. energy profiling, energy cost management
- Automatic process and operations event monitoring and alarm notifications e.g. across manufacturing operations (own and suppliers), quality management, equipment conditions, etc.
- Remote site asset condition monitoring and operations e.g. conveyors, cranes, sub-stations, pipelines, towers, etc.
- Mobile asset tracking e.g. vehicle movement, intelligent transportation movement, collision avoidance, etc.
- Predictive operations based on real time data e.g. system behaviour modelling and quality defect predictions.
- Flexible assembly lines to produce multiple products and options in response to customer demand.
- Integrated contractor and service provider platforms for MRO
- Smart capex e.g. sensing based digital twin creation of a sub-surface terrain in a manufacturing plant.

IoT use cases in manufacturing

Smart supply chains

- Automated inventory/spares tracking and traceability (barcode/RFID) throughout the supply chain
- Fleet monitoring and analytics to provide real-time visibility and intelligent allocation of all vehicles
- Autonomous systems (e.g. vehicles and robots) in warehouses
- Wearable technology (e.g. digital eyeglasses, data gloves, etc.) combined with beacons and sensors in warehouses
- Telematics in trucking fleets

Health, safety and environmental compliances

- Human resource safety (locate staff and contractors)
- Integrated emergency and event response communication (converge disparate communications, visual displays, monitoring and alarm systems)
- Distributed wireless environmental sensing (Fixed indoor/outdoor and mobile sensor network)
- Consolidated monitoring, reporting and alerting (Automated sensor analytics and visuals)
- Health, safety, environment predictive analysis (Trended and forecasted analytics).

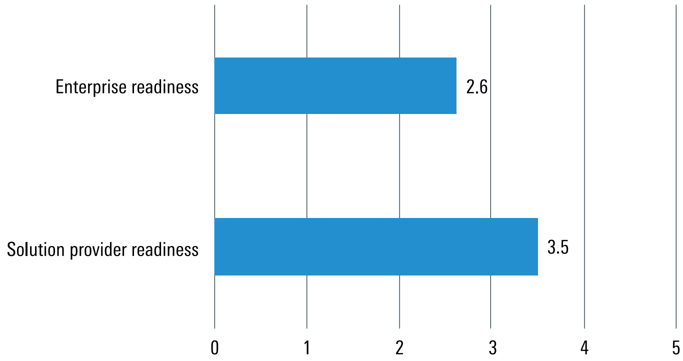
Integrated command and control operations

- Virtual expert and remote diagnostics
- Real time operations visibility anywhere and anytime
- Mobile/remote process and operations console.

Is India ready?

In a survey conducted by KPMG in India in October 2015, both, the Indian manufacturing enterprises who are to adopt IoT and the suppliers of IoT solutions are in the very early stages of their IoT journey (Exhibit 5).

Exhibit 5: Both the enterprise and IoT solution providers are in very early stages of IoT readiness



Source: KPMG in India, IoT Study, 2015

IoT enterprise readiness index

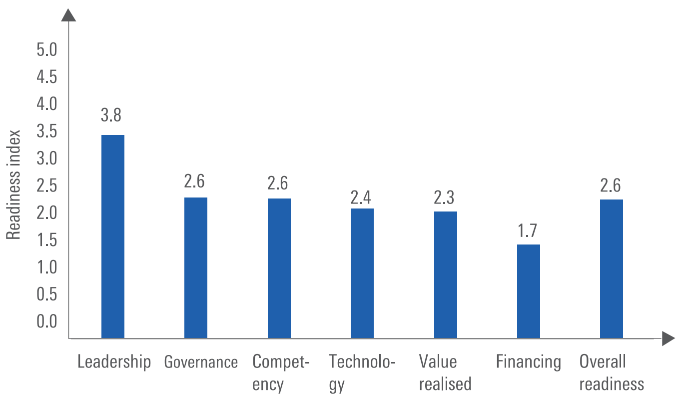
The starting point for a manufacturing enterprise in its IoT journey is to establish its maturity profile on six key dimensions.

1. Leadership: Alignment and sponsorship of the senior leadership team towards IoT and its business impact
2. Governance: Organisational design to provide direction and decision-making with regards to IoT programmes
3. Competency: The ability of the organisation to execute IoT projects and other emerging technology initiatives (e.g. social, mobility, analytics, cloud, robotics, etc.)

