Make in India Initiative for Smart Manufacturing with Automation

Foreword

The evolution of Industrial Internet of Things (IIoT) has enabled the concept of smart manufacturing. Dynamic customer requirements, intricate manufacturing processes, and the sudden upsurge of distributed assets have resulted in this manufacturing transformation. As manufacturing processes evolve, customers are also on the lookout for additional functionality in the form of manufacturing intelligent tools to address key manufacturing requirements and improve the overall efficiency of their operations. Additionally, interoperability with business and legacy systems of the enterprise to maximize visibility of their manufacturing operations is of utmost importance. At a global level, solution providers and end users are looking to adapt IIoT based technologies to stay ahead in this competitive world. Owing to the conservative nature of the manufacturing industry, solution providers need to put forth a legitimate business case to the enterprise wherein they see a sizable return on their investment in order to gain acceptance on a global scale and adoption across a diverse set of end-user segments.

The Indian Government through its Made in India initiative has created ripples across the international manufacturing sector. This initiative is poised to bring in large-scale foreign direct investment in the manufacturing sector. In this white paper, developed for SPS Automation India, Frost & Sullivan has evaluated the key IIoT-based technologies, which have been successfully embraced in global manufacturing industries. Furthermore, the white paper distils down the impact of these technologies and analyses the impact in the India manufacturing sectors. Deep diving further the write-up brings out the level of adaption of technologies across industries vertical, challenges faced to enable Industry 4.0 vision for India. In this context, the future IIoT-based manufacturing model for India is analysed.

Contents

Introduction

The global manufacturing market is at crossroads as the burgeoning competition, huge influx of technology, and volatile global economy has pushed the need for transformation across the manufacturing value chain. A reflection of this growing need is witnessed in the new programs and initiatives that are mushrooming across the world. Concepts like Industrial Internet of Things (IIoT), Industry 4.0 and smart or advanced manufacturing resonate the fundamental challenges pervading the global manufacturing landscape. At the supplier level, this has given way to the emergence of new applications with a heavy influx of commercial Information and communications technology (ICT).

Internet of Industrial Things: The Four Functional Facets

At Frost & Sullivan, we understand that the IIoT needs to be built across the four functional pillars, namely, Industrial Convergence, Services 2.0, Supply Chain Evolution, and Business Ecosystem. It can be defined as a new manufacturing framework that will be a confluence of technologies, collaborative exercises, and process innovations.

Exhibit 1: Internet of Industrial Things — The Four Functional Facets

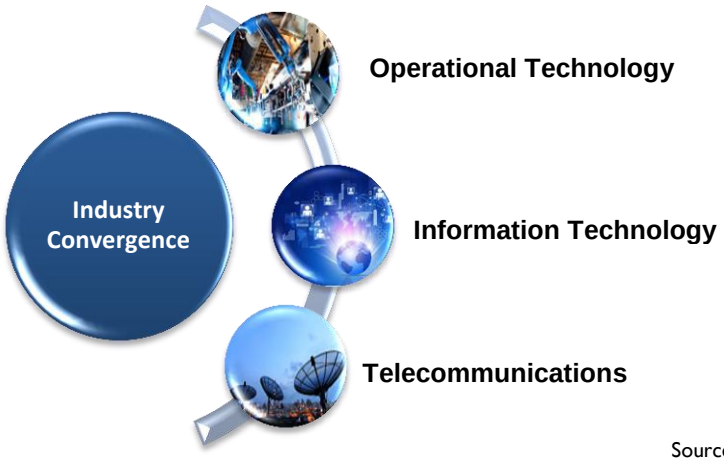
Source: Frost & Sullivan

Convergence can be considered as a mature trend that has evolved from the concept of Industrial Internet of Things (IIoT). Everyday millions of devices are being connected across the value chain of diverse industrial sectors. End users are constantly establishing robust connectivity across these assets, people, and enterprise systems to completely leverage the benefits from convergence of Information Technology (IT) and Operational Technology (OT). This convergence is poised to erase the existing data flow restrictions across different layers of enterprise systems. This paradigm shift would also create a unified approach of data transmission across multiple platforms. This integration of data

is also likely to create large-scale data management systems, applications, and analytical platforms throughout the industrial value chain. Furthermore, the intricate processes that have evolved from convergence would require high-quality analysis and testing before being implemented into the targeted environments.

