Grant Thornton
An instinct for growth™

PHD CHAMBER
NATIONAL APEX CHAMBER

# Industry 4.0: Transforming the manufacturing landscape

December 2018

# Contents

# Message from the President

Considering India's demography and comparatively lower wages, the manufacturing sector is of utmost importance for our economy.

I am happy to state that the PHD Chamber of Commerce and Industry is organising the Industry 4.0 Global Summit to sensitise the Indian manufacturing sector about the advantages of adopting Industry 4.0 at their shop floors.

Considering India's demography and comparatively lower wages, the manufacturing sector is of utmost importance for our economy. Automation and smart manufacturing are essential for us to become a global manufacturing hub, increase our exports and be successful in the Make in India mission.

To initiate and move forward towards smart manufacturing for improving efficiency and flexibility, the Summit is designed as a forum for manufacturers, visionary leaders as well as policy makers, innovators, researchers and strategists to exchange information, innovations and success stories.

I hope the event will go a long way in highlighting the significance of smart manufacturing and encouraging the Industry 4.0 solution providers and manufacturing sector companies to adopt smart manufacturing.

**Rajeev Talwar**
President
PHD Chamber of Commerce and Industry

# Message from the Secretary General

Industry 4.0 is the new buzz word in manufacturing and provides an opportunity to Indian companies to leapfrog into manufacturing attractiveness.

Being a proactive National Apex Chamber, PHD Chamber of Commerce and Industry is at the forefront of encouraging Indian businesses to adopt new technologies and innovations to become more competitive. Though India relies heavily on its service sector for growth, the manufacturing sector needs to play a significant role in the economy, too. The Fourth Industrial Revolution in manufacturing, which is a marriage of the Internet of Things (IoT) with traditional manufacturing systems, is the new buzz word and provides an opportunity to Indian companies to leapfrog into manufacturing attractiveness.

The Industry 4.0 Global Summit is designed with the aim of making businesses understand the step-by-step approach from conventional to smart manufacturing, educating them about the digital tools for the factory of the future, and informing them about success stories in India and international practices in implementation and policy design for Industry 4.0.

I wish the Summit all success and I am delighted to state that PHD Chamber will organise such programmes and projects across various industry clusters of India in line with our mission of promoting innovations and capacity building for a better economic growth of the country.

**Dr Mahesh Y Reddy**
Secretary General
PHD Chamber of Commerce and Industry

# Foreword from Grant Thornton in India

Global manufacturing ecosystems are undergoing a paradigm shift driven by a host of technology advancements at an unprecedented pace.

Industry 4.0 has many facets to it including automation and data exchange in manufacturing technologies, cyber-physical systems, IoT and cloud computing. It creates what can be called a 'smart factory', where machinery, storage systems and production resources can carry out complex tasks, exchanging information and giving instructions to each other, without the need for human involvement.

With over 6.5% economic growth annually over the last three years, India is the fastest growing major economy in the world. The manufacturing sector historically has been contributing about 16% to the GDP of the country. Going ahead, this is projected to increase to about 25% by 2025.

With the government now providing significant incentives, tax breaks and favourable policy measures under the National Manufacturing Policy and subsequently the Make in India programme, the investment and initiatives from the private firms, both foreign and domestic, are expected to increase.

The government's push to manufacturing through Make in India has garnered considerable attention from the industry and brought the spotlight back on the manufacturing sector. Since the launch of Make in India, India has moved up 65 spots in the World Bank's Ease of Doing Business rankings – from 142 in 2015 to 77 in 2018. The National Policy for Advanced Manufacturing is another key tool to attain the objectives of increasing the contribution of manufacturing output. With these measures, there will be tremendous impetus towards modern manufacturing including additive manufacturing, industrial IoT manufacturing intelligence.

With a plethora of crippling regulations and under-developed infrastructure that was plaguing the manufacturing sector, the government is focusing more on enabling policies and improving infrastructure for certain key sectors. With the development of NIMZ, country specific zones, SEZs, industrial clusters and special economic corridors for rapid transport of goods and introduction of GST, the country provides a robust development infrastructure for the manufacturing sector.

The manufacturing industry, given its potential contribution to GDP and employment, presents a significant opportunity to be one of the biggest growth drivers for the economy. We need to emerge as a "world-class manufacturing hub". For this, there is a concerted effort from the government and the industry to create an enabling ecosystem. The country's key strengths such as a large domestic consumption base, a cost competitive value chain (that includes low design, testing and validation costs, frugal engineering capabilities and low labour costs) and strategic geographical location would go a long way to develop the country as a world class manufacturing base.

It is imperative for the manufacturers at all levels to understand, adopt and adapt their businesses to the future of production. it is not just a matter of competitiveness, but of survival.

We hope the report will encourage more discussions around the opportunities and challenges facing organisations in this new era in manufacturing, specifically focusing on the Indian manufacturing industry.

We hope you enjoy reading it and look forward to your feedback.

**Depender Kumar**
Partner
Grant Thornton Advisory Private Limited

# What is Industry 4.0

# Definition

The genesis of the first industrial revolution can be traced back to Britain. Colonies were a huge marketplace for produced goods and also a source of raw materials. The revolution was also fueled by the transition of agrarian societies to industrialised urban landscapes employing special purpose machines and factories especially in the textile industries. The primary technology driver for Industry 1.0 was the emergence of steam engines in the 18th and 19th centuries. Since the dawn of the Industrial Revolution, the primary factor responsible for a paradigm shift in disrupting the status quo in manufacturing has been technological leaps.

Industry 2.0 commenced in the 20th century with electricity as the key technology driver. This was the period when Henry Ford introduced the assembly line manufacturing in automotive industries and standardised various processes in manufacturing, giving rise to basic concepts like factory designs, supply chains and factory operations.

Industry 3.0 began by the late 1970s with electronics and industrial scale automations as the key drivers. This impacted all aspects of manufacturing from product design, quality analysis and inventory tracking to supply chain management. This was also the age where computing systems like servers, databases and networks and specialised enterprise resource planning software from SAP, Oracle and Microsoft made a foray into the manufacturing sector.

Now, a new age has dawned in manufacturing led by the digital and emerging technologies with a potential to transform and disrupt the entire manufacturing ecosystem. This revolution is termed as Industry 4.0. Industry 4.0 will make it possible to gather and analyse data across machines, enabling faster, more flexible and more efficient processes to produce higher-quality goods at reduced costs. It shall provide complete visibility and traceability on the status and inventories in real time to the stakeholders.

Industry 4.0 is characterised by highly intelligent connected systems that create a fully digital value chain. It is particularly based on cyber physical production systems that integrate communication, IT, data and physical elements, transforming traditional plants into smart factories. Here, the objective is that machines talk to other machines and products and information is processed and distributed in real time.

Industry 4.0 is all about optimisation of smart, flexible supply chains, factories and distribution models where machines capture and convey more data via machine-to-machine communications and to human operators. All this aims at enabling businesses to make quicker, smarter decisions while minimising costs. This in turn will increase manufacturing productivity, shift economics, foster industrial growth, and modify the profile of the workforce — ultimately changing the competitiveness of companies and regions. It is estimated that Germany's initiatives for Industry 4.0 will contribute as much as EUR 78 billion to the German GDP by 2025.

Industry 4.0 is all about optimisation of smart, flexible supply chains, factories and distribution models where machines capture and convey more data via machine-to-machine communications and to human operators

**Industry 4.0: An optimised world-class manufacturing system**

### Predictive maintenance

- Digitise performance management through real-time data and alarms
- Use of advanced analytics to evaluate sensor data and predict machine failures

### Automatic parameter recording

Automatic recording of operational data and centralised storage

### Robotics

Use of robotics (including automated guided vehicles) to maximise labour productivity and minimise human failure

### Advanced analytics for optimisation

Yield, energy consumption, and throughput optimisation using advanced analytics over machine operating parameters

### Advanced quality control

Quality issues identified in real time with data relayed to control room for advanced analytics and parameter adjustment

### Common operating picture

- Controls many machines
- Monitors quality and component performance in addition to throughput
- Uses advanced analytics to update parameters in real time to improve quality and yield

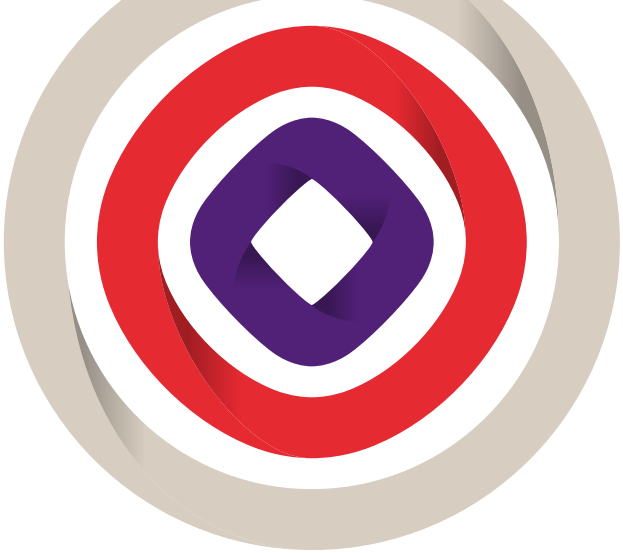
### Batch matching to demand

Advanced analytics for demand forecasting and optimisation of inventory levels

### 3-D printing

Reducing lead time for critical parts by 3-D printing critical components

Source: McKinsey, Industry 4.0: Reinvigorating ASEAN Manufacturing for the Future



## Evolution from the current industrial scenario

Advancements in digital technologies could fuel the next industrial change. Prospectively, the fusion of physical and virtual worlds into a cyber-physical system may have a significant impact on every element of the manufacturing sector.

In comparison to Industry 3.0, the traditional industries foresee unprecedented degree of integration between information, communication and manufacturing systems at their disposal, including:

- Smart sensors that knit together an industrial IoT, allowing real-time data collection during production processes
- Ubiquitous broadband, allowing large volumes of data to be transmitted between people, machines and production sites
- Cloud computing, allowing instant storage and availability of date at any location
- Big data analytics allowing large volumes of data to be processed collaboratively

Industry 4.0 is a convergence of disruptive digital technologies that are set to change the manufacturing sector beyond imagination, driven by an astonishing rise in data velocity, volume and variety, system integrations and connectivity, emergence of advanced analytics and business intelligence capabilities, machine learnings and improvements in the transfer of digital instructions to the physical world.

Companies may evince interest to initiate the efforts to digitise factories as is seen at Siemens, Bosch, Daimler, Deutsche Telekom and Trumpf. Among others, the introduction of Industry 4.0 can lead to sensor-packed products, connected to the internet in order to provide better products and services to customers.

## Impact on the manufacturing sector

Despite the broadness of the term, most agree that Industry 4.0's impact on the manufacturing industry will be significant. It has the potential to disrupt both processes and products. There could be a 360-degree change in the way the sector is operating now.

Industry 4.0 entails handling massive volumes of data using business intelligence software to interpret, address and transfer that data to other parts of the business, back to the enterprise resource planning (ERP) systems or supply chain partners.

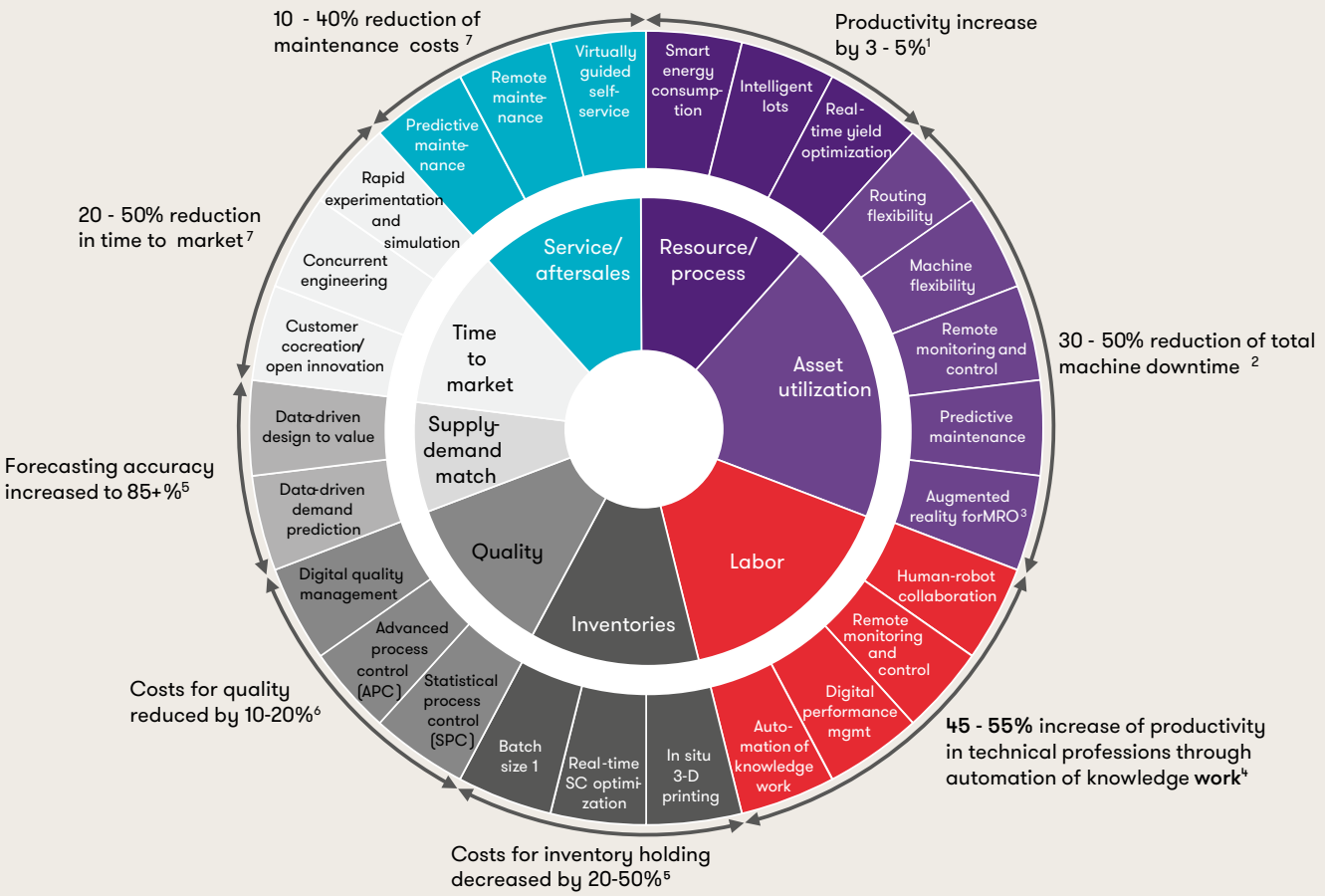
In consonance with Industry 4.0, manufacturers and suppliers could majorly be confronted with increasing complexities such as:

- Increasing numbers of products and options
- Challenging mass customisation scenarios
- Shorter technology cycles
- Increasing pressure to innovate and global supply networks
- Constant competitive pressure to cut down the time to market
- Changing customer preferences w.r.t performance characteristics, safety, features, personalisation, individualisation, etc.
- Technologically enhanced products

Manufacturers need to increase the number of feasible buildable combinations and require manufacturing processes that can handle large variations to cater to the personalisation demands of the users. A study of various simulations is the need of the hour. Direct interactions of value chain partners with customers will help suppliers to understand and analyse customer preferences and shall help them to strategise a better market approach.