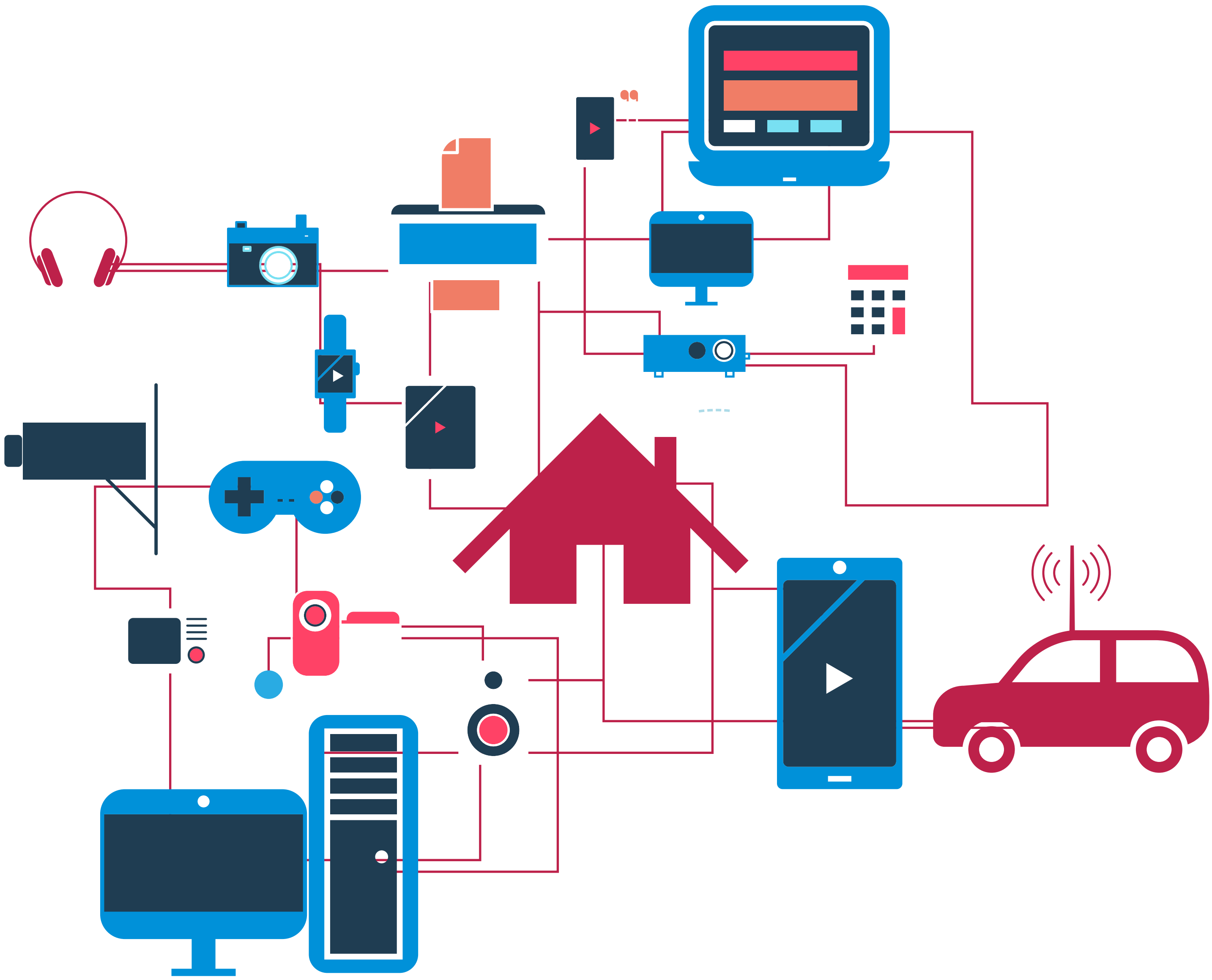
4. Technology: The ability and adaptability of an organisation to address three unique architectures i.e. information technology, operational technology and digital technology
5. Value realisation: Readiness in terms of identification of use cases and situations where the increased use of emerging technologies will drive business impact
6. Financing: Availability of financial capital to fund IoT implementations.

During our research, it has been observed that despite increasing interest from businesses and the IT leadership, the overall readiness of Indian manufacturing enterprises is low on their ability to define, govern, run, design and fund IoT implementations. (Exhibit 6)