1. **Industry Convergence:** The coming together of the worlds of information technology and operational technology is defined as industry convergence. The convergence of IT and OT can further be extended to include the telecommunication sector — a fast growing segment with regard to technology and market revenue. Technologies such as 2G, 3G, 4G, Wifi, and Bluetooth 4.0, which were designed to meet the growing needs of the commercial market, are now being leveraged by industries to manage their data-flow requirements.

Exhibit 2: Industry Convergence — A Cross-Pollination of OT, IT, and Telecommunications



Source: Frost & Sullivan

Five key value additions that the telecommunication segment brings to the industrial segment are better connectivity, data flow intelligence, reliability, improved efficiency, and better user experience. Telecommunication technology platforms and infrastructure are poised to become critical pillars for successful execution of IIoT-based applications in the industrial environment. In the years ahead, IIoT-based solution providers are expected to capitalize on advanced telecommunication platforms to address the peripheral issues of process, discrete, and hybrid industries.

2. **Services 2.0:** The concept of connected operations across multiple industries has enabled the integration of the services segments, thus creating an ecosystem of services. The new service models are more oriented to match platform-based

solution architectures; moreover, their key value proposition encompasses process-based applications. The multifarious service models require complex functionalities for execution, paving way for commercial ICT applications to enter the industrial services space. The future of services can be visualized as an ecosystem of business systems and strategies to execute optimized operations supported by the technologies developed through the IIoT approach. As a result, models such as Software as Service (SaaS) and Product as a Service (PaaS) would be the new business propositions that enable end users to address challenges surrounding operational expenditure.

3. **Supply Chain Evolution:** The manufacturing supply chain segment is another key aspect that will be completely transformed by the IIoT wave. The traditional commodity-driven supply chain model would reinvent itself to become technology- and service-driven platforms. Furthermore, non-industrial services partners such as ICT service providers would play a crucial role in the future of supply chain activities. The existing supply chain design is a collection of collaborative network models that involve competitors and vendors focused towards product-based and strategic value additions. The next generation of IIoT-based supply-chain models will comprise an extended ecosystem that includes both industrial and non-industrial suppliers. Open source frameworks would support the platforms built for such supply chain models.
4. **Business Ecosystem:** The confluence of IT, OT, and telecommunications is expected to result in fundamental changes across the competitor landscape. This new business ecosystem will involve new synergies, collaborations, coopetition, and competitions between industrial suppliers, ICT vendors, measurement and instrumentation providers, and banking and financial organizations.

Challenges

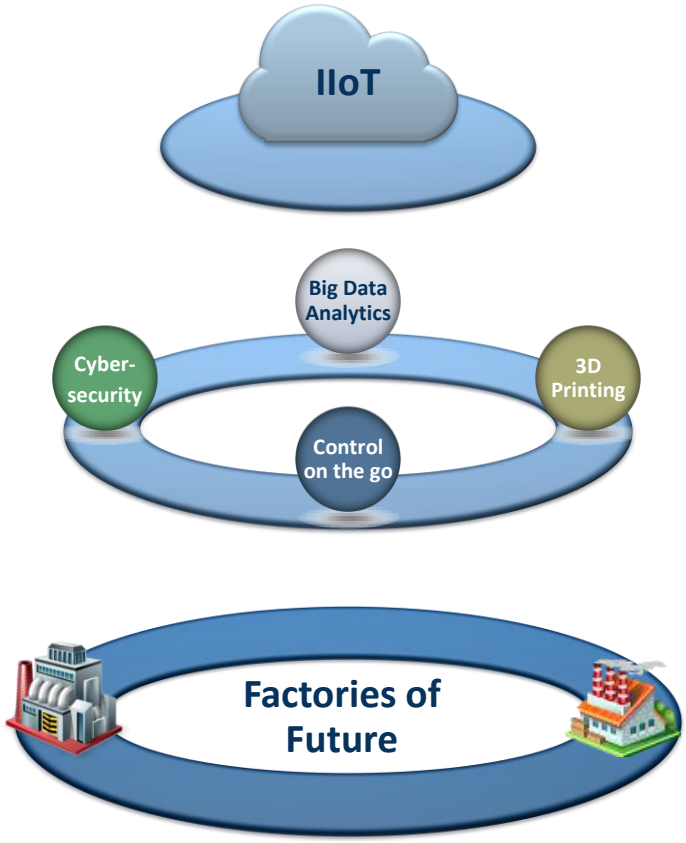
Intricate processes are poised to evolve from the cross pollination of IT, OT, and telecommunication sectors, particularly in manufacturing production, industrial services, and extended supply chain. Development of effective deployment strategies is essential to stay ahead in this competitive market. Virtual product and process prototyping has helped to create robust and cost-effective design cycles and provide best-in-class products to the market. This requires high-quality simulations before being implemented in the targeted industries. All facets of convergence are bound to be driven by the core end-user needs of enhancing productivity and reducing total cost of ownership. Despite the robust advancements achieved through convergence, failures, and downtimes are inevitable during the design, engineering, and production cycles. This inevitable gap can be countered by advanced analytics and robust connectivity. IIoT-based technologies