Industry 4.0 is expected to bring forth the idea that advances in manufacturing will help the sector focus on key functional pillars such as technology, integration/collaboration and processes. It includes some mega trends that are expected to be key enablers for the manufacturing sector's transition, majorly cloud computing, big data and cyber security.

## McKinsey Digital Compass to identify most promising Industry 4.0 opportunities




1 Client experience
2 McKinsey analysis
3 Maintenance, repair, and operations
4 Cf. McKinsey Global Institute: Disruptive technologies
5 McKinsey analysis
6 Cf. T. Bauernhansl, M. ten Hompel, B. Vogel-Heuser (Ed.): Industries 4.0 in Produktion, Automatisierung und Logistik (2014)
7 Cf. McKinsey Global Institute: Big data: The next frontier for innovation, competition, and productivity

Source: Industry 4.0 at McKinsey's model factories

# Global readiness towards Industry 4.0

Advancements in technology have brought people, businesses, countries and the overall global market place closer than ever before, and this trend will continue to accelerate over time.

## Readiness

It is necessary to assess the Industry 4.0 readiness of industrial enterprises as the manufacturing sector has been disrupted by concepts such as the IoT, cyber physical systems and cloud-based manufacturing.

A foundation for mechanical engineering, plant engineering and information technology of the German Engineering Federation (VDMA) has coined a six-dimensional model to assess the readiness of enterprises. Industry 4.0 holds immense potential, especially for Germany´s mechanical engineering industry and plant engineering sector, both for providers and for users of technologies across the spectrum. But there are still many unresolved questions, uncertainties and challenges.

The readiness study seeks to address this need and offer insights. It also highlights the challenging milestones that many companies must still pass on the road to Industry 4.0 readiness.

A key point in this understanding is that the dimensions smart factory and smart products relate to the physical world, while smart operations and data-driven services represent the virtual representation of physical dimensions. According to this concept, Industry 4.0 can be called as the fusion of the physical and virtual worlds. The six components of the readiness model are elaborated below:

## Strategy and organisation

Industry 4.0 offers a new opportunity for developing altogether new business models apart from improving the current processes through the use of digital technologies. The current openness and the cultural interaction can be examined using the following criteria:

- Existing knowledge strategy implementation of Industry 4.0
- Review strategies through a system of indicators for better operation
- Measure the enterprise investments relating to Industry 4.0
- Understand the use of technology and innovation management
- Understand the current state of research and development

## Smart factory

The smart factory is a production environment in which the production systems and logistics systems primarily organise themselves without human interventions. It relies on cyber physical systems (CPS), which links the physical and virtual worlds by communicating through an IT infrastructure/IoT.

A company's progress in the area of smart factory can be measured using the following four criteria:

- Digital modelling
- Equipment/Component infrastructure
- Data usage
- IT systems/infrastructure

## Smart operations

The technical requirements in production and its planning which are necessary to realise the self-controlling work piece are known as smart operations. Industry 4.0 readiness for smart operations can be determined by the following:

- Information sharing
- Cloud usage
- IT security
- Autonomous processes

## Smart product

Smart products are the foundation of 'smart factory' and 'smart operations' and are critical components of a unified 'smart factory' facilitating automated, flexible and efficient production. Physical components are equipped with technical components such as sensors, RFID, communication interface, etc. to collect data on their environment and their own status. Readiness in the area of smart products shall be determined by looking at the ICT add-on functionalities of products and the extent to which data from the usage phase is analysed.

## Data-driven services

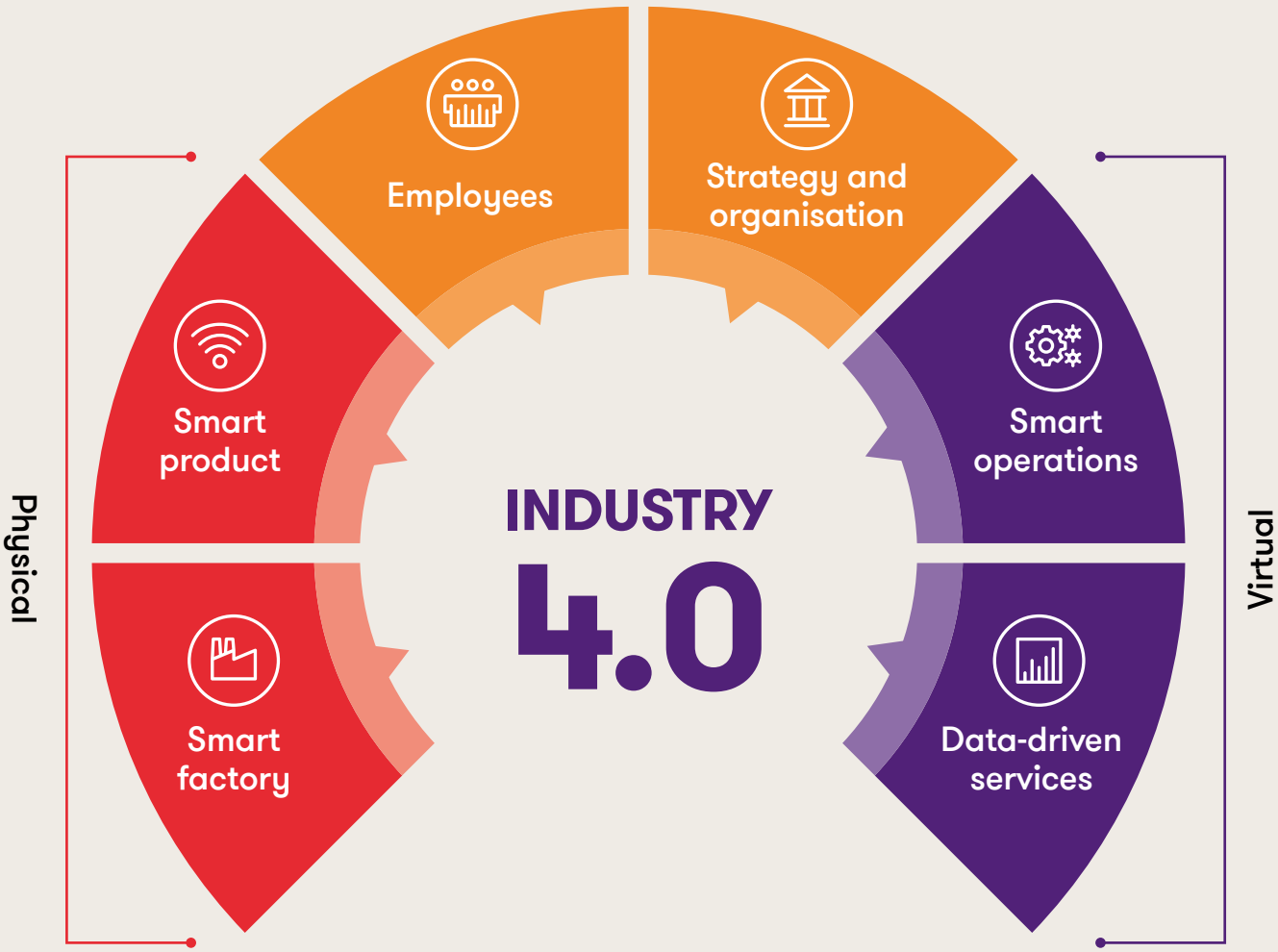
Companies evolving from selling products to providing solutions substantiate data-driven services which are used to align future business models to enhance the benefits to the customers. The aftersales services business is based on the evaluation and analysis of collected data and reliance on enterprise-wide integration. The physical products themselves must be equipped with physical IT so they can send, receive or process the information needed for the operational processes. Readiness in this area can be determined using the following three criteria:

- Availability of these service
- Share of revenue derived
- Share of data used

## Employees

Employees help companies realise their digital transformation dreams, and readiness in this dimension can be determined by analysing employees' current skills and the ability to acquire new skills as employees are most affected by the changes in technology in an organisation, directly impacting their work environment. This requires them to acquire new skills to get well equipped with the digital workplace. Thus, the above model will help assess the company's readiness on various critical parameters and analyse the potential gaps which need to be addressed in order to adopt Industry 4.0.

**India's readiness for Industry 4.0**




## Business objectives

### Operational excellence

- Enhanced efficiency through greater automation
- Customised products at the cost of a mass-produced product

### Expanded services

- Higher revenues from digitally refined products
- Access to new markets

Source: Grant Thornton: India's readiness for Industry 4.0

## Leading countries and segments

As stated by the WEF and McKinsey report titled Technology and Innovation: The Next Economic Growth Engine, "Germany was the first to launch an Industry 4.0 programme (in 2011), followed by the United States, Italy and France between 2012 and 2013. Asian countries (South Korea, Japan and China) have kicked off their national efforts more recently. China's 2016-2020 plan seeks to upgrade key areas of its 10 priority traditional manufacturing sectors to digital manufacturing. This initiative is part of the country's long-term strategic vision to develop intelligent manufacturing to generate new growth and strengthen Chinese manufacturing. Russia became the latest large economy to create a national programme by launching its Advanced Industrial Technologies in 2017. The Indian government launched the Make in India initiative, and is slated to come up with a revamped industrial policy with a key focus on technology adoption. Many other countries, including Australia, Canada and Spain, have also started national-level programmes."

By 2020, the US aims to achieve 74% digitisation from the current levels of 32%, Asia Pacific to 67% from the current 36% and Europe, the Middle East and the Africa to 71% from the current 30%.

## How is Germany getting ready for Industry 4.0

With the government rolling out Digital Strategy 2025, Germany's efforts with digitisation go beyond Industry 4.0. This is a step guide to a successful digitisation. It focuses on modernising manufacturing through Industry 4.0 research and innovation. It also concentrates on providing an international playing field and strengthening data security while adhering to existing and incoming regulatory compliances such as the EU's General Data Protection Regulation. Funding for running these projects and to do the research and development around these projects is one of the major challenges that the industry can face in implementing these projects.

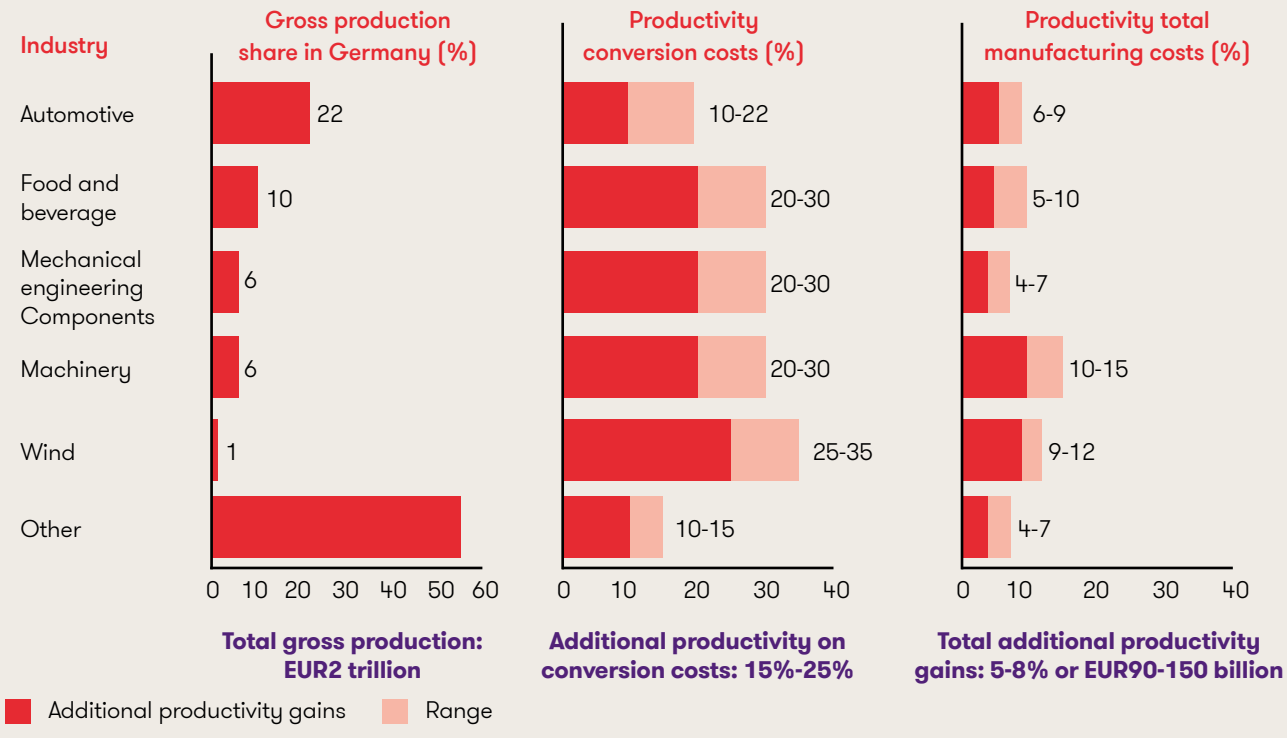
Automotive industry is one of the pioneers to implement Industry 4.0. The boundaries between the IT sector and automotive sector are getting blurred. Car manufacturers are increasingly looking to provide additional connected services in vehicles and are expecting an automated and a connected car market worth $160 billion by 2020.

In order to tackle the challenges that accompany Industry 4.0, the Federal Ministry is providing education and resources to SMEs which are currently unaware of the benefits of Industry 4.0. The Ministry is also providing support schemes where SMEs can test IoT use cases in a safe environment. There are issues which are to be resolved such as skill shortages, lack of standards and security concerns. The primary focus of Germany will be on:

- Finding new options for implementing Industry 4.0 than creating new business models
- Developing recommendations for industry and government
- Mobile SMEs

In order to accept and adopt this new trend, partnerships will be key for the progress. Germany has signed Industry 4.0 MoUs with countries such as China and Japan. In addition to this, Industry 4.0 is to be formalised through an agreement with France's Alliance d'industrie du futur (collaborating on standardisation, test beds, use cases, education).

