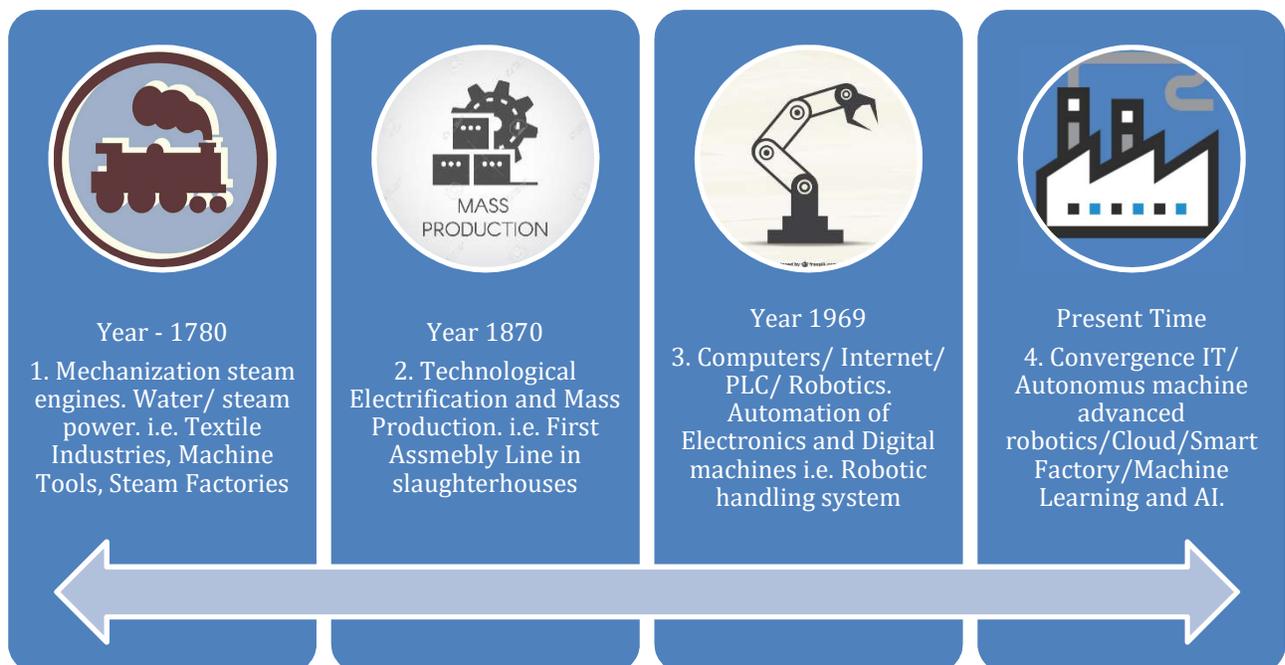


Industry 4.0: Basic Understanding and Readiness of India

Mankind has witnessed 3 industrial revolution between 17th to 20th century starting from first revolution in which machine operation from steam engine in power loom industry. Subsequently mankind has invented electricity which has changed the way of life and gave birth to assembly lines and mass production concept and give momentum to industrialization worldwide. However, all operations of assembly lines and industry were still totally dependent on manpower and labours which may cause dependence and some errors as well depending on variation in skills of one labour to another. In this time, technology has increased its importance and with invention of computers and robotics, conventional manpower has been replaced with robotics. Further, synchronization of operation with computer to do repetitive task without errors and better speed. It gave birth to 3rd revolution in Industrialization.

Now, we are fortunate enough to witness the 4th phase of industrialization which is renowned as “Industry 4.0” particularly term given by Germany and same can be referred as “Internet of Things (IoT) by many English-speaking countries including USA. Industry 4.0 is all about optimization 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 aims at enabling businesses to make quicker, smarter decisions, all while minimizing costs and minimum human interventions. Timeline of industrialization evolution is given below.