such as big data analytics, smart clouds, and mobility would play major roles in tackling these challenges.

IIoT-based Technology Trends

1. **Big Data Analytics:** Data analytics is set to play a huge role in manufacturing, particularly in re-structuring of the maintenance modules. Equipment uptime mapping, prognostics, failure mapping are the key functionalities that can be embedded in the current Manufacturing Execution System (MES). The integration of MES with the big data engine will provide real-time data enhancing visibility and simplifying monitoring procedure and helping to detect and plug the problem at the earlier stages. Developing countries such as India, which is looking to expand its manufacturing network through the "Make in India" initiative, are going reap huge benefits from such new manufacturing business model.

Exhibit 3: Enabling Technologies of Smart Factory



Source: Frost & Sullivan

2. **3D Printing:** The Global 3D Printing Market to be worth US $21.5 Billion by 2025 and 70% of the market share will be across aerospace, defense, automotive,

medical devices, and consumer electronics sectors. The influx of metal 3D printing technologies has pushed the industry vertical to adapt 3D printing for execution actual production of components. This global trend is rapidly moving to Asia Pacific (APAC) and additive manufacturing in this region will grow at a CAGR of 23.8% (2009-2016).

3. **Cybersecurity:** IIoT influx on manufacture software platforms such as MES, Product Lifecycle Management (PLM), Enterprise Resource Planning (ERP), and automation technologies such as automation technologies such as distributed control system (DCS), programmable logic controller (PLC), supervisory control, and data acquisition (SCADA) have increased a number gateways for inflow and outflow of data across value chain. Increasingly, there is a growing concern regarding cybersecurity among discrete manufacturing industries such as healthcare and automotive due to the increased adoption of smart devices and processes. Security has moved from being within the walls of a production facility to the actual product as insider attacks are a serious concern across. Moreover, the unstructured manufacturing practice in small and medium scale industries in countries such as India would create big loopholes in the security aspects of a factory. These factors are set to create a growing demand for on network security measures, end point security solutions in the industrial space the treat to the discrete industries.
4. **Control-on-the-go:** Anytime, anywhere access of key metrics by diverse personnel across the enterprise is a necessity in any manufacturing environment. Exclusive connectivity and smart devices has enabled the instant viewing of key performance metrics by enterprise personnel (field operator to C-level executive) across multiple points in the supply chain. 'Control-on-the-go' is the key concept that can be implemented at single operator level or in production line or in extended production line showing metrics that includes utilization, line effectiveness, process efficiencies, product transit monitoring, and so on. Such technologies will increase flexibility of manufacturing processes and ensure quick decision making to facilitate ad-hoc design and engineering changes. 'Control-on-the-go' will be the most sought after technology in developing countries with diversified manufacturing environment.

Manufacturing Sector in India

Manufacturing is one of the cornerstones of the Indian economy and it is imperative that India invests in establishing state-of-the-art facilities, or factories of the future. India has taken a step forward with its 'Make-in-India' initiative, which promotes investment, both

foreign and domestic, to set up production facilities in India. The initiative was launched in August 2014 and since then PM Narendra Modi has been discussing with global leaders as to how India is an opportune destination to replace China as the manufacturing powerhouse of the world. The main aim of the initiative is to increase the share of manufacturing to India's GDP, develop infrastructure, and promote skill development and employment. The current contribution of manufacturing to GDP is 17% percent, and the Government wants the share to increase to about 25% by 2022. Manufacturing has to be the cornerstone of India's GDP growth over the next decade to achieve that goal. With growth in China dipping, India is better placed to take the numero uno position as the world's fastest growing economy.