**Productivity gains generated from Industry 4.0**




Source: BCG: Industry 4.0 the future of productivity and growth.

**Many countries across the globe are attracted towards the concept of Industry 4.0. The following is a glimpse of other countries which are trying to embrace Industry 4.0.**

## USA

WEF and McKinsey report titled 'Technology and Innovation: The Next Economic Growth Engine' states that, recently, manufacturing has declined more rapidly in the US than in other advanced economies. While it makes up only 9% of employment and 12% of the country's GDP, manufacturing drives 30% of US productivity growth, 60% of exports and 70% of private-sector R&D. Although the largest US manufacturers have managed to thrive despite growing headwinds, SMEs have been hit hard. This has implications for the broader economy, as manufacturing's decline represents two-thirds of the fall in labour's share of US GDP and has limited the prospects of middle-income workers. Larger manufacturers are also concerned because they face more risk without a healthy ecosystem of domestic suppliers to provide agility and opportunities for collaboration. In addition, the US manufacturing sector has been slow to adopt digital technologies, thus dragging down its productivity.

According to the McKinsey Global Institute, the US could capitalise on its strengths to boost manufacturing output by 14%–20% by 2025. This is based on the impact of progressively higher adoption of technology, export growth and share of domestic content in finished goods. The World Economic Forum Country Readiness for the Future of Production project sees the US as strongly positioned for the future.

The US Government has taken several initiatives to embrace industry 4.0:

- It has built National Network for Manufacturing Innovation (NNMI). This consists of regional hubs that will accelerate development and adoption of cutting-edge manufacturing technologies for making new, globally competitive products.
- To increase the domestic manufacturing competitiveness, the National Additive Manufacturing Innovation Institute aims to accelerate the adoption of additive manufacturing and 3D printing technologies in the US manufacturing sector.
- Other initiatives and installations such as Design Innovation Institute (DMDII), American Lightweight Materials Manufacturing Innovation Institute (ALMMII), Clean Energy Manufacturing Innovation Institute for Composites Materials and Structures and Materials Genome Initiative, National Export Initiative (NEI), etc. have been initiated.
- 'Startup America' is a White House initiative to celebrate, inspire, and accelerate high-growth entrepreneurship throughout the nation.

## Vietnam

- Manufacturing strengths include: strategic location, younger population and lower costs than China
- Vietnam is fast becoming the preferred base of operations for companies looking to set up overseas manufacturing facilities, replacing China and Taiwan as the preferred manufacturing location in Asia
- Vietnam is well-positioned, post the Trans-Pacific Partnership and Free Trade Agreement (FTA) with the European Union, to allow investors to utilise its cheap workforce and close proximity to existing Asian based supply chains
- Most of the Vietnam's industries are still at the second revolution which does not mean they don't have electronics or IT products, but they are still weak in quality and quantity
- Manufacturers are looking support from the government to extend help and form policies and reforms which encourage adoption of new technologies and investments.

## Philippines

- Manufacturing sector aims to grow to 30 percent by 2020 from 22 percent as in 2016
- It is expected to be one of the fastest growing automotive markets in Southeast Asia after 2020 with annual sales capable of growing at least 10 percent
- The government has introduced Comprehensive Automotive Resurgence Strategy programme because of which by 2020, the country is aiming to become a major automotive market in Southeast Asia as domestic sales are expected to continue grow while local production is seen ramping up

## UK

Only 8% of the UK manufacturers have a significant understanding of Industry 4.0 processes despite 59% recognising that the fourth industrial revolution will have a big impact on the sector.

## China

- The 13th Five Year Plan (2016-2020), adopted in March 2016 by the Chinese Government, aims to implement 'Made in China 2025' and 'Industry 4.0' initiatives simultaneously. Made in China 2025 aims for much higher levels of locally made content in core components and materials, increasing the levels to 40 percent by 2020 and 70 percent by 2025.
- Industry 4.0 is expected to increase China's productivity by 25 to 30 percent and lower unforeseen production losses by 60 percent.

# Importance of Industry 4.0 for Indian manufacturing sector

## Is India ready to leapfrog to Industry 4.0?

With over 6.5% economic growth annually over the last three years, India is the fastest growing major economy in the world. This has been enabled by various measures taken by the government. The manufacturing gross value added saw a healthy growth of 10.6% and 7.7% in 2015-16 and 2016-17 respectively.

The manufacturing sector historically has been contributing about 16% to the GDP of the country. Going ahead, this is expected to increase to about 25% by 2025 to sustain the existing pace of growth. With the government now providing significant incentives, tax breaks and favourable policy under the National Manufacturing Policy and subsequently the Make in India programme, the investment and initiatives from the private firms, both foreign and domestic, are expected to increase.

Make in India has resulted in one of the strongest country brands ever, thereby boosting the country's image and investor confidence. The Government of India's push to manufacturing through the Make in India initiative has garnered considerable attention from the industry and brought the spotlight back on the manufacturing sector.

The impact of Make in India is already visible in terms of FDI inflows into the country. India remained number one destination for greenfield FDI for the second consecutive year in 2016. FDI inflows by capital investment for the year 2016 stood at $62.3 billion across 809 projects. During April-September 2017-18, FDI reached $25.35 billion, an increase of 17% year-on-year (DIPP). Since the launch of Make in India, India has moved up 65 spots from 142 in 2015 to 77 in 2019 in the World Bank's Ease of Doing Business rankings.

Tight coupling of Industry 4.0 with the Make in India initiatives is imperative if Indian manufacturing has to remain competitive against global competition. India has a unique opportunity to innovatively pave its own road to smart manufacturing. It can skip several steps that other countries adopted in their evolution from an agrarian society to their current stage of development.

There will be tremendous impetus towards modern manufacturing including advanced materials, advanced robotics and 3D printing, among others. Industry 4.0 is expected to transform manufacturing in India by bringing operational efficiencies to manufacturing industries like automotive, electrical and electronics.

Considering the plethora of crippling regulations and under-developed infrastructure that was plaguing the manufacturing sector, the government is focusing more on enabling policies and improving infrastructure for certain key sectors. With the development of National Investment and Manufacturing Zones (NIMZs), country-specific zones, SEZs, industrial clusters and special economic corridors for rapid transport of goods and introduction of GST, the country provides a robust development infrastructure for the manufacturing sector.

India is now finalising on the National Policy for Advanced Manufacturing, which would be one of the key tools to attain its objective of increasing the contribution of manufacturing output.

India's first smart factory, moving from automation to autonomy, where machines speak with each other, is being set up in Bengaluru. It is making progress at the Centre for Product Design and Manufacturing (CPDM) of the Indian Institute of Science (IISc) with an investment from The Boeing Company. Reports peg the smart factory industry to touch $215 billion by 2025 and all major economies are likely to accept it

Major Indian states are taking initiatives to adapt to Industry 4.0. For example, the Andhra Pradesh state government has approved the first-of-its-kind IoT policy with an aim to turn the state into an IoT hub by 2020 and tap close to 10% market share in the country.

The Indian Government has created Green Energy Corridors to bring in more renewable energies, to make smart grids that will support the variable input of renewable energies and create storage. India has committed over $1 billion in this initiative and has started projects in many states, such as Andhra Pradesh, Rajasthan, Tamil Nadu, Gujarat and Himachal Pradesh.

Various Indian companies are increasing their focus and partnering with other companies for developing new IoT and M2M solutions. The Digital India initiative from the Government of India is expected to enhance the focus on IoT in tackling the domestic challenges.

# India's competitive advantage

By 2020, India's manufacturing sector is expected to undergo tremendous growth and significantly contribute to the country's GDP. With this vision, the massive expansion in the Indian manufacturing industry makes the country ready for the era of Industrial Revolution 4.0 where the manufacturing process can be integrated with growth drivers of Industry 4.0 to capitalise on the opportunity presented to the manufacturing sector.

The country's key strengths such as a large domestic consumption base, a cost competitive value chain (that includes low design, testing and validation costs, frugal engineering capabilities and low labour costs) and strategic geographical location would go a long way in developing the country as a world-class manufacturing base.

Policy impetus has been making a visible difference in a host of critical areas, which include improving the business environment (Make in India, Merchandise Exports from India Scheme, Services Exports from India Scheme, Government e-Marketplace, etc.), support for futuristic urbanisation (Smart Cities), greater financial inclusion (JAM Trinity), boost to entrepreneurs (Startup India), Standup India, Skill India, Mudra Yojana, etc. These initiatives are significant as they recognise India's current context and future potential as an economy and the growth drivers and areas that merit urgent intervention.

Several large manufacturers such as Havells, Godrej and Bosch have already shifted their manufacturing units to India.

The key competitive advantages for India in leveraging Industry 4.0 to disrupt manufacturing are as below:

- India is a global pioneer in engineering R&D and design outsourcing. The country's engineering process outsourcing sector is expected to reach $40 billion by 2020, around 30% of the global market.
- Investments in the Indian manufacturing sector have been on the rise, both domestic and foreign. Gross fixed capital formation, which represents net investments in fixed assets, has grown 10.44% annually between FY16 and FY18
- A growing working population and an expanding middle-class are expected to remain key demand drivers.
- India has the world's 12th largest number of high-net-worth individuals, with a growth of 20.8%, the highest among the top 12 countries.
- Disposable incomes in the rural agri sector shows increasing trends.
- There is a presence of a large pool of skilled and semi-skilled workers and a strong educational system.
- Abundant raw material availability is another advantage for India's manufacturing sector.
- Favourable sector-wise government policies such as:
  - NIMZs developed to create an ecosystem for industries in India.
  - Host of tax incentives for R&D, new plant and machinery etc.
  - Most sectors are opened to 100% FDI under the automatic route, which has provided capital to adopt Industry 4.0 technologies in the manufacturing sector.
  - Sector-specific incentives, eg lower excise duties, automotive mission plans, the constitution of NEMMP (National Electric Mobility Mission Plan 2020) and FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicle).
  - Skill India, a multi-skill development program has been started to equip the workforce with the necessary skills required by the sector.

# Steps to make India a leading manufacturing hub

The Indian manufacturing sector is witnessing a boost and thrust from the Government of India, which emphasises and focuses on the introduction of new and revolutionary production processes into the Indian manufacturing system by keeping ICT at the heart of development. Along with this, there is also a great thrust from programmes/policies such as Make in India, introduction of GST and FDI policies.

## Manufacturer perspective

Manufacturing is expected to create 100 million additional jobs by 2025, considering that the country has become one of the most attractive destinations for investments in this sector. Many of the leading companies, including mobile phone and automobile brands, have established or are looking to set up their manufacturing base in the country, which will have a positive impact on job creation.

India has a well-distributed demography which drives a consistent demand, thereby providing a huge market waiting to be tapped on a recurring basis. In addition, it also has a significantly large tech-savvy and educated population and skilled labour workforce. Now, the government is also favouring regulated liberalisation. Thus, going ahead, India is expected to emerge as a strong manufacturing destination. Below are some of the sub-sector wise growth expectations which could drive the growth of the manufacturing industry in India.

### Defence sector

India is the fourth largest country globally in terms of defence spending, with INR 3,59,854 crore allocated to the Ministry of Defence in the Union Budget 2017-18. In addition, the Make in India programme allows foreign defence original equipment manufacturers (OEMs) to enter into strategic partnerships with Indian defence manufacturers. These partnerships could increase their manufacturing capability in India and help them cater to global markets. Defence manufacturing has recently witnessed a lot of interest. The government has now allowed foreign companies to own up to 100% equity in the local defence sector through the government approval route in cases where it is likely to result in access to modern technology, thus driving foreign investment beyond the previously stipulated 49%. The move is expected to allow foreign companies to start manufacturing in India and make the country their manufacturing base.

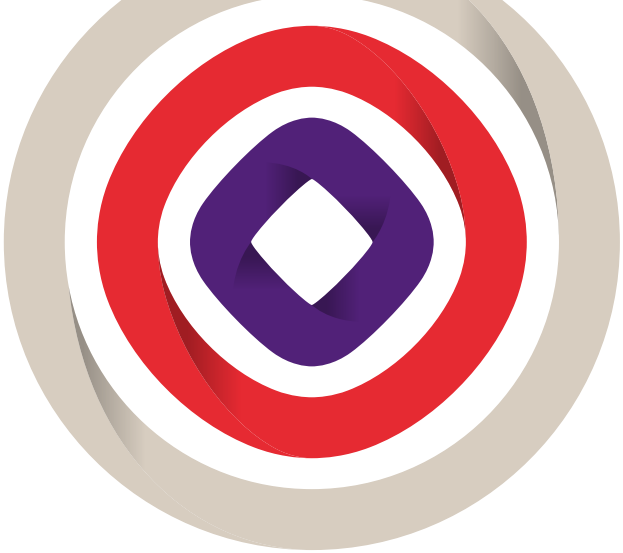
Going ahead, they could supply weapons not only to Indian establishments but also abroad. In addition, the DIPP has previously granted permission to 19 private companies to manufacture a range of defence products. The permission is for services such as manufacturing, maintenance and overhaul of torpedoes, missiles and mines for large platforms operations such as tanks, off-road military vehicles and hovercrafts. the DIPP has also allowed well-known domestic players to invest in the sector and develop infrastructure. Players such as Tata Group, Mahindra Group, Hero Group and Reliance are entering the market and making the most of the opportunity. For example, the Tata Group has ramped up operations and created an in-house ballistic test facility.

The primary objective of India's offset policy, since its introduction in 2005, has been to reduce imports and promote self-reliance in defence manufacturing. The government has introduced, in May 2018, a draft amendment to its offset guidelines which provides additional ways in which foreign OEMs can discharge their obligations and at even higher multipliers. Besides the traditional forms of direct and indirect offset discharge avenues, this amendment also provides for investment in defence industry corridors, which will enable the setting up of defence production facilities, as well as SEBI-regulated funds which can be used for the discharge of offset obligations, at high multipliers. The government is proposing an increase of the FDI limits for defence to 74% to provide an attractive avenue for discharge of offsets in the long term. As per the draft defence production policy of 2018, defence industrial corridors (DICs) will be set up in collaboration with states (Tamil Nadu and Uttar Pradesh) to provide state-of-the-art infrastructure and facilities for setting up defence production facilities. This will allow for concentration of the defence industrial base from a long-term perspective. Investment by foreign OEMs in these defence corridors will enjoy a higher multiplier as compared to other areas with regard to the discharge of offsets.