Exhibit 6: Readiness index of Indian enterprises for IoT implementation



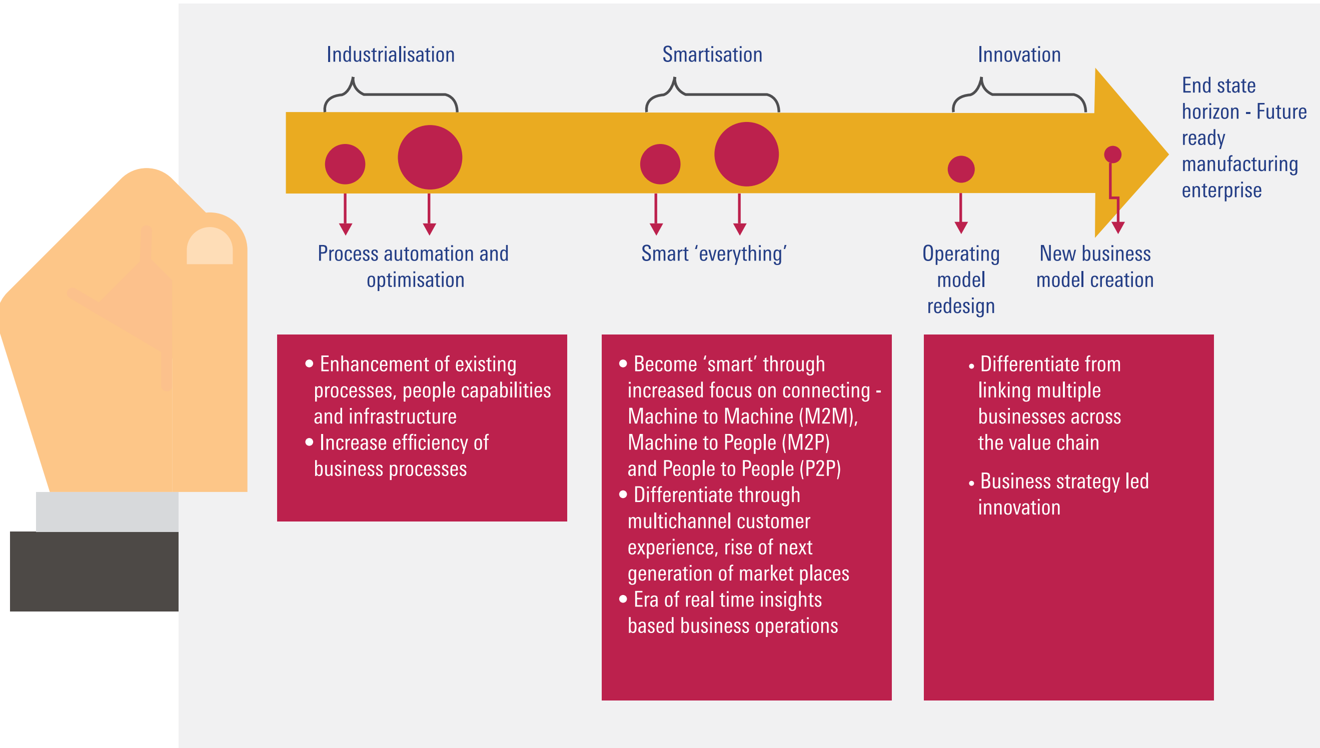
Source: KPMG in India, IoT Study, 2015



The IoT trend is here to stay and Indian manufacturing enterprises may have to embrace this at a different pace and in different ways. The compelling reasons to adopt IoT initially could be either external (peers or industry forces) or internal (need for greater efficiency). Over the longer term however, a compelling reason for IoT adoption is the need for gaining competitive advantage, compliance with environmental and regulatory norms and risk management.

The path to reaching IoT maturity is expected to more or less follow a similar trajectory; only the rate of adoption and the manner in which Indian manufacturing enterprises embrace IoT could vary. At this stage, we introduce a directional journey (Exhibit 7) that an enterprise may undertake to IoT maturity.

Exhibit 7 – KPMG in India's view on journey to IoT maturity



Source: KPMG in India, IoT Study, 2015

Indian enterprises are more likely to start with the industrialisation phase where the primary focus could be on increasing the efficiency of business processes. For example, asset intensive companies (industries, ports, mines, etc.) are more likely to adopt improvement programmes around enterprise assets (e.g. predictive maintenance), people (e.g. safety) and movement (e.g. supply chain). Consumer focussed companies (e.g. healthcare, consumer goods, automotive, etc.) are more likely to focus on improvement programmes around customers (e.g. omnichannel experience), plant operations (e.g. flexibility, predictive maintenance) and movement (e.g. supply chain).

Two common programmes in the industrialisation phase, across asset intensive and consumer focussed industries shall lay the foundations of the beginning of smartisation phase –

1. The role of data science driven improvements.
2. Establishing the right organisational design and enterprise architectures that embrace convergence of systems i.e. Operational Technology (OT), Information Technology (IT) and Digital Technology (DT).

In order to proactively shape the transition of Indian enterprises, both, the leadership at manufacturing enterprises and IoT solution providers should take decisive actions in embracing a programme based and an architecture centric approach.