Exhibit 4: Significance of Manufacturing in India Context

Source: Frost & Sullivan

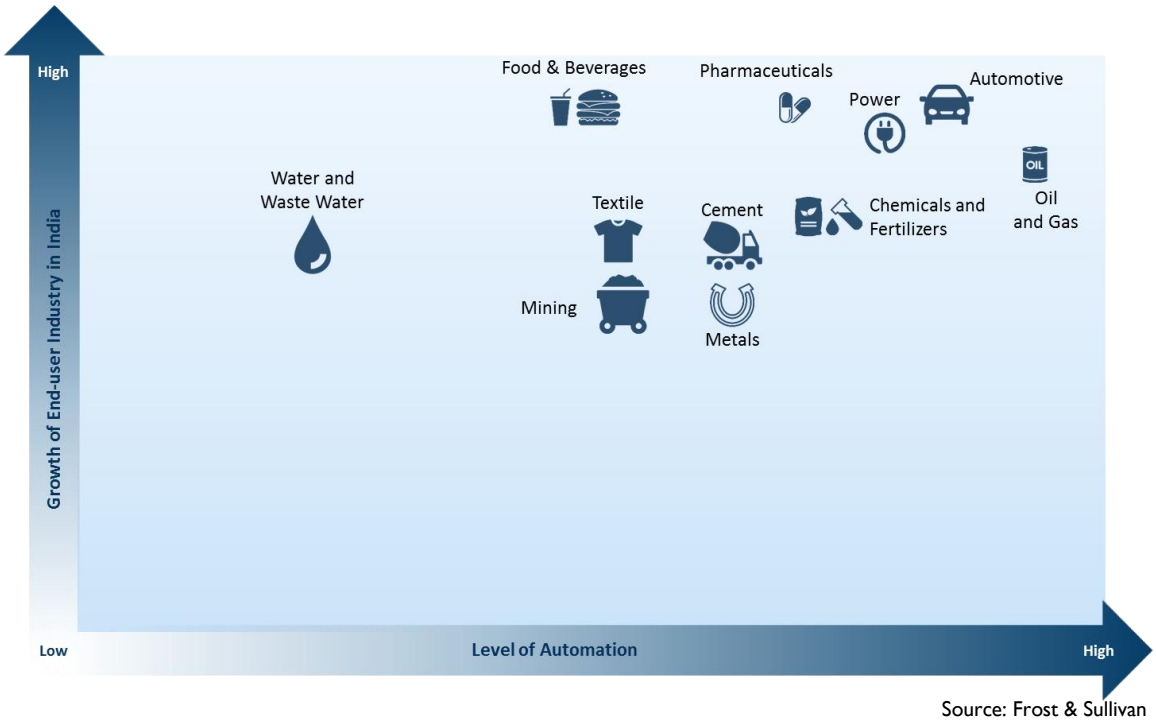
The above image depicts why India needs to invest in establishing manufacturing facilities across sectors. India needs to invest in manufacturing facilities to move away from a service-cantered economy paving the way for inclusive growth and catering to both domestic and international demand. Manufacturing of high-end electronics and defense equipment will reduce India's reliance on imports and help catalyze growth in the domestic market. Establishing manufacturing facilities will also help create employment for the millions joining the workforce every year. The Government of India has also focused on skill development initiatives to ensure upgrades of skills and avail better employment opportunities.

Automation technology is expected to be one of the key contributors to the growth of the manufacturing sector in India. The country needs to invest in products, solutions, and systems that can increase the efficiency and productivity of current assets while creating opportunities for product development and improving efficiencies across the value chain. Automation will increasingly play a crucial role for productivity enhancement and operational excellence. As competition increases, companies willing to invest in various automation solutions will be more likely to be successful in the long term.

Role of Automation in the Manufacturing Sector

India has traditionally used automation technologies such as DCS, PLC, and SCADA along with enterprise level automation software's such as MES, PLM, and ERP. Power, metals and mining, oil and gas, automotive, and auto ancillaries are at the forefront of using automation technologies in India. The power sector has been a leading user of automation technologies including DCS, and increasing automation will enable higher asset efficiency and productivity including reduced losses in transmission and distribution. Oil and gas are among the highest adopters of automation systems including control, safety, and terminal automation systems. Robotics is primarily used in discrete manufacturing for activities such as welding and material handling. India is increasingly being seen as an automotive export hub; this will drive the need for higher automation on the plant floor, inventory, and supply chain management.