According to the press release by the Ministry of Defence, the policy on strategic partnerships in the defence sector was approved by the Defence Acquisition Council (DAC) in May 2017. It was promulgated on 31 May 2017 as Chapter-VII of Defence Procurement Procedure (DPP) – 2016 titled 'Revitalising Defence Industrial Ecosystem through Strategic Partnerships'. The policy is intended to institutionalise a transparent, objective and functional mechanism to encourage broader participation of the private sector, in addition to DPSUs/OFB, in the manufacture of defence platforms and equipment such as aircraft, submarines, helicopters and armoured vehicles. It will serve to enhance competition, increase efficiencies, facilitate faster and more significant absorption of technology, create a tiered industrial ecosystem, ensure development of a wider skill base and trigger innovation, leading to reduction in dependence on imports and greater self-reliance in meeting national security objectives. The following four segments have been identified for acquisition under the strategic partnership (SP) route:

- Fighter aircraft
- Helicopters
- Submarines
- Armoured fighting vehicles (AFVs)/Main battle tanks (MBTs).

The strategic partnership model (SPM) is a different category of capital acquisition in addition to the existing categories as mentioned in Chapter-I of DPP-2016, ie 'Buy (Indian-IDDM)', 'Buy (Indian)', 'Buy & Make (Indian)', 'Buy & Make' and 'Buy (Global)'.



### Engineering

It includes a number of areas such as infrastructure, power, steel, oil and gas, consumer durables, etc. It has seen significant growth in the last few years primarily driven by high investments in infrastructure and industrial production. The engineering sector is of strategic importance to the country's economy, and domestic players are starting to compete globally in this sub-sector. For example, Power Grid, the country's national transmission utility, is planning to bid for engineering, procurement and construction jobs overseas in partnership with foreign entities.

The country's space programme is a huge success, and it has launched 180 satellites for 23 countries (as in February 2017). The Indian electrical machinery industry is expected to double in sales to $ 100 billion between 2015 and 2022. The country produces around 4.5 million pumps annually and exports pumps to nearly 100 countries. It is almost self-sufficient in pumps for nuclear power and completely self-sufficient in pumps for captive power generation, pulp and papers, energy efficient pumps in utilities and in the agriculture sector.

Abundant raw material availability is another key driver of India's manufacturing sector. The Indian steel industry has seen rapid growth since 2007-08, driven by a fast growing economy and rising demand for steel. India is the second largest producer of crude steel since FY 2016, with its production capacity in 2017-18 reaching 137.97 million tonnes (MT). India is also the largest producer of sponge iron in the world. Growth in demand for steel has continuously outpaced growth in supply since 2012. Going ahead, domestic demand is expected to reach 145 MT by 2020. With the government easing out FDI norms in the steel sector, huge investments are expected to be made in the sector. The National Steel Policy 2017 has set a target of 300 million tonnes per annum (MTPA) of production capacity by 2030

### Food processing industry

The Indian food processing industry is expected to grow significantly from about $258 billion in 2015 to about $482 billion by 2020. It is one of the largest industries in India and ranks fifth in terms of production, consumption and exports. In FY15, the food processing industry constituted 14% of India's GDP through manufacturing, and the organised sector is estimated to have a 70% share in the sector. India's exports of processed food and related items rose at a CAGR of 21.5% during FY 2011–16, accounting for $19,337.4 million in FY 2016.

### Automobile components manufacturing and assembling

India is expected to be the third largest automobile industry by 2020. According to the Society of Indian Automobile manufacturers (SIAM), India is one of the largest automobiles producers, produced a total 29,075,605 vehicles including passenger vehicles, commercial vehicles, three-wheelers, two-wheelers and quadricycles in April-March 2018 as against 25,330,967 in April-March 2017, registering a growth of 14.78%. The country has also seen a tremendous increase in exports since 2014 mainly in passenger, commercial and two-wheeler segments. For example, manufactured in India, Suzuki Ertiga has been launched in foreign markets such as South Africa and Philippines. Between April 2000 and March 2017, the Indian automobile industry attracted FDI of around $16.67 billion.

### Leather

India's leather industry has transformed from being a supplier of raw materials to being an exporter of value-added finished products. Currently, about 50% of India's leather business comes from international trade. It exports largely to countries such as Germany, US, UK, Italy, France, Hong Kong and Spain. Being the fifth-largest exporter of leather goods and accessories in the world, the industry is expected to grow as the government has identified it as a focus sector in the foreign trade policy.

### Pharmaceuticals

The Indian pharmaceutical industry accounts for about 2.4% of the global industry in value terms and 10% in volume terms. It is expected to grow from $20 billion in 2015 to $55 billion by 2020 at a CAGR of about 15.9%. India has the largest number of pharmaceutical manufacturing facilities registered with US Food and Drug Administration (FDA) for any country outside the US. The Indian government allows 100% FDI under the automatic route in the drugs and pharmaceuticals sector. As per DIPP, the drugs and pharmaceuticals sector has attracted FDI of $14.71 billion during April 2000 to March 2017. India has a total of 24,000 pharmaceutical companies, of which around 250 fall under the organised category, controlling nearly 70% of the market. Some of the major Indian private companies are Alembic Chemicals, Aurobindo Pharma, Ambalal Sharabhai Limited, Cadila Healthcare, Cipla, Dr. Reddy's, IPCA Laboratories, Kopran and Lupin Labs. Going forward, private sector participation is expected to increase and many global manufacturers could invest in India.

### Textiles manufacturing

The Indian textiles industry was valued at $108 billion in 2016 and is expected to reach $223 billion by 2021. The industry provides employment to about 45 million people directly and 60 million people indirectly. It is for this reason that the textile industry is the second largest employer after agriculture. It has the potential to further reach $500 billion by 2025. Of this, $315 billion is expected to come from domestic consumption and the remaining $185 billion is expected to come from exports. In 2016, the government approved a special package for employment generation and promotion of exports in the textile and apparel sector. This lead to a cumulative increase of $30 billion in exports and investment of INR74,000 crore during 2016-19.

### Electronics

The Government of India launched the National Policy on Electronics in 2012 (NPE 12) with the aim of making India an investor-friendly and growth market that can attract domestic and international players to invest in the country's electronics manufacturing sector. The government also focuses on promoting electronics manufacturing in the country with a target of net zero imports by 2020. The Indian electronics market is one of the largest in the world. At a CAGR of about 19.1% during 2012-22, it is expected to grow to $400 billion in 2022 from $69.6 billion in 2012.

### Chemicals

The Indian chemical industry is a major player in terms of the volume of chemicals produced. It could grow at 14% per annum to reach a size of $350 billion by 2021. India currently produces 7% of global dyestuff and dye intermediates. It is the world's third largest consumer of polymers and fourth largest producer of agrochemicals.

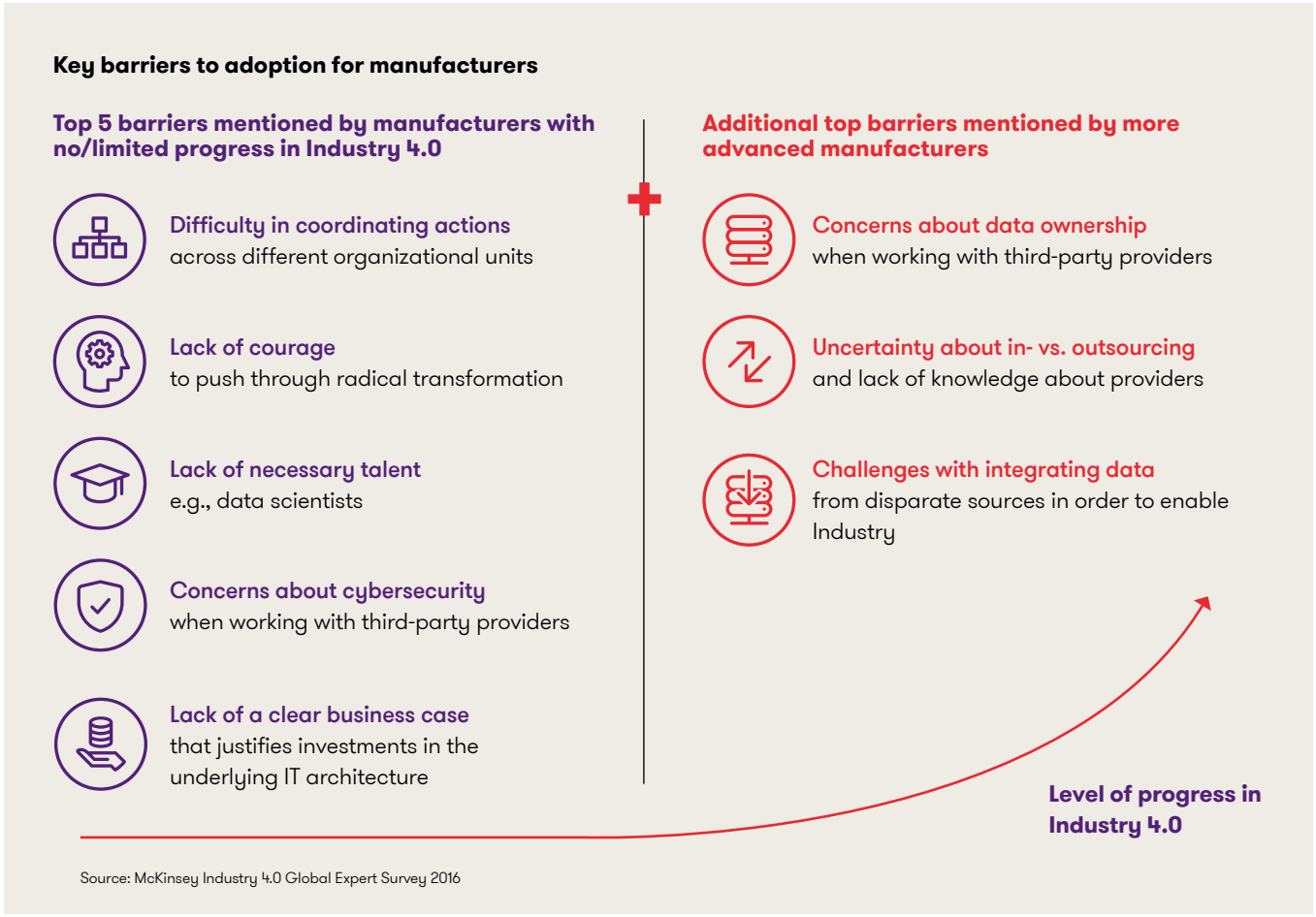
### Gems and jewellery

The gems and jewellery sector contributes nearly 6% to India's GDP. It is a highly export-oriented and labour-intensive sector. The sector generated $38.6 billion of revenue from exports in FY 2016. The Indian jewellery market is expected to grow at a CAGR of 15.9% during 2014-19. By 2022, the Gems and Jewellery Skill Council of India plans to provide training to more than four million people to fulfill the existing skill gap.

### Some recent projects/initiatives

In July 2018, Samsung inaugurated the world's biggest mobile phone factory in Uttar Pradesh. The factory will double the company's mobile phone production capacity to 120 million units by 2020.

- Huawei, the China-based smartphone manufacturer, entered into an agreement with solutions provider Flextronics Technologies (India) Private Limited to manufacture its smartphones in India. Flextronics would start by making 3 million smartphones at its facility in Chennai and is expected to generate an additional 1,500 jobs by year 2020.
- Zopo Mobile, a China-based smartphone manufacturer, plans to invest INR100 crore ($15 million) to set up a manufacturing plant in Noida, which will have a monthly production capacity of 100,000 units.
- Honda Motorcycle & Scooter India announced its plans to invest around Rs 600 crore ($88.94 million) to add a new line at its Narsapura facility at Karnataka, and launch at least 10-15 products
- In June 2016, Boeing Company, an American plane maker, and Tata Advanced Systems Ltd (TASL), a fully owned subsidiary of Tata Sons, entered into a joint venture to set up a new facility in Hyderabad to manufacture Boeing AH-64 Apache helicopter fuselages.
- As an outcome of World Food India held in November 2017, 13 companies (global and domestic) committed to invest a total of INR68,000 crore in food processing over the next few years.




## Government perspective

The India Economic Survey 2016-17 asserts that India is not only one of the fastest growing economies in the world, led by 'a stable macro-economy with declining inflation and improving fiscal and external balances', but also one of the few economies that are carrying out 'major structural reforms'. The growth prospects for India look optimistic and India is gearing up to becoming a global manufacturing powerhouse as the manufacturing sector forms the backbone of the Indian economy.

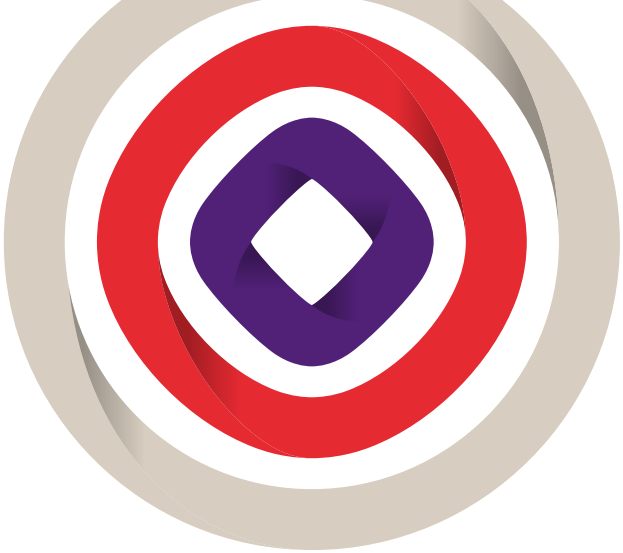
The government has remained focused on enhancing the situation of the manufacturing sector in the country. For this, it has brought in key policy changes and introduced initiatives including tax incentives and breaks. A key initiative in this respect is the Make in India project launched in September 2014, as a part of a wider set of nation-building measures. The programme is aimed to transform India into a global hub for manufacturing, research and innovation and an integral part of the global supply chain.

The first ever public-private collaborative process to finalise action plans for 21 focus sectors and state governments was undertaken in December 2014. In all, 118 action Plan Points for 21 focus sectors are being monitored; and 78% of the short-term action points had been implemented as last year.

Here is a list of various initiatives being taken by the government under the Make in India programme. These are expected to accelerate the growth of the 25 sectors that the programme covers.