Ref: What is Industry 4.0 and is India prepared for the change?

Following are the three key trends in Industry 4.0 that are changing the way of life for industrial companies and their employees today are

- 1) **Digitize:** Production processes in all sectors from high tech to industrial equipment are being transformed today through digital technologies.
- 2) **Industrialize:** Companies are already integrating these technologies to improve and evolve.
- 3) **Optimize:** State of the art manufacturers identify that enhancing the manufacturing process for even the simplest of the products presents new opportunities for growth.

India is on the verge of start its journey of becoming economic, industrial and defense superpower in next 3 decades looking to its current growth trajectory of continuous GDP growth at around 7.0% plus annually and vision of “Digital India”, “Make in India” and “Smart Cities” projects. For this vision, Indian industry need to understand the importance of “Industry 4.0” and make themselves equip and gear up for 4th industrial revolution. In this dream of India, Supply Chain Industry will play crucial role. Before analyzing the “Readiness for Industry 4.0 - 6-dimensional model”, we first understand 9 major technological components which foundation stones of Industry 4.0 are.

- 1) **Huge Data Quantum:** System gathers too much data makes it difficult to identify the relevant information and trends that can lead to some intelligent analysis. In this juncture, huge data analysis techniques come into picture. They make it possible to identify the performance of an individual component and its operating restrictions in order to prevent future production issues and take preventative action.

- 2) **Cloud computing:** The industry has seen a large shift in utilizing cloud solutions and the cloud is being used for applications such as remote services and performance benchmarking and its role in other business areas will continue to expand. With continuous advancements in technology, machine data and functionality will only continue to shift towards cloud solutions. The cloud allows for a much faster roll out of updates, performance models, and delivery options than standalone systems.
- 3) **Internet of things (IoT):** The IoT is a key functionality in Industry 4.0 driven solutions. IoT is a system of interrelated computing devices, mechanical and digital machines, objects and people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. For instance, smart watches in the market have turned our wrists into smartphone holsters by enabling text messaging, phone calls, and more. Devices such as Fitbit and Jawbone have helped revolutionize the fitness world. With the proper connections and data, the IoT can solve traffic congestion issues, reduce noise and pollution.
- 4) **Simulation:** The simulations of systems allow assessment of various scenarios. Once the scenarios are assessed, cost effective solutions can be developed, tested and implemented much quicker leading to reduced cost and time to market.
- 5) **Autonomous robots:** They are used to automate production methods across the various sectors and are powered by the concept of Internet of Things (IoT). This connects devices and computer machines to communicate with each other. Materials can be transported across the factory floor via autonomous mobile robots (AMRs), avoiding obstacles, coordinating with fleet mates, and identifying where pickups and drop offs are needed in real-time. By connecting to a central server or database, the actions of robots can be coordinated and automated to a greater extent than ever before. They can complete tasks intelligently, with minimal human input. i.e. ASRS stacker cranes, shutter cars etc.
- 6) **Augmented reality (AR)** Augmented reality grows in use by providing real-time information in an effective manner to allow humans to better integrate and interact with electronic systems. Examples can include the transmission of information on repairs for a part that can be viewed through different devices or the training of personnel using simulations and 3D views of the facility or equipment.
- 7) **Cyber security:** The security of information becomes paramount as we move away from closed systems towards increased connectivity from the IoT and cloud. Security and reliability enable the successful implementation of a truly modern

and digitized production workflow, leveraging all of the benefits of a connected environment.

- 8) **System Integration:** Mostly systems are highly automated within their own operations and struggle to communicate with other systems. Standards and open architecture support the easy transfer of information both to the business and to the customer/end user. This can involve defining common languages for data exchange such as JDF for job information.

- 9) **Additive manufacturing:** This continues to become increasingly important for small-batch applications or for the production of individual parts or personalized products. This will be used either directly with the customer or by suppliers to improve designs with increased performance, flexibility, and cost effectiveness.