Exhibit 5: Varying Levels of Automation Adoption across Segments

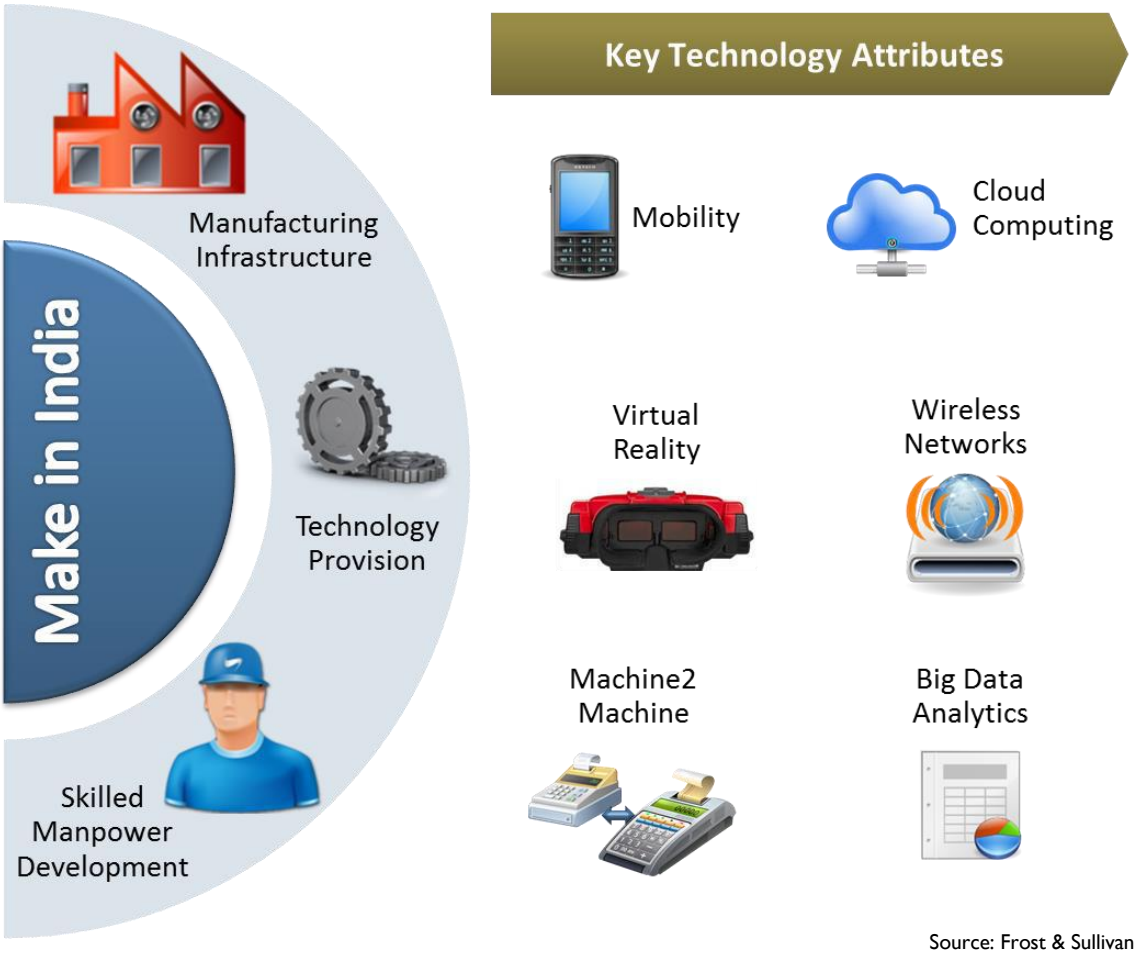


Source: Frost & Sullivan

Among the core industries, cement and metals also focus on implementing automation solutions for safety, control, and quality management across the plant. These industries, by virtue of being among the top energy consumers, also focus on energy-efficient equipment such as electric drives and energy management solutions. The metals and mining segment also uses Level 4 enterprise solutions such as ERP and SCM and Level 3 solutions such as MES to manage production, batch management, and supply chain management. Pharmaceuticals is another key segment for use of automation systems.