### Improvement in infrastructure

- The Government of India is developing industrial parks so as to develop manufacturing hubs in the country. For example, NIMZs are being set up which are a combination of production units, public utilities, logistics, residential areas and administrative services. The zones will have manufacturing facilities along with processing areas, associated logistics and other required infrastructure. The non-processing areas will include residential, commercial and other social and institutional infrastructure. There are eight industrial and manufacturing zones which are planned to be set up inside the DMIC (Delhi Mumbai Industrial Corridor) and 14 are planned to be built outside the DMIC. Out of these, the NIMZs at Prakasam in Andhra Pradesh and Medak in Telangana have been granted final approval. The first phase of NIMZs is expected to be completed by 2020.
- India intends to leverage Industry 4.0 concepts and new technology in initiatives for manufacturing, smart cities, and overall infrastructure as part of the country's Digital India initiative. Special attention is being given to the development of the 25 sectors selected under the Make in India programme. For example, defence manufacturing has recently seen investments from both foreign as well as domestic investors. Significant developments in other sectors such as pharmaceuticals, textiles, food processing, chemicals, etc. are expected to boost the manufacturing sector as a whole. This is expected to create 100 million additional jobs by 2022. As per media articles, placement firms are bullish on the employment that the Make in India programme would generate. As per estimates, India is expected to employ 2.9 million flexi staff by 2018, thereby becoming the third largest country to employ contract employees globally. This would add 8% to 13% to the current pool of jobs in the country.
- More SEZs are being set up. These zones are considered as foreign territory for the development of industry, services and trade. Special relaxations are provided in customs duties. A liberal regime is followed in foreign investment and other levies.
- The Government of India is developing industrial corridors like the Delhi-Mumbai Industrial Corridor (DMIC). The first phase of development is expected to be completed by December 2019. It uses the high-capacity western Dedicated Railway Freight Corridor (DFC) through which the goods are transported. Other industrial corridors being developed are the Bengaluru-Mumbai Economic Corridor (BMEC), Amritsar-Kolkata Industrial Development Corridor (AKIC), Chennai-Bengaluru Industrial Corridor (CBIC) and East Coast Economic Corridor (ECEC).
- Clusters of specific industries are being set up such as electronic manufacturing clusters and mega food parks.
- Country-specific zones are being set up where all players from a particular country are allowed to set up operations. For example, the Neemrana Japanese Zone has been set up to help companies from Japan to set up base and production.



### Incentives under the Income-tax Act

- The Government of India in the Union Budget 2014-15 has provided investment allowance of 15% to manufacturers who invest more than $4.17 million in a particular year in new plant and machinery.
- Higher deductions of up to 200% have been provided for expenditure related to R&D (subject to the fulfillment of stipulated conditions).
- Export incentives have been provided under the Foreign Trade Policy. Several incentives such as duty drawback and duty remission schemes have been provided. The FTP for 2015-20 has notably simplified the various incentive schemes by merging them into one scheme each for merchandise and service exports, namely Merchandise Exports from India Scheme (MEIS) and Services Exports from India Scheme (SEIS).

### Incentives offered for manufacturing

- Sector-specific subsidies for promoting manufacturing are being provided. For instance, the Government of India is providing capital subsidy of up to 25% for 10 years for manufacturing of electronics.
- Incentives are provided for units in SEZs/NIMZs as specified in respective acts. In addition, projects in special areas such as the North East Region, Jammu & Kashmir, and Himachal Pradesh and Uttarakhand are also eligible for incentives.

### Ease of doing business

The following policies have been announced for improving the ease of doing business in the country.

- The rate of corporate tax for Indian registered companies has gone down from 30% to 25% of the net profit over four years starting from FY 2016-17 in a phased manner.
- The government paved the way for the roll-out of GST, a new tax regime, from 01 July 2017. GST is focused on ironing out the creases left by the predecessor tax regime and enhancing ease of doing business.
- The process for applying for Industrial License (IL) and Industrial Entrepreneur Memorandum (IEM) has been made easy and online.
- Initial validity period of IL has been increased from two years to three years. In addition, two extensions of two years each are allowed taking the total time up to seven years. This would give enough time to licencees to procure land and obtain all the necessary clearances/ approvals from respective authorities.
- Through an eBiz portal, a business user can fill the eForms online/offline, upload the attachments, make payment online and submit the forms for processing to the concerned department.
- In the Union Budget 2017-18, the Finance Minister announced reduction of income tax for MSME companies with annual turnover up to INR 50 crore to 25%.

## Customers' viewpoint on Industry 4.0

India is a young country, with nearly two-thirds of Indians under 35 and half under 25. By 2020, India is expected to be the youngest country in the world, with a median age of 29 years, compared with a median age of 37 years in China at that point. India's large youth population could potentially make it the biggest consumer market and the biggest labour force in the world.

India's youth who dominate its 130 million strong urban mass, earning $3,200 (INR 21,361) on average per month, is expected to be the key driver of the country's consumption story in the next 5-10 years. India has a young tech-savvy and educated population which creates a consumer market deeply tied into mobility and connectivity. The consumer growth today is driven by not only life's essential needs (food, clothing and house) but also growing consumption trends spanning better food, looking better, mobility, connectivity, having more fun, well-being and luxury.

The Indian market is ready to absorb the global trends as 86% of India's Generation Y uses mobile phones, 78% has access to the Internet and 75% has accounts on social media. The Indian youth is far more educated and aware than ever before.

They are keen to acquire the newest technologies in the market and show interest in utilising the components of Industry 4.0. India has been a dynamically driven country and welcomes new technologies introduced every now and then. Thus, if Indian manufacturers do not provide the consumers with the latest technologies, it is likely to impact the sales and may drive influence towards global manufacturers.

If Indian manufacturers do not provide the consumers with the latest technologies, it is likely to impact the sales and may drive influence towards global manufacturers.

# Innovations/ Developments that would support India

The Fourth Industrial Revolution encompasses a wide spectrum of technological advances across the value chain. It is considered an information revolution, which is the superimposition of big data, connectivity and information on top of industrial automation.

## Convergence of disruptive technology

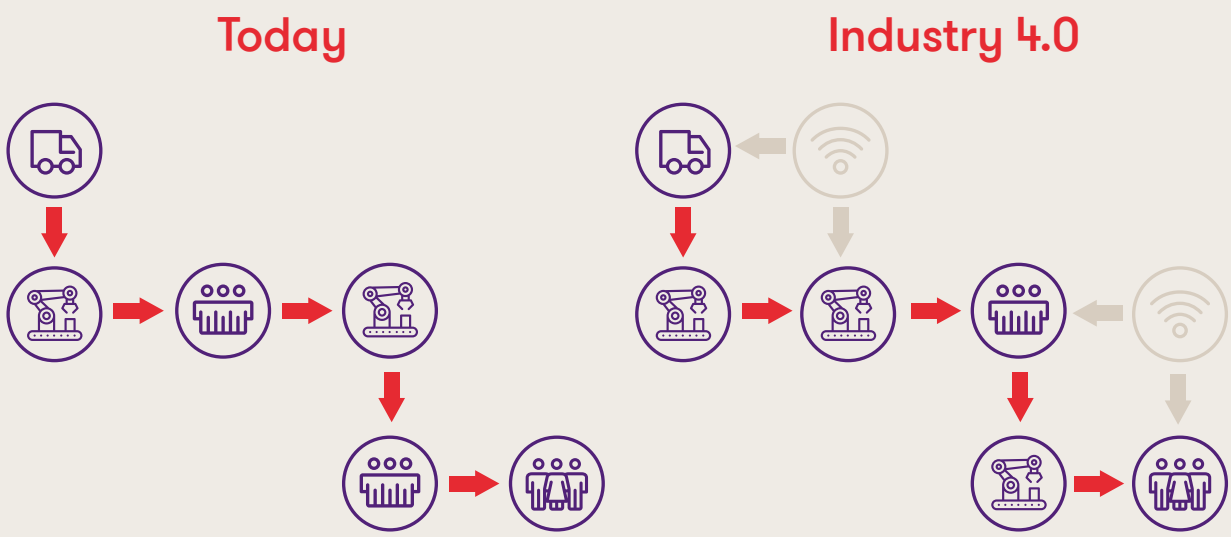
Industry 4.0 is a mélange of many futuristic and advanced concepts and technologies which have the potential of transforming the production scenario in the 21st century. It comprises a 'connected shop floor' where data is collected from various sensors and other input devices to be used for predictive maintenance, better control and long-term analysis. Any smart device or sensor in the field earlier had a lot of data related to the device or sensor itself, but this data was not accessible beyond the device. Industry 4.0 has ushered in a paradigm shift by focusing on a collaborative and connected ecosystem where all elements are part of a high speed network comprising of sensors, analytics platforms, enhanced humans and even comprising of robots and autonomous control systems.

The guiding philosophy of Industry 4.0 is the optimisation of smart, flexible supply chains, factories and distribution models where machines capture and convey more data via machine-to-machine communications and to human operators. All this aims at enabling businesses to make quicker, smarter decisions, all while minimising costs. Industry 4.0 is a paradigm shift from the traditional automation and enterprise planning systems in the fact that it leverages a constant stream of data from connected operations and production systems to derive actionable insights and drive optimisation and productivity.

**Changing traditional manufacturing relationships in Industry 4.0**

**From isolated, optimised cells...**

**... to fully integrated data and product flows across borders**




Greater automation will displace some of the least skilled labour but will require higher-skilled labour for monitoring and managing the factory of the future

Source: BCG: Industry 4.0 the future of productivity and growth.

# Big data and analytics

Success in manufacturing depends on constantly streamlining the operations. This traditionally involved in-depth analysis of processes, experimenting and testing out new ideas and implementing those changes, all manually. Analytics has disrupted this area by providing actionable, real-time insights that optimise manufacturing processes, reduce wastage, minimse downtime, reduce defects and wastages, etc.

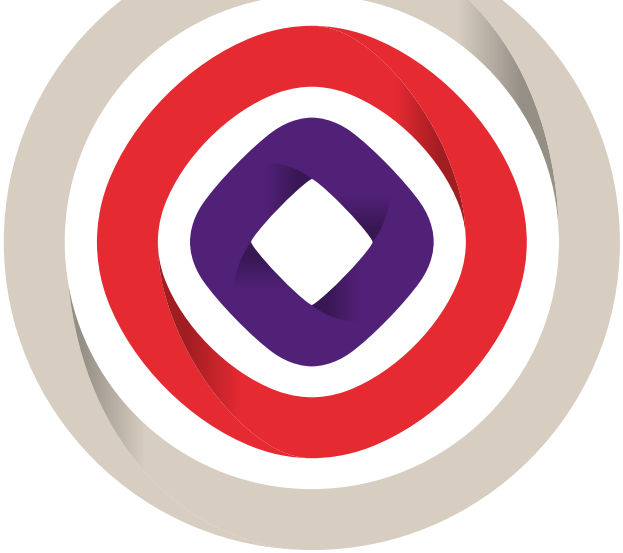
Real-time manufacturing intelligence is a key theme in Industry 4.0 driven by manufacturing analytics and machine monitoring.

The core theme behind manufacturing analytics is to create actionable insights by capturing, aggregating and analysing pertinent data from manufacturing operations ecosystems. This intelligence is then leveraged by humans to perform preventive maintenance with minimum downtime, insights-driven process changes and defect reduction. Smart factories managed primarily by systems can autonomously optimise operations and learn from different scenarios to adapt to the performance goals. Machine intelligence employs both prescriptive as well as descriptive analytics to generate insights majorly by monitoring machines and processes at an enhanced granularity.

Machine monitoring primarily leverages IoT sensors over a high density data communication channel to gather data and generate meaningful, contextually relevant information for manufacturing plant operations. This includes monitoring, managing, measuring and even predicting the production cycle times. Machine monitoring scope extends to measuring the efficiency of production process in addition to tracking failure.

Real-time manufacturing intelligence combines the real time monitoring capability of machine monitoring with the prescriptive and predictive capability of machine monitoring to provide the capabilities listed below:

- Reduce unscheduled downtime and optimise the scheduled downtime of the manufacturing process
- Identify opportunities for improvement and highlight deviations in the defined operating parameters
- Remote operation control that enables plant personnel, business managers, off-site technical support specialists and even autonomous plant management systems to monitor production data around the clock and provides the ability to make informed decisions, based on real-time production data from any location
- Integrate data from multiple platforms ranging from enterprise resource planning (ERP), supply chain management (SCM) to customer relationship management (CRM) and other enterprise systems to create and provide contextual intelligence
- Diagnostic capabilities to define new metrics and KPIs for tracking production capacity utilisations
- Enable tracking production costs and variances, as well as provide data to streamline failure analysis
- Predictive and prescriptive modelling discovers constraints or roadblocks in improving cycle times even at a process level
- Real-time tracking on the order stats from initialisation to production work in progress, finished goods, inventory and shipment status
- Overall equipment effectiveness enabled by sensors that measure the overall performance of a given machine, product line or work centre
- By combining order histories, customer purchase patterns, production scheduling, supply chain delivery and quality schedules, it is possible to determine which factors most and least contribute to perfect order performance. Manufacturers in build-to-order and engineer-to-order manufacturing rely on perfect order performance to determine how well their customised manufacturing workflows are working daily. One manufacturer found that just a 3% improvement in perfect order performance led to a 12% increase in gross contribution margins
- Track and optimise overall throughput effectiveness (OTE)
- Predict production yield and benchmark how the product, process and plant locations are performing versus the plan with a high amount of precision
- Return material analytics: At present, due to relying on Microsoft Excel spreadsheets to manage RM, manufacturers have no insight on what led to products being returned but with analytics, insights can be generated from return causes and patters which could enable manufacturers to take actions to alleviate the return factors and reduce costly refunds



**Revision in KPIs to align with updated maintenance strategies**

| | | From | To |
|---|---|---|---|
| **Examples of primary KPIs** | **Maintenance engineer** | • Mean time between failure<br>• % emergency or unplanned work orders | • Machine downtime<br>• % of failures not detected by models |
| | **Maintenance scheduler** | • % of deferred work orders (ie, %completed or scheduled) | [Reduced role, only applicable in large organisations]<br>• % of deferred work orders by equipment criticality |
| | **Maintenance technician** | • % of scheduled orders completed<br>• % of rework orders | • % of scheduled orders completed<br>• % of rework orders1 |
| **Performance dialogue** | **Content focus** | • Focus on diagnosing potential root causes | Review of effectiveness of maintenance strategies (eg, identifies new sensors to predict failures) |
| | **Frequency** | Regular (eg, weekly, monthly, quarterly) | Real time (where needed) to allow for agile and fast-paced actions |
| | **Medium** | Physical whiteboard on shop floor, printouts, or simple digital tools (eg, spreadsheet) | KPIs automatically measured in real time and visualised in digital app (viewed on mobile device) |
| **Key data sources** | | Multiple sources of enterprise-resource-planning (ERP) data (eg, Maximo, SAP) on relevant events (historical failures, work orders) | Single source of data in unified system:<br>• ERP data on relevant events (historical failures, work orders)<br>• – Machine-condition data from programmable logic controller and sensors (condition monitoring, predictive maintenance app) |

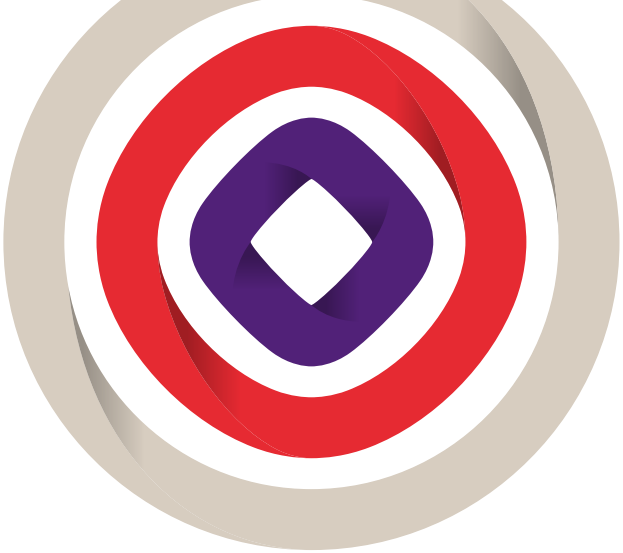
Source: Industry 4.0: Reinvigorating ASEAN Manufacturing for the Future, McKinsey

# Autonomous robots

Autonomous robots have a huge potential in reducing repetitive manual labour, bringing down the manufacturing cost and reducing defects. Autonomous systems, which were introduced during Industry 3.0, were highly specialised for a singular task, costly and expensive to maintain or reprogram. With Industry 4.0, the robots are leveraging AI and machine learning to be more autonomous, flexible and cooperative.