Way forward for Indian manufacturing enterprises

Enterprises must set priorities and develop programmes that are aligned to solving critical business problems

These programmes require significant expenditure (capex and opex) and are a complex implementation exercise involving significant organisational change management and orchestrating a multivendor environment (OEMs, domain vendors, master system integrators, system integrators, technology OEMs, etc.).

Enterprises hence have to set their priorities which could be focussed on profits, sustainability, cash flows and workforce, as follows:

1. Take an end-to-end view of the value chain (e.g. source to customer) and identify key improvement focus areas such as growth and innovation, customers, assets, people, operations, sustainability and ecosystem partners. Thereafter, consider how the availability of real time data i.e. information automisation, can drive significant improvements (avoiding getting stuck in incremental improvements).
2. The 'how' of increased information automisation is developing compelling use cases in each of the six focus areas above and analysing the use cases with three perspectives:
   - In place already
   - Not interested, it is too early (e.g. complex, value not clear, timing not right)
   - Interested and believe it is worthy of further evaluation
3. Further prioritise use cases based on the business value, complexity in implementation, dependencies, degree of change management effort, etc.
4. Narrow down the list of top impact use cases (e.g. ideally up to five use cases) for further study
5. For each use case, develop a detailed road map along with the solution providers. (Exhibit 8).

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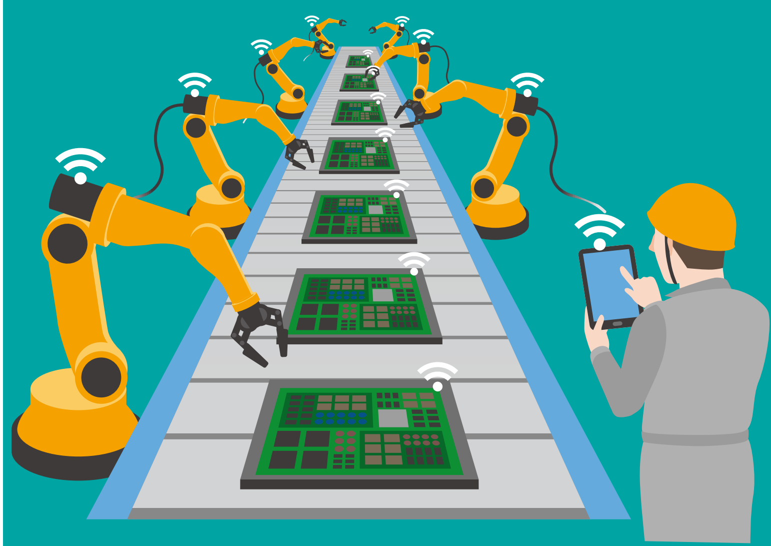


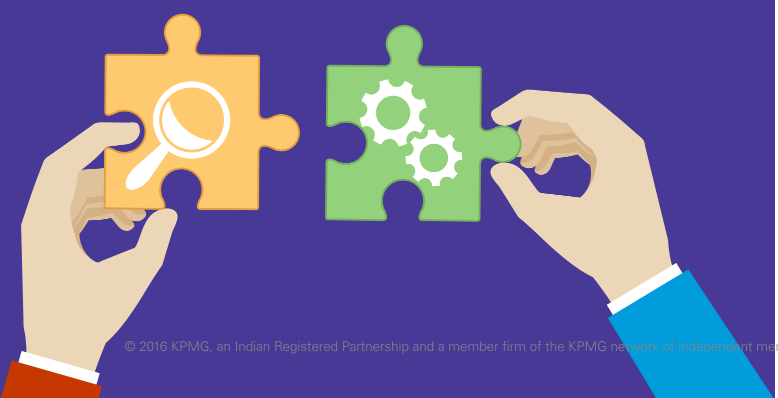
Conclusion

Indian manufacturing enterprises are still in the very early stages of IoT adoption; perhaps, even in a pre-IoT phase where automation and IT are still disparate, data is still controlled within the enterprise boundaries and even within functions in case of manufacturing operations.

The recent instances of some automobile manufacturers using sophisticated algorithms to mislead emission control tests, create the need for a wide ranging IOT policy.

Increased smartisation in terms of buildings, grids, manufacturing industries, agriculture, cities, healthcare, homes, vehicles etc. requires increased awareness and regulations to deal with information automisation. This further leads to the need for a comprehensive debate and development of legal frameworks, standards, competition laws, institutional mechanisms, incubation and caapability building, innovation and R&D, etc.