Many pharmaceutical companies looking to get FDA approval are keen on investing in automation systems to ensure compliance to FDA regulations and focus on hygiene and safety.

Exhibit 6: Make in India – Enabling an Industry 4.0 Vision for India



Source: Frost & Sullivan

Investment in automation systems in India has gradually been increasing over the years as manufacturers look to expand beyond boundaries, integrate their plants with other plants across the world, and standardize the level of automation with that of assets abroad. End users are looking to also conform to international regulations in power, oil and gas, and pharmaceuticals industries for safety, product tracking, and process automation. There is a huge opportunity for ICT players who can collaborate with automation companies to bring together products and technology for a successful IOT implementation.

End Users' Expectations from IIOT

1. **Higher asset utilization and ROI**: End users looking to invest in IOT solutions look to improve their current manufacturing ecosystem through real time management of remote assets, enabled by smart devices and backed by analytics and big data to aid higher utilization of assets. End users' primary concern is return on investment (ROI) and if automation solution providers and ICT companies can address this area of concern through consultative approach, it can result in higher adoption in the manufacturing sector.
2. **Product development**: IOT, as a system of interconnected devices can generate information, which when analyzed using analytics and big data can be utilized to develop intelligence and insights to develop new products and services. Manufactured products can have a way to provide user feedback on operational performance and other parameters to ensure designers synthesize information to improve product features and services.
3. **Optimize manufacturing functions**: Currently, all functions in a manufacturing organization work in silos, from production to supply chain to inventory management. IIOT should bring in seamless integration and data transfer across silos through a centralized control for efficient data utilization and analytics. This will enable a quick feedback and a redressal mechanism, for example, product design team can work on changing specifications of the product based on real time customer feedback or the vendor can supply just in time based on real time inventory data.
4. **Lifecycle management**: IIOT has the ability to associate with the product throughout the entire lifecycle of the product from its manufacturing to its disposal. For example, sensors in an automobile can send real-time feedback to the manufacturer on the car's performance through condition monitoring devices and assist manufacturers to launch new product and service offerings.

Challenges to IIOT Implementation

1. **Integration of legacy equipment:** Most of the end users in India use equipment from different manufacturers; some of them which have been in use since the plant have been operational, for approximately 15-20 years. These are legacy equipment, which work on different protocol standards and require protocol conversion to enable machine to machine communication or form part of the connected factory.
2. **Cyber Security and Data Security**: In a connected factory, all machines and equipment are connected through sensors with a central application that collects, analyses data, and assist in the decision-making process. In the manufacturing world, a lot of data is proprietary in nature such as the product

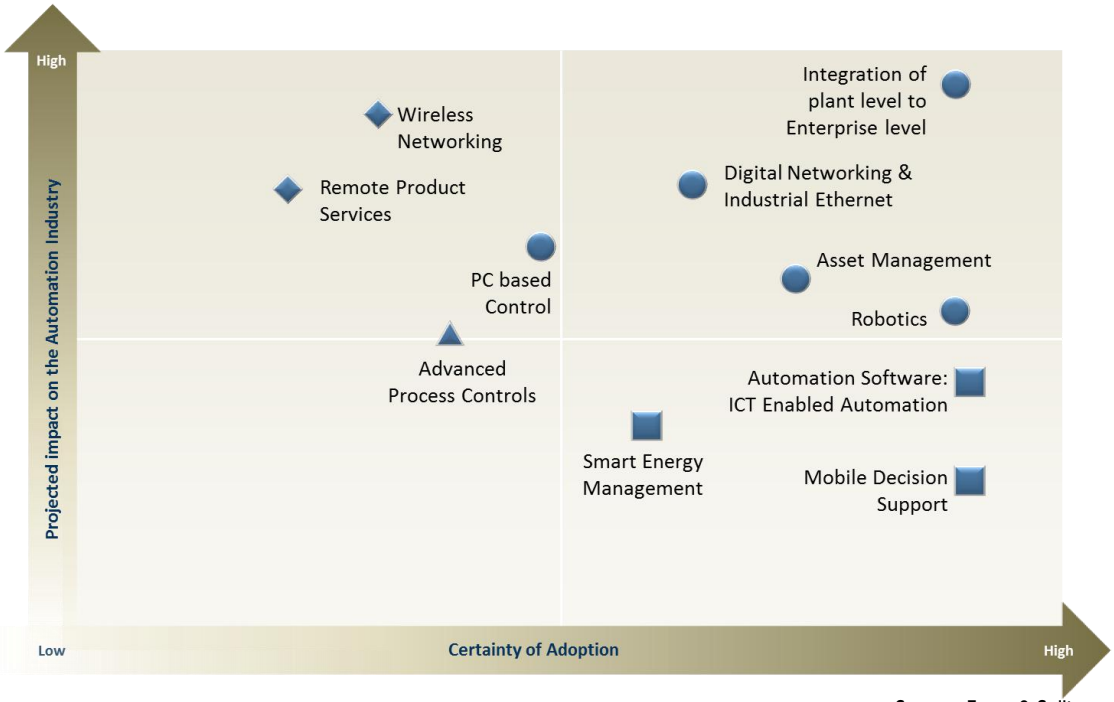
details, cost of manufacturing, supply chain information. The data is vulnerable to being hacked and misused. Cyber security is a key challenge, which IOT needs to address to protect against external threats.