Industry 4.0 focuses on the close collaboration between robots and humans in tackling manufacturing challenges. Deep actionable insights from autonomous robots (physical or software-based) and human employees can quickly and deliberately remedy issues or handle increasing volumes at the same or lower-unit cost.

Leaps in camera technology, machine vision, image analytics have been the key drivers in propelling plant robotics. Robots are increasingly being deployed in the shop floor production, materials handling and distribution warehouses. AI has enabled robots to operate in a range of static as well as dynamic environments, along with the capabilities to collaborate side by side with humans and even learn tasks that they are not exclusively programmed for. In addition to reducing the cost of labour, the deployment of physical robots also encourages employees to further refine complex skillsets and heighten strategic capabilities — ultimately lending greater value to the organisation.



## Industrial Internet of Things (IIoT)

IIoT focuses on how smart machines, networked sensors and sensor analytics can improve manufacturing. IIoT leverages and seeks to improve on the already existing technologies of sensor data, machine-to-machine (M2M) communication, machine learning and industrial automation technologies. IIoT is basically a technology that connects devices to the internet and the real-time data to be captured.

Leveraging machine learning on the pool of sensor data can generate contextually relevant actionable insights that could drive operational improvements. In the Industry 4.0 context, IoT enables the capture of all available information from the plant floor to supply chain and real-time analysis and actionable insight generation from this data in real time leveraging machine analytics. This would enable streamlining and optimising of business processes, systems and devices. IIoT enables manufacturers to identify inefficiencies and problems at an early stage, thus saving money and enabling business intelligence.

In Industry 4.0, IIoT is the driving technology for quality control, supply chain efficiency, supply chain traceability and promoting sustainable green practices.

## Industrial cybersecurity

Cyber-attacks have been increasingly getting higher in frequency and catastrophic in nature. With Industry 4.0, the industrial enterprises would be highly networked, shared and connected, which raises the stakes of cyber-attacks even further. From a security perspective, the increased networking and usage of commercial off-the-shelf (COTS) products introduces a variety of exposure points that could be abused by threat actors. In contrast to generic IT where the focus is the information, industrial cyber security focuses on the industrial process. In contrast with traditional cyber risk, which focuses on acquiring and exploiting information of confidential nature, in the Industry 4.0 context the attacks could disrupt the availability and integrity in the physical world.

In Industry 4.0, with integration and deployment of IoT sensors, robots and autonomous plant control systems, the security risks are heightened in manufacturing, production and enterprise networks. The security impacts could lead to downtime in production, equipment damage, catastrophic machine failures and, in extreme cases, even physical injury or loss of life of workers. In addition to immediate incident-remediation costs revenue loss, fines or litigation expenses lasting months or even years could occur.

There is no panacea that could enable complete protection from all the cyber risks and vulnerabilities out there. Manufacturers would have to prioritise their cyber risk mitigation strategies, business continuity and disaster recovery plans to accommodate the evolving and complex cyber landscape. Deploying a risk-reducing architecture and staying abreast of the latest in cybersecurity (threats and possible mitigation steps) by relying on trusted partners are a must to protect all connected devices and environments on all fronts.

Technologies such as advanced cryptography and encryption, hardware authentication protocols, trusted platform modules and physical security modules incorporated into physical and software systems can provide a level of risk mitigation. By combining this approach with robust access controls, mission-critical operations technology can be secured at the application points and endpoints to protect its data and processes.

Any secure smart environment should have a sound foundation that uses next-generation intrusion detection and prevention, application whitelisting, integrity monitoring, virtual patching, advance sandboxing analysis, machine learning, behaviour analysis, antimalware, risk detection, vulnerability assessment, next-generation firewall, anti-spear-phishing, spam protection and data leakage technologies.

## Product lifecycle management (PLM)

PLM is the process of managing the entire lifecycle of a product from inception, through engineering design and manufacture, to service and disposal. It integrates people, data, processes and business systems and provides a product information backbone for companies and their extended enterprise. PLM is about breaking the silos between engineering, manufacturing, sales and marketing, service and support. Industry 4.0 will take PLM to an extra level of integration and complexity. It is a gradual process as it will require:

- New collaboration networks that are more spontaneous and flexible
- Rapidly scalable solutions which are based on user-centric and on-demand collaboration, instead of document-centric data exchanges
- Openness and IP management
- Replacement of all legacy solutions which are not integrated by new technology solutions that embrace consumer IT innovations, technologies and cross-industry and cross-organisational learning

This may allow companies to involve their customers more closely in the production process and react faster on changing market requirements. Also, the ideal factory envisages a self-controlling production process, in which production reacts autonomously to changes or faults and takes appropriate measures. This shall bring systems engineering, production IT and business systems to a new level — leveraging business benefits from an increasingly integrated PLM.

## Cyber physical production systems (CPPSs)

CPPSs are a consequence of the far-reaching integration of production, sustainability and customer-satisfaction forming the basis of intelligent network systems and processes.

At present, we find ourselves at the beginning of this fourth stage, which is characterised by CPPS. These systems provide the basis for the creation of an IoT which combines with the Internet of Services to make Industry 4.0 possible. They are 'enabling technologies' which make multiple innovative applications and processes a reality as the boundaries between the real and virtual worlds disappear. The interplay between high performance software based embedded systems and dedicated user interfaces which are integrated into digital networks creates a completely new world of system functionality. Cyber physical systems are expected to represent a paradigm break from existing business and market models, as revolutionary new applications, service providers and value chains become possible. Industry sectors including the manufacturing industry, the energy economy and production technology, for example, may in turn be transformed by these new value chain models.

## 3D printing, computer-aided engineering and prototypes

CPPSs are a consequence of the far-reaching integration of production, sustainability and customer-satisfaction forming the basis of intelligent network systems and processes.

At present, we find ourselves at the beginning of this fourth stage, which is characterised by CPPS. These systems provide the basis for the creation of an IoT which combines with the Internet of Services to make Industry 4.0 possible. They are 'enabling technologies' which make multiple innovative applications and processes a reality as the boundaries between the real and virtual worlds disappear. The interplay between high performance software based embedded systems and dedicated user interfaces which are integrated into digital networks creates a completely new world of system functionality. Cyber physical systems are expected to represent a paradigm break from existing business and market models, as revolutionary new applications, service providers and value chains become possible. Industry sectors including the manufacturing industry, the energy economy and production technology, for example, may in turn be transformed by these new value chain models.

# Cloud

Cloud can be considered as a game changer in the way it has brought into the picture unprecedented levels of computation, storage and network capabilities without adding to the capital expenditure. Cloud computing is a driving element in Industry 4.0 that helps to pool and centralise information for the businesses, while also offering a platform for open source collaboration to expedite and refine research. Cloud enables the amalgamation of analytics, robotics and IoT, which contribute to innovative developments in the long run.

The value propositions of the cloud are enhanced agility, accelerated product development, innovations and significant cost saving from shifting to an OPEX model. Cloud enables manufacturers to securely store, process and analyse data from their industrial devices. By using the cloud platform, manufacturers can optimise production processes, enhance supply chain efficiencies and embrace predictive maintenance capabilities.

In the Industry 4.0 context, cloud also drives collaboration between the numerous ecosystem players. Companies are now more willing to pool and share information, instead of hoarding and concealing it from competitors. This effort to open up channels of communication will benefit everyone and allow more refined results.

Cloud computing provides nearly unlimited storage capabilities. Thus, the more information that is acquired, the greater the need for proper organisation in order to make that information contextually relevant, accessible and actionable. With that, returns will be observed quicker and frequently.

## AR, VR and simulations

AR platforms in the context of Industry 4.0 can be potent real-time information-dissemination systems that could enhance decision making and collaboration. Use cases range from guiding a skilled worker in production to real-time collaboration within a team.

AR can be a great tool in plant scenarios where guidance is required by the worker for installation, assembly, retooling, repair, etc. AR can be invaluable in reducing human errors and execution times and optimising the production process by relaying performance analytics to maintenance managers in a readily cognisable form. In training scenarios, for training new hires or upgrading the skills of experienced employees, AR courses can be very effective. AR is also being increasingly used in logistics of distribution and warehouse management operations for navigating indoors and locating items.

AR platforms are also used in quality control to compare the product specifications with the prescribed ones easily and conveniently. AR is also impacting the designing phase by providing interactivity in design, visualisation and prototype phases.

Virtual reality (VR) solutions are innovating and transforming the traditional manufacturing environment to a digital work place. VR enables training in a virtual world that accurately mimics the virtual world and enables training of personnel to gain experience that would be time consuming to organise, expensive to replicate and even carry an amount of safety risk in an effective and cost-efficient manner

VR is also impacting factory planning in the context of establishing a new plant or revamping one — activities that carry a lot of work and operational loads in the design, testing and trials. Traditional methods are highly time consuming and costly in terms of delays and production line shut downs. VR is proving to be a potent alternative in this context. Virtual models that mimic the real world can be developed and tested virtually infinitely without the time to reset and the cost burden attached to it. VR is also driving remote maintenance and inspection in conjunction with drones and robots for hard-to-reach and unsafe areas.

Simulation in the Industry 4.0 context enables a key concept called 'digital twin', which can be defined as a digital representation of a physical entity that could be a machine, product warehouse and even an entire manufacturing plant. Digital twin is a real-time representation that reflects the status of the physical counterpart using sensors and data from multiple sources and even integrates historical data to predict outcomes. This has been made possible by the leaps in computing power and connectivity in this digital age. The value proposition of simulations is to design, test, build, operate and service products and machines in a virtual environment. This could reduce the go-to-market time, downtime and costs.

A digital twin is a digital model that has the ability to update and change as its physical counterpart changes. The digital twin is constantly learning and updating itself from multiple sources to represent the real-time status. It can also integrate historical data from past machine usage to factor into its digital model.

Hero Moto Corp, the world's largest two-wheeler manufacturer, has implemented digital twin concepts in their Vadodara manufacturing facility to enable changes and enhancements virtually before implementing them physically.

## Challenges

India, being in the nascent stages of disruption from Industry 4.0, faces a plethora of challenges to adopt, adapt and scale at an enterprise level to derive meaningful impact from the efforts. The key challenges include:

- Low awareness of adopting Industry 4.0 themes as the core in the manufacturing business strategy. This is even more troubling in the context of public enterprises and government sector.
- Lack of real life, implemented business use cases highlighting the ROI from Industry 4.0, pertinent to players across the manufacturing sector.
- High costs of tools and platforms such as analytics and autonomous management platforms, implementation cost and costs associated with enabling hardware such as IoT sensors, high density data connections, AR/VR/simulation platforms, security hardware, autonomous control hardware, etc.
- Lack of adequate talent and skilled resources to build and implement Industry 4.0 technologies at scale. According to NITI Aayog estimates, only 4% of professionals in India have worked on emerging technologies such as machine learning and manufacturing intelligence. There is also a significant gap of PhD research scholars in the field.
- Difficulty in access to industry-specific data required to build customised platforms and solutions currently concentrated in the hands of a few major players. It is difficult for new entrants to deliver tailor-made services that can compete with global data-rich incumbents. This phenomenon results in the creation of a virtuous cycle which reinforces the hegemony of the big few, especially in the manufacturing AI space, creating a huge entry barrier for startups.
- Unclear privacy, security and ethical regulations.
- Unattractive intellectual property regime to incentivise research and adopt the Industry 4.0 technology stack.
- The IT industry in India has remained content in delivering traditional IT services and has been slow to adapt to new digital technologies compared to its counterparts in China and the US.

These challenges, while by no means exhaustive, if addressed through concerted collaborative efforts by relevant stakeholders, with government playing a leading role, could lead to fundamental building blocks that form the core of India's march towards leadership in Industry 4.0.

## Talent supply

History is full of examples of how technology has disrupted the nature of jobs and the skills required to perform them, requiring the global workforce to continuously adapt. The advent of Industry 4.0 has accelerated this disruption to a pace that has not previously been seen, due to the wide range of capabilities it offers and the speed at which it is developing.

NASCCOM predicts that by 2022, 46% of the Indian workforce will be engaged in entirely new jobs that do not exist today or jobs that require radically changed skill sets. Some other sources estimate that demand for Industry 4.0 specialists in India is expected to see a 60% rise by 2033. In the data domain as well, an independent study has estimated that India will face a demand-supply gap of 2,00,000 data analytics professionals by 2020.

India appears to be relatively well positioned to take advantage of the Industry 4.0 disruption by virtue of its advanced IT sector and large youth demographic potential to establish itself as the future hub for technology-related activities. However, given the poor availability of qualified faculty and researchers, this advantage could fast transform into a liability without urgent government interventions towards promoting access to such skills. This is a critical component of the Industry 4.0 technology stack skill development, and should be a national priority.