IoT presents tremendous potential for Indian enterprises, solution providers and the country as a whole. The IoT transformation along with the subsequent transformations are expected to be faster and each enterprise may have its own pace and timing in reaching the IoT maturity state. Organisations today do not have the choice about whether to adopt IoT or not, since it has the potential to disrupt business models, economies of an enterprise and eventually the survival of enterprises. Shifts are expected to take place wherein Indian enterprises can adopt industry IoT to gain competitive advantage, create sustainability and manage key risks.



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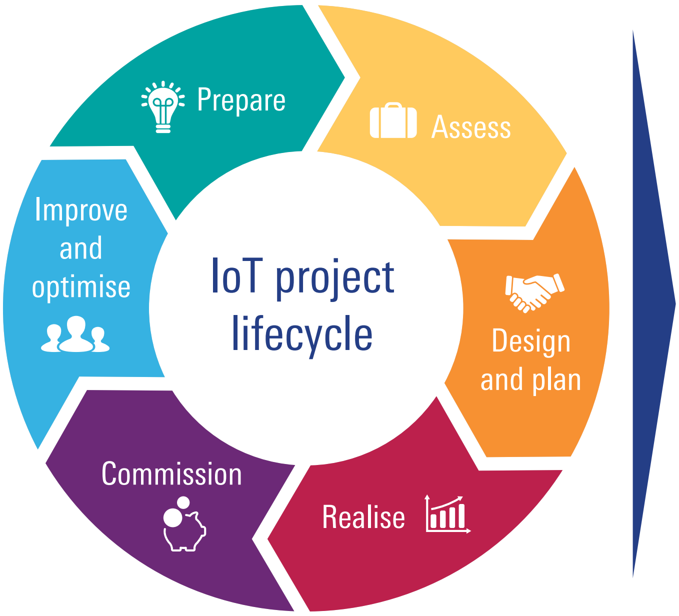
Manufacturing enterprises should consider four key aspects in developing programmes from an implementation stand point:

- Establish a central Architecture Management Office (AMO) which sets the principles of integrating the business process layer with three converging systems – IT, OT and DT. The AMO sets the architecture priorities, required activities and work streams with strategic guidance from experienced practitioners and is managed via blueprints that have a version control established. The AMO also strategically involves the ecosystem partners to solve complex integration problems (e.g. networking, compute and storage, security, proprietary systems, collaboration, mobility, etc.).

Exhibit 8 – KPMG in India’s approach from concept to implementation



Conceptual plans
- Selection of the right use cases and technologies
- Financial case

Use case validation
- Assessment and evaluation of technologies
- Simulations and prototypes

Proof of Concept (POC) definition
- Specifications
- Vendor selection and commercial contracting

IT and BPM architecture
- Business process definition
- Architectures

Integration and commission
- IT and equipment integration
- Support negotiation
- Process optimisation

- Infuse an innovation culture in an enterprise, where the:
  - Formal steps include: refining the strategy planning process to include the explicit consideration of digital disruption and opportunities, appointing an ‘IoT Leader’ who is accountable for driving the IoT agenda (including the strategy and increasing awareness amongst senior leaders), establishing a senior level forum for broad sharing of learnings and successes and progressively introducing tailored digital training for selected staff.
  - Informal steps include: selective reverse mentoring, launching an enterprise ideation/crowdsourcing forum specifically tasked to investigate IoT trends and create content through an existing forum/community or leveraging social media.
  - In addition, the IoT team shall undertake enterprise awareness by providing tools, research and ongoing training on digital to businesses.
  - Establish the right operating model, where it provides resource scalability and allows development/ acquisition of skills in new capability areas e.g. analytics, IoT (platform selection, development and testing platform management), partner certification, etc.
  - Establish a strong operating model governance framework with clearly defined roles and responsibilities and a hands off mechanism between the IoT core team and the business units impacted by IoT initiatives.

Acronyms

OEM - Original Equipment Manufacturer
IP - Internet Protocol
KPI - Key Performance Indicator
MRO - Maintenance, Repair and Overhaul
OEE - Overall Equipment Effectiveness
POC - Proof of Concept
IoT - Internet of Things
SCADA - Supervisor Control and Data Acquisition
ERP - Enterprise Resource Planning
MES - Manufacturing Execution Systems
RPA - Robotic Process Automation
AI - Artificial Intelligence
WWW - World Wide Web
ARPANET - Advanced Research Projects Agency Network
RFID - Radio-frequency identification
LPDT - Linear Potentiometric Displacement Transducer
LHD - Load, Haul, Dump machine
ICCR - Integrated Command and Control Room
AMO - Architecture Management Office

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Acknowledgement

We would like to acknowledge the efforts of the following individuals towards the compilation of this publication.

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Printed in India. (022_THL0816)