3. **Skill Development**: In a smart factory, all critical equipment are interconnected and performance is analysed against set parameters. The industry also has to upgrade skills of its workforce to align with the needs of a modern manufacturing organization, along with training on smart factory and its relevant modules.

Future of IIOT in India

India presents huge potential for Industry 4.0, as current and prospective companies look to invest in latest technologies and adapt to modern methods of manufacturing. Smart factories will bring in seamless machine to machine connectivity on the shop floor and integration of every aspect of manufacturing from suppliers to end customers. Industry 4.0 is important for India, considering its ambition of being the global manufacturing center, replacing China, which has held that distinction for a good part of the 21st century.

Exhibit 7: Technology and its Adoption in the Manufacturing Sector



Source: Frost & Sullivan

Energy, automotive, power, FMCG, and healthcare will be among the lead adopters of IOT in manufacturing in India over the short to medium term. Advanced data analytics and connectivity in the power generation, transmission, and distribution will enable load consumption data to be correlated to power generation. Within the power generation domain, there are huge opportunities for producers to link their vendors with real time inventory levels to optimize their supply chain. IOT in the automotive sector can link consumers to manufacturers and provide real-time feedback, which can be utilized to improve product design and features. Manufacturers today are hard pressed against time to introduce new products and solutions with a faster time to market, while reducing costs and eliminating risks. Virtual manufacturing, rapid prototyping, and 3D printing can essentially help in reducing time to validation and remove production bottlenecks, thus keeping manufacturers a step ahead of competition. It is imperative that IOT solution providers use a consultative approach to increase adoption among these segments.

Conclusion

The Indian Government has been quick to realize the importance of becoming a manufacturing powerhouse to sustain in this competitive global industrial environment. Initiatives such as Make in India have paved an easy path for global manufacturing companies to set up large-scale manufacturing plants in India. This will ensure the implementation of best practices in manufacturing in India.

The country has already started its journey into the realms of the Industrial Internet of Things to reach global standard of manufacturing. With significant support from the Government and FDI inflows, new strategic partnerships are emerging and technology-based manufacturing is being implemented on the plant floor. Technology-driven manufacturing is poised to grow the confidence and faith of global customers bringing-in large-scale investments for development of manufacturing sourcing and knowledge center in India. For successful IOT implementation, existing and upcoming manufacturers have to embrace new technologies and the older generation has to invest their vast experience to ensure higher returns on investment. The culmination of all the aforementioned technological forces will help transform India into a manufacturing capital of the world.

Contact Details

Frost & Sullivan - Bangalore

Brunton Rd, Sivanchetti Gardens,

Bengaluru, Karnataka 560025

For information regarding Frost & Sullivan's whitepaper, please write to:

Arunkumar Janarthanan

Associate Director,

Automation & Electronics Practice,

Frost & Sullivan

P: +91-80-67028016 | M: +91-9972201045 | ajanarthanan@frost.com

Indrajit Chanda

Business Development Manager,

Industrial Automation and Process Control,

Frost & Sullivan

P: +91-20-40778890 | M: +91-9503930238 | **indrajit.chanda@frost.com**