Multiple studies have underlined the lack of employment readiness of science, technology, engineering, and mathematics (STEM) graduates, thus highlighting the poor standard of education in engineering colleges in India. As per some estimates, almost 80% of engineering graduates are unemployable. Low availability of specialised faculty, lack of flexibility in curriculum revisions in engineering and computer science courses to keep up with rapid advancements

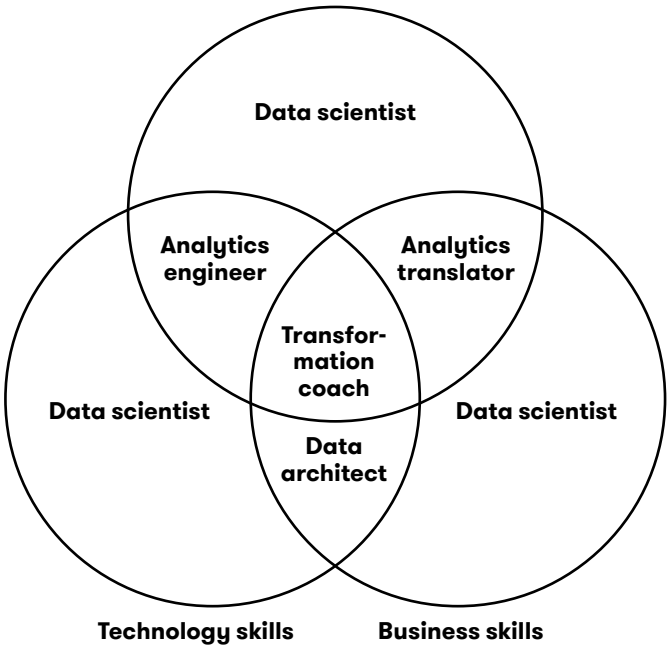
in technology and low levels of interdisciplinary research in AI, robotics, IoT and related fields to facilitate an emerging technology education for non-computer science engineering (and vice versa) are just some of the factors that have led to this scenario.

At the school level as well, poor outcomes in maths and reading are particularly troubling, since these subjects form the foundation of knowledge required to move to an analytics and machine AI related education and later jobs in the domain.

Talent creation also does not come cheap and has a long gestation period. Again, scale plays a role and the large tier I manufacturers have started to show the way by hiring world-class talent in leadership roles. Paucity of management and technical talent, together with upskilling programmes for workers, which are all affecting the industry growth, need attention. Productivity will be realised only if we have the talent to manage technology, and subsequent scale created by R&D investments.

**Key barriers to adoption for manufacturers**

**Digital and analytics skills**




**Example of roles and typical profiles needed**

| | |
|---|---|
| **Data scientist** | • Background in (applied) mathematics, data mining, statistics, machine learning, computer science, physics<br>• Builds the mathematical algorithms |
| **Analytics engineer** | • Data-scientist background with more focus on computer science and programming<br>• Takes data scientist's algorithms and makes them more efficient |
| **Analytics translator** | • Data-scientist background + additional background and experience in business<br>• Understands business problem and translates into technical language and vice versa |
| **Transformation coach** | • Lines up top talent, with 5–10 years of business and operations experience and with an open mind to learn digital and IT<br>• Coaches line operators and managers on driving integrated performance and digital transformation |

Source: McKinsey, Industry 4.0: Reinvigorating ASEAN Manufacturing for the Future

The following are some of the key barriers that hamper specific research initiatives in Industry 4.0 technologies as detailed by the Project Report of Inter-Ministerial National Mission on Interdisciplinary Cyber Physical Systems:

- **Lack of collaborative/interdisciplinary approach:** Research is mostly focused in silos in academic institutions.
- **Lack of scale for experimental validation:** Due to various practical and financial reasons, university research is largely restricted to theoretical or laboratory scale. This needs to be augmented with pilot projects/large-scale test beds/laboratories.
- **Lack of facilities to support large-scale experimental test beds:** Large-scale experimental test-beds are difficult to construct, maintain and operate, solely by academic institutions.
- **Lack of connect with stakeholders and practitioners to convert outputs to outcomes:** The views of the stakeholders in terms of what application problems to focus on will be of great importance to ensure practical applicability of the research. At the same time, this should be facilitated in a way which does not constraint/suffocate the academic researchers in order for them to make foundational advances. Involving 'technology translators' at an early stage, ie entrepreneurs/agencies/companies which can convert the research technologies to commercial products, is needed.
- **Lack of large-scale mission mode project management capabilities:** Academic researchers usually work best individually (with a small team of students and research project staff). Current approaches to research and related facilities may not be suited for large scale experimental projects.

The key government initiatives aligned to address the talent supply gap are as follows:

## Skill India

The government has launched a multi-skill development programme to make the labour workforce job-ready and fit for pursuing entrepreneurship. Its mission is to create a workforce which is more mobile and more employable. The programme aims at fulfilling the skilling needs of approximately 800 million citizens of the country by incentivising skill training and providing financial rewards to candidates who successfully complete approved skill training programmes. Emphasis is being given on new areas like real estate, construction, transportation, textile, gem industry, jewellery designing, banking, tourism, etc., where demand for skill development is high.

**IPR norms have been amended to spur innovation:**

The Patent Amendment Rules 2016 provide for:

- Timelines imposed for speedy disposal
- 80% rebate in fees for start-ups
- Expedited examination on certain grounds
- Refund of fees and withdrawal of application
- Hearing through video conferencing

Some of the recommendations as outlined from NITI Aayog's National strategy for AI that can be considered for addressing the talent supply gap are as follows:

Incentivising creation of jobs that could constitute the new service industry: Specific policy interventions could be considered like tax holidays, inclusion under CSR activities, etc., to help solve the dual problem of workforce job displacement and creation of expertise in fundamental sections of the solution development value chain.

**Recognition and standardisation of informal training institutions:** The increasing demand for Industry 4.0 technology related job positions has not gone unnoticed by the Indian workforce, with a large percentage of them opting for training institutions to bridge their knowledge gaps. In technology hubs such as Bengaluru, this has led to many traditional IT training institutions establishing courses in new-age technologies. However, their standard of education is hard to assess for companies looking to hire.

Implementation of recognised certificate courses through higher education institutions could be a major boost to

recognising resources spent on re-skilling, and holding these institutions to standards in delivery of knowledge. International School of Engineering (INSOFE), for example, provides certification recognised by the Language Technologies Institute of Carnegie Mellon University (CMU) for a post-graduate programme in data analytics and optimisation. Jigsaw Academy's data science postgraduate programme gets its students certified from the University of Chicago Graham School. Integration and application of existing standards such as laid out by the National Skill Qualification Framework (NSQF) should also be explored. Given that standards in areas such as big data exist but are not used by institutions for certification also highlights the need for them to be designed in closer collaboration with the private sector.

**Creation of open platforms for learning:** Initiatives such as the NASSCOM Future Skills Platform will play an instrumental role in large-scale dissemination of requisite skills to some major sections of the employed workforce. Online and self-learning platforms, such as Coursera and edX, are able to connect learners to the best universities and institutions from around the world and can play a crucial role in this scenario. There is a need to bring out guidelines for promoting these while ensuring uniformity, standards and usability. As in the promotion of MOOCs, large-scale deployment and adoption of these platforms requires stringent measuring of quality, and recognition of their certification.

**Creating financial incentives for reskilling of employees:** Initiatives in reskilling of employees or allowing employees to undergo reskilling initiatives have a high opportunity cost for private companies and may affect their willingness to let their employees engage in the process at scale. Thus, co-funded models between the government and companies need to be explored, in the IT sector particularly. Financial incentives for private companies could include payroll taxes which are dedicated to subsidising training opportunities, income tax deductions for companies participating in reskilling initiatives, special taxes to be paid if a minimum training budget is not disbursed, as well as public grants for subsidising training especially for smaller sized firms. Considering also the time required for reskilling, and the cost it entails to employers, financial incentives may also be tied to mandatory allocation of time for reskilling activities by companies for their workforce. However, in the absence of standardisation of training modules and institutions, such initiatives could be prone to misuse.

# Investment scenario

## FDI trends

According to the Department of Industrial Policy and Promotion (DIPP), the total FDI investments in India during April-June 2018 stood at $12.75 billion, indicating that the government's efforts to improve ease of doing business and relaxation in FDI norms are yielding results.

Data for April-June 2018 indicates that the services sector attracted the highest FDI equity inflow of $2.43 billion, followed by trading at $1.63 billion, telecommunications at $1.59 billion and computer software and hardware at $1.41 billion. The total FDI equity inflows for the month of June 2018 touched $2.89 billion.

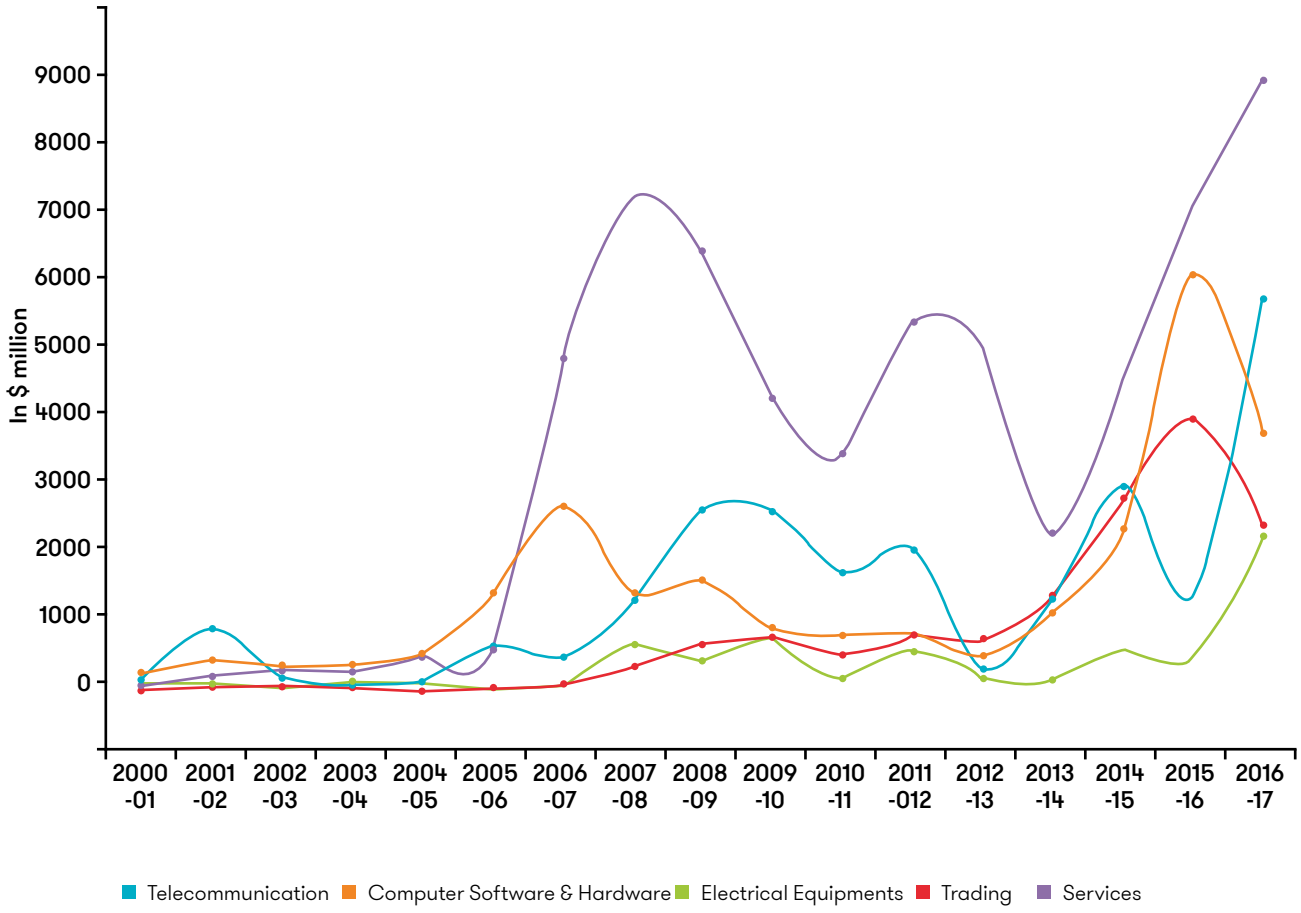
During April-June 2018, India received the maximum FDI equity inflows from Singapore ($6.52 billion), followed by Mauritius ($1.49 billion), Japan ($0.87 billion), Netherlands ($0.84 billion) and United Kingdom ($0.65 billion).

If Indian manufacturers do not provide the consumers with the latest technologies, it is likely to impact the sales and may drive influence towards global manufacturers.

## India Brand Equity Foundation (IBEF) investment trends

- India has become the most attractive emerging market for global partners (GP) investment for the coming 12 months as per a recent market attractiveness survey conducted by the Emerging Market Private Equity Association (EMPEA).
- Annual FDI inflows in the country are expected to rise to $75 billion over the next five years, as per a report by UBS.
- The World Bank has stated that private investments in India are expected to grow by 8.8% in FY 2018-19 to overtake private consumption growth of 7.4% and thereby drive growth in India's GDP in FY 2018-19.
- In February 2018, IKEA announced its plans to invest up to INR 4,000 crore ($612 million) in the state of Maharashtra to set up multi-format stores and experience centres.
- In November 2017, 39 MoUs were signed for investment of INR 4,000-5,000 crore ($612-765 million) in the north-east region of India.
- In December 2017 , DIPP approved FDI proposals of Damro Furniture and Supr Infotech Solutions in the retail sector, while the Department of Economic Affairs, Ministry of Finance, approved two FDI proposals worth INR 532 crore ($81.4 million).
- The Department of Economic Affairs closed three FDI proposals leading to a total foreign investment worth INR 24.56 crore ($3.80 million) in October 2017.
- Kathmandu-based conglomerate CG Group is looking to invest INR 1,000 crore ($155.97 million) in India by 2020 in its food and beverage business.
- International Finance Corporation (IFC), the investment arm of the World Bank Group, is planning to invest about $6 billion through 2022 in several sustainable and renewable energy programmes in India.

**Key barriers to adoption for manufacturers**




Source: Open Government Data (OGD) Platform, Government of India

According to a Grant Thornton report, The Fourth Wheel, e-commerce, start-ups, banking and financial services, real estate and IT/ITeS continued to the top sectors in terms of PE investments. A common theme across investments since 2015 has been 'technology as an enabler'. E-commerce, start-ups, IT/ITeS and a portion of BFSI, all of which are technology-driven, have contributed to over 80% of deal volumes and 57% of deal values since 2015, and the share will continue to grow going forward. Based on the analysis of these trends, it can be noted that start-up investments, specifically in the manufacturing sector and manufacturing use cases focusing on Industry 4.0 themes, are a minority. The major deterrents for start-ups in the manufacturing sector seem to be the capital and skilled man power intensive nature of the business.