Readiness: Industry 4.0

It is necessary to assess the Industry 4.0 readiness of industrial enterprises as manufacturing sector is currently facing substantial challenges. These challenges are in regard to disruptive concepts such as the IoT, cyber physical systems or cloud-based manufacturing. Subsequently, increasing complexity on all firm levels creates uncertainty about respective organizational and technological capabilities and adequate strategies to develop them. A Foundation for mechanical engineering, plant engineering, and information technology of German Engineering Federation (VDMA) has coined a six-dimensional model to assess the readiness of the enterprises, wherein VDMA experts and some industry representatives served in an advisory capacity in the development of the study.

The potential, especially for Germany's mechanical engineering industry and plant engineering sector, is indeed great, both for providers and for users of technologies across the spectrum of Industry 4.0. But there are still many unresolved questions, uncertainties, and challenges. The readiness study seeks to address this need and offer insight. It also highlights the challenging milestones that many companies must still pass on the road to Industry 4.0 readiness.

Six-Dimensional Model

As per the current understanding of Industry 4.0 the readiness of the enterprises can be assessed on the below mentioned six dimensions:

INDUSTRY 4.0 - Six-Dimensional Model	
<p>Operational Excellence</p> <ul style="list-style-type: none"> ● Enhanced efficiency through greater automation ● Product Customization at the cost of mass produced products. 	<p>Enhanced Services</p> <ul style="list-style-type: none"> ● Higher revenues from digitally refined products ● Access to new markets
Physical Elements	Virtual Elements
<p>Smart Factory</p> <ul style="list-style-type: none"> ● Digital Modeling ● Equipment Infrastructure ● Data Usage ● IT Systems 	<p>Strategy and organization</p> <ul style="list-style-type: none"> ● Strategy ● Investments ● Innovation Management
<p>Smart Product</p> <ul style="list-style-type: none"> ● ICT add-on functionalities ● Data Analytics in usage phase 	<p>Smart Operations</p> <ul style="list-style-type: none"> ● Cloud usage ● IT security ● Autonomous Processes ● Information sharing
<p>Employees</p> <ul style="list-style-type: none"> ● Skill acquisition ● Employee Skill Sets 	<p>Data driven services</p> <ul style="list-style-type: none"> ● Services ● Shares of revenue ● Shares of Data used

Based on above six dimensional models, India’s rank on the Network Readiness Index in 2013 was 61. In 2016, India ranked 91 out of 139 countries. At 91, India was ahead of Pakistan (110) and Bangladesh (112), but behind Sri Lanka (63), Malaysia (31), and China (59). Singapore topped the rankings for second year in a row. The US was placed at 5th position.

India’s Position:

- According to Indian Brand Equity Foundation (IBEF), the Government of India has set an ambitious target of increasing the contribution of manufacturing output to 25 percent of Gross Domestic Product (GDP) by 2025, from 16 percent currently.
- IoT, being one of the most important aspects of Industry 4.0 for India, is expected to capture close to 20 percent share in global IoT market in the next five years. According to IBEF forecast, the IoT market in India is projected to grow at a CAGR of more than 28 percent during 2015-2020.

- Government of India has taken initiatives such as Green Corridors and 'Make in India'

Today, in an Industry 4.0 factory, machines are connected as a collaborative community. Such evolution requires the utilization of advance prediction tools, so that data can be systematically processed into information to explain uncertainties, and thereby make more "informed" decisions.

Industry 4.0 is expected to be a huge boon to companies that fully understand what it means for them. Change of this nature will transcend company's boundaries where they operate. The focus in the forthcoming segment will be laid on the importance of the fourth industrial revolution on the Indian economy, the major steps taken by the OEMs, government and the customers to adapt the new trend and recent technological developments.

Is India ready to jump into Industry 4.0?