# Conclusion

Industry 4.0 will revolutionise manufacturing around the globe, as did the first three industrial revolutions. With global supply chains and highly interactive markets, this revolution will be vastly different from the previous ones: being much faster and generating unprecedented results. It will highlight the fact that small changes in one area of the manufacturing ecosystem will create significant ripples throughout the ecosystem, due to connectivity throughout the supply chain and the speed at which information propagates. Furthermore, Industry 4.0 will enable information to flow not only from manufacturer to product, but between producers, products and, most importantly, customers.

The ability to embrace Industry 4.0 and use the opportunities that will rapidly (and, in many instances, unexpectedly) present themselves will be the key to success in the new global market. Enabling that innovation to proceed from a concept to a mass-produced product will be critical for success; thus, creating a talent pool in the manufacturing workforce that can move those innovations rapidly forward will be equally important. India has a number of programmes to enable innovation and ensure the talent pipeline for manufacturing. Some are well established and some are quite new and very innovative.

NITI Aayog, in their National Strategy for Artificial Intelligence, recommends that to achieve technology leadership, India needs to pursue 'moonshot' projects – ambitious explorations that aim to push the technology frontier and which would require the pursuit of world-class technology development and leadership in applying AI technologies to solve some of the biggest challenges. A potential project could be tested on a twin criterion of whether it is (a) a new technology or scientific area that has emerged or gained traction and has the capability of solving, often in new ways, practical problems of importance, and (b) whether it addresses emerging user needs that existing and available technology solutions cannot address.

The education sector needs to be re-aligned in order to effectively harness the potential of AI in a sustainable manner. In primary and secondary schools, there is a need for transition to skill-based education in subjects relevant to AI. Increased amount of project-related work across education levels, promoting schemes like ATLs (Atal Tinkering Labs) in schools and necessary change in curricula in schools are some of the steps that need to be considered to promote early adoption of technology organically.

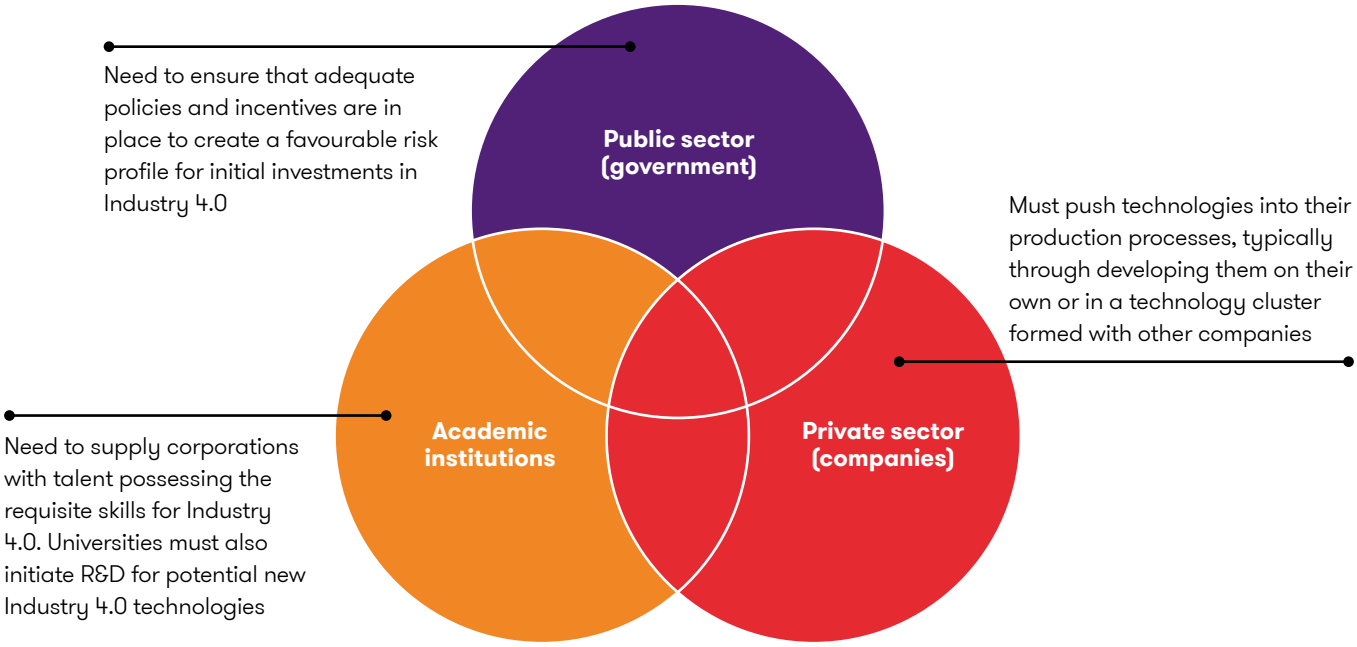
The limited success of Indian technology players to effectively adapt and carry forward the revolution suggests the need for government intervention to promote Industry 4.0 technology adoption, lest India lose the chance to secure a prominent position on the global technology map. While acknowledging the need to promote Industry 4.0, governments at different levels, along with their various instrumentalities, should adopt proactive measures to accelerate adoption in private and public sector undertakings.

In higher education institutions, there is need for increased collaboration between industry and academia through creation of channels of communication between faculty and industry to promote exchange of ideas and expertise. Various avenues of collaboration need to be explored, including workshops, incentives for guest lectures by professionals and institutional arrangements for regular re-design of courses in collaboration with the private sector.

Startups and smaller firms are the engine for growth in a dynamic evolving economy like India, and are constrained in the Industry 4.0 technology stack, thus requiring targeted government interventions.

- Incubation hubs, specifically for startups in collaboration with state governments and private sector stakeholders, need to be set up to provide space and other infrastructure facilities for new startups to incubate along with interacting with other startups at various levels of maturity in order to interact and provide advice.
- A fund needs to be established to provide grant funding to start-ups to facilitate their operation and business. This should be aimed at assisting start-ups to sustain the initial years of business when they are unable to generate venture capital funds or have to sacrifice a large share of the business for early stage seed funds.

**Industry 4.0 enablers and their roles**




Source: McKinsey, Industry 4.0: Reinvigorating ASEAN Manufacturing for the Future

- It is clear that Industry 4.0 presents tremendous opportunities, and this fact highlights the need for a highly trained and flexible workforce and production capacity that can answer the needs of tomorrow as well as those of today.
- To quote Eric Hoffer (1902-1983), a 20th century American philosopher, "In times of change, learners inherit the earth; while the learned find themselves beautifully equipped to deal with a world that no longer exists." This statement was true in the 20th century and is certainly true today. However, with the ever-accelerating pace of technology innovation, it will become increasingly pertinent in the future. India stands ready for that future: not only to participate, but also to lead!

# About PHDCCI

PHD Chamber of Commerce & Industry, a leading industry chamber of India, ever since its inception in 1905, has been an active participant in the India growth story through its advocacy role for the policy makers and regulators of the country. Regular interactions, seminars, conferences and conclaves allow healthy and constructive discussions between the government, industry and international agencies bringing out the vitals for growth. As a true representative of the Industry with a large membership base of 1,30,000 direct and indirect members, PHD Chamber has forged ahead leveraging its legacy with the Industry knowledge across sectors (58 Industry verticals being covered through expert committees), a deep understanding of the economy at large and the populace at the micro level.

At a global level, we have been working with the embassies and high commissions in India to bring in the international best practices and business opportunities.

## Seven thrust areas

- **Industrial development**
- **Infrastructure**
- **Housing**
- **Health**
- **Education and skill development**
- **Agriculture and agribusiness**
- **Digital India**

**PHD Chamber of Commerce and Industry**

PHD House, 4/2 Siri Institutional Area, August Kranti Marg, New Delhi 110016

T: 91-11-26863801-04, 49545454 F: 91-11-26855450, 49545451

E: iphdcci@phdcci.in | W: www.phdcci.in

# About Grant Thornton in India

Grant Thornton in India is a member of Grant Thornton International Ltd. It has over 3,000 people across 15 locations around the country, including major metros. Grant Thornton in India is at the forefront of helping reshape the values in our profession and in the process help shape a more vibrant Indian economy. Grant Thornton in India aims to be the most promoted firm in providing robust compliance services to dynamic Indian global companies, and to help them navigate the challenges of growth as they globalise. Firm's proactive teams, led by accessible and approachable partners, use insights, experience and instinct to understand complex issues for privately owned, publicly listed and public sector clients, and help them find growth solutions.

Over 3000 people

15 locations in 13 cities

One of the largest fully integrated Assurance, Tax & Advisory firms in India

"Our competitive advantage includes our use of software technology, experience in working with international clients, language skills, and commitment to value and excellence."

**Vishesh C Chandiok,**
**Chief Executive Officer, Grant Thornton India LLP**

# Sources

World Economic Forum: The Next Economic Growth Engine Scaling Fourth Industrial Revolution Technologies in Production, 2018

NITI Aayog, National Strategy for AI

Grant Thornton: India's Readiness for Industry 4.0 – A focus on Automotive Sector:

McKinsey & Company - Industry 4.0: How to navigate digitization of the manufacturing sector

NASSCOM: NASSCOM sets-up cyber security task force to build India as the cyber security hub

IMPULS Foundation of VDMA, Industry 4.0 Readiness

World Economic Forum: White Paper: Technology Innovation Future of Production, 2017

McKinsey & Company: Getting the most out of Industry 4.0

Indian Brand Equity Foundation

Xavier Mesnard, Partner, A.T. Kearney

Data.gov.in

IBEF: FDI and Investment trends

Grant Thornton: The Fourth Wheel, 2018

McKinsey & Company, Industry 4.0: Reinvigorating ASEAN Manufacturing for the Future

# Acknowledgements


**Grant Thornton in India**

Depender Kumar
Navin Kumar
Rahul Anil

**PHDCCI**

Dr. Jatinder Singh
E: jatinder@phdcci.in

Mr. Punit Chaudhry
E: punit@phdcci.in
M: +91 99115 76699

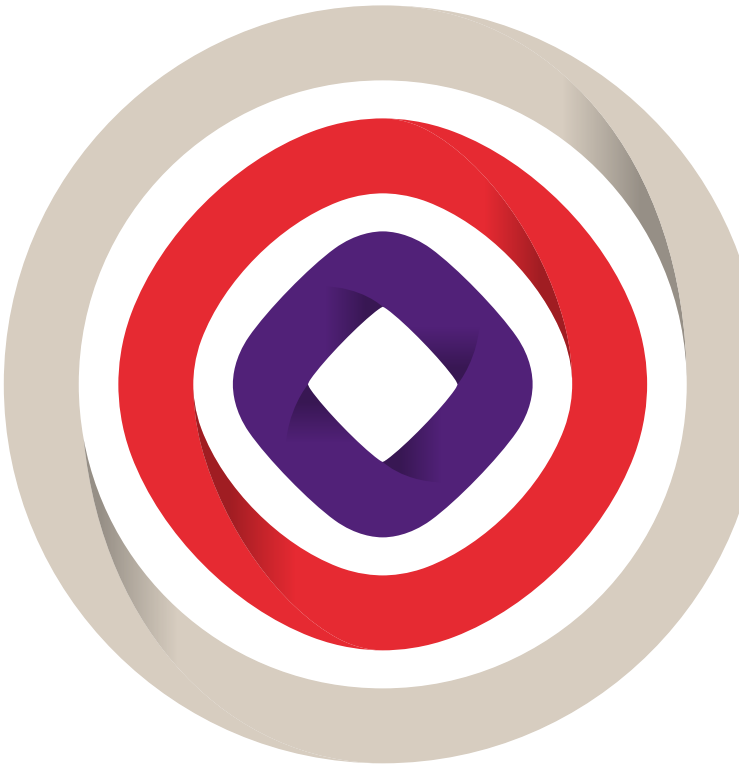
**For media queries, please contact**

**Spriha Jayati**
E: spriha.jayati@in.gt.com
M: +91 93237 44249

| Editorial review | Design |
| --- | --- |
| Tanmay Mathur | Gurpreet Singh |

**For more details, contact**

**Depender Kumar**
Partner
Grant Thornton Advisory Private Limited
E: depender.kumar@in.gt.com

# Notes

# Contact us

**To know more, please visit www.grantthornton.in or contact any of our offices as mentioned below:**

**NEW DELHI**
National Office
Outer Circle
L 41 Connaught Circus
New Delhi 110001
T +91 11 4278 7070

**NEW DELHI**
6th floor
Worldmark 2
Aerocity
New Delhi 110037
T +91 11 4952 7400

**AHMEDABAD**
7th Floor,
Heritage Chambers,
Nr. Azad Society,
Nehru Nagar,
Ahmedabad - 380015

**BENGALURU**
5th Floor, 65/2, Block A,
Bagmane Tridib, Bagmane
Tech Park, C V Raman Nagar,
Bengaluru - 560093
T +91 80 4243 0700

**CHANDIGARH**
B-406A, 4th Floor
L&T Elante Office Building
Industrial Area Phase I
Chandigarh 160002
T +91 172 4338 000

**CHENNAI**
7th Floor, Prestige Polygon
471, Anna Salai, Teynampet
Chennai - 600 018
T +91 44 4294 0000

**DEHRADUN**
Suite no. 2211, 2nd floor Building
2000, Michigan Avenue,
Doon Express Business Park
Subhash Nagar, Dehradun - 248002
T +91 0135 2646 500.

**GURGAON**
21st Floor, DLF Square
Jacaranda Marg
DLF Phase II
Gurgaon 122002
T +91 124 462 8000

**HYDERABAD**
7th Floor, Block III
White House
Kundan Bagh, Begumpet
Hyderabad 500016
T +91 40 6630 8200

**KOCHI**
6th Floor, Modayil Centre point
Warriam road junction
M. G. Road
Kochi 682016
T +91 484 406 4541

**KOLKATA**
10C Hungerford Street
5th Floor
Kolkata 700017
T +91 33 4050 8000

**MUMBAI**
16th Floor, Tower II
Indiabulls Finance Centre
SB Marg, Elphinstone (W)
Mumbai 400013
T +91 22 6626 2600

**MUMBAI**
9th Floor, Classic Pentagon
Nr Bisleri factory, Western
Express Highway, Andheri (E)
Mumbai 400099
T +91 22 6176 7800

**NOIDA**
Plot No. 19A, 7th Floor
Sector – 16A
Noida 201301
T +91 120 485 5901

**PUNE**
3rd Floor, Unit No 309 to 312
West Wing, Nyati Unitree
Nagar Road, Yerwada
Pune- 411006
T +91 20 6744 8800

**For more information or for any queries, write to us at contact@in.gt.com**


Follow us @GrantThorntonIN