According to International Yearbook of Industrial Statistics 2016- published by United Nations Industrial Development Organization (UNIDO) with its ranking going up by three places, India has now been ranked sixth among the world's 10 largest manufacturing countries. India is no exception to this global trend and is steadily increasing its share of Global Manufacturing GDP. All leading countries are embarking on major initiatives to promote manufacturing by adopting the advancements in Internet and Information Technology arenas. German government announced "Industry 4.0" while governments in China and India have their own focused programs, "Made in China 2025" and "Make in India" respectively.

Idea is to encourage multinational, as well as national companies to manufacture their products in India. With a plethora of crippling regulations and under-developed infrastructure, the Government is focusing more on enabling policies and improving infrastructure for certain key sectors.

According to IBEF, the Government of India has set an ambitious target of increasing the contribution of manufacturing output to 25 percent of Gross Domestic Product (GDP) by 2025, from 16 percent currently. There is no escape from integrating principles of Industry 4.0 with the "Make in India" initiative, if Indian Manufacturing has to win against global competition. India has a unique opportunity to innovatively pave its own road to Smart Manufacturing. Industry 4.0 is expected to transform manufacturing in India by bringing operational efficiencies to manufacturing industries like automotive, electrical and electronics.

The major area of focus shall be the technological advancement across various industries. IIOT (Industrial Internet of Things), 3DP (3-dimensional printing) 3D sensors, social

software, augmented reality, location awareness is considered to user in the next era of smart production. These automation technologies collectively are moving the manufacturing industry towards the next phase of technological advancement.

Industry 4.0 is a holistic automation, business information, and manufacturing execution architecture to improve industry with the integration of all aspects of production and commerce across company boundaries for greater efficiency.

Internet of Things, being one of the most important aspects of Industry 4.0 for India is expected to capture close to 20 per cent share in global Internet of Things (IoT) market in the next five years. The global market is expected to touch US \$ 300 bn by 2020.

Major Indian states are taking initiatives to adapt to Industry 4.0. Andhra Pradesh has taken an initiative to capitalize on the IoT potential in the country. The 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 per cent 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 US\$ 1 bn in this initiative and has started projects in many states, such as Andhra Pradesh, Rajasthan, Tamil Nadu, Gujarat and Himachal Pradesh.

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 Indian Institute of Science's (IISc) Centre for Product Design and Manufacturing (CPDM) with an investment from The Boeing Company. A smart factory, armed with data exchange in manufacturing and the Internet of Things (IoT) is the future and experts are calling it revolution Industry 4.0. Reports peg the smart factory industry to touch US\$ 215 bn by 2025 and all major economies are likely to accept it.

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 landscape

The manufacturing landscape is changing. Countries are constantly being challenged on technical capabilities and manufacturing value adds. Specifically, India faces competition from China and Europe and there is a risk of her being crowded out by the increasing technical capabilities of these regions as they are focusing on medium-value segment where India has always been prominently operating. Historically, China has focused on

the low technology-low manufacturing value add space while Europe has focused on high technology - high value add segment. India's manufacturing zone of comfort has been in the middle, both on the technology and value add axis.

Now, a significant push from China to move up from the low technology - low value add zone and expand into the medium technology zone has been noted, thereby expanding the market for Chinese companies. Concurrently, there is a push from Europe to move down from the high technology - high value add zone and expand into the medium technology zone thereby expanding the market for European companies.

India's strengths over others:

- 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
- Favourable government policies like GST, the constitution of NEMMP (National Electric Mobility Mission Plan 2020), FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicle) are advantageous for the sector.

Conclusions

Industry 4.0 will revolutionize 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 results that were heretofore unexpected. 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 a 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; and ensuring a talent pool in the manufacturing workforce that can move those innovations rapidly forward will be equally important.

India has a number of programs to enable innovation and ensure the talent pipeline for manufacturing. Some are well established, and others are quite new and very innovative. 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.

India stands ready for that future: not only to participate, but also to lead!

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