

Industry 4.0: Makes Manufacturing Factory Smarter

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ABSTRACT

The purpose of this article is to present an overview of industry 4.0. The goal of this presentation is to give a brief perspective of what Industry 4.0 is, its challenges in today's manufacturing environments. Many researchers have mentioned that implementing industry 4.0 is a response to the current challenges in fast changing environments. In this paper, I have provided a comprehensive introduction and definition about this Industry 4.0 concept, transformation steps and explain the technologies involved in Industry 4.0 ecosystem. After that, I have presented several points about challenges and issues of Industry 4.0, then the most relevant and potential benefits of this new industrial paradigm. Lastly, I have ended this presentation by drawing a conclusion.

The successful path to smarter Industry 4.0 depends on having a vision and enterprise-wide strategy, rather than taking a piecemeal approach to implementing technology solutions. Focus on business drivers, tech enablers that overcome pain points, and working with the right partner ecosystem to accelerate sustainable transformation for greater business value and opportunity outcomes. Now in competitive market, it is more likely a company will be more profitable and create jobs when it produces products with higher flexibility, quality and technology content and applying Industry 4.0 than by competing on low-price products. In addition, companies can take advantage of the broad range of aspects of Industry 4.0, including smart products, smart assets, and optimized factories operating sustainably and creating optimal conditions for empowered workers. Manufacturing organizations need an enterprise-wide strategy to gain the full business value of Industry 4.0, including productivity, sustainability, and competitive edge. A smarter Industry 4.0 approach helps organizations overcome the challenges they currently face, and it also enables them to become future-ready to build anything, anytime, anywhere. The goal of Industry 4.0 implement is to enable autonomous decision-making processes, monitor assets and processes in real-time, maintaining improved quality and enable equally real-time connected value creation networks through early involvement of stakeholders, and vertical and horizontal integration.

Keywords - Industry 4.0, IOT, IIOT, Manufacturing, Smart Factory

INTRODUCTION

Manufacturing has undergone several eras of change from the first industrial revolution - use of steam power and mechanical production, to the second - use of electricity and mass production and a third era - defined by increased automation of manufacturing processes due to the use of information technology (IT). A fourth era of change – Industry 4.0 – is driven by trends on connectivity, service orientation, advanced materials and processing technology, and collaborative advanced manufacturing networks; networks of advanced manufacturing devices controlled by computers combining them into a physical – digital environment. This change includes the entire value chain from raw materials to end use to recovery, impacting business and support functions too e.g. supply chain, sales. Industry 4.0 enables the manufacturing sector to become digitalize with built-in sensing devices virtually in all manufacturing components, products and equipment. The analyzing of related data within a ubiquitous system with the fusion of digital data and physical objects has the ability to transform every industrial sector in the world to evolve much faster and with greater impact than any of the three previous industrial revolutions. Hence, Industry 4.0 is a contemporary issue that concerns today's industrial production as a whole and is meant to revolutionize it.

In 2011, Germany introduced Industry 4.0 at the Hannover Fair event, symbolizing the advent of a brand-new era of industrial revolution. When the idea was first mooted, extensive efforts were undertaken by the European manufacturing researchers and companies to embrace it. Their interest in this project or concept is due to the fact that under Industry 4.0, production will become more efficient and less costly. This is achieved by easy exchange of information and the integrated control of manufacturing products and machines acting simultaneously and smartly in interoperability. Industry 4.0 is often used interchangeably with the notion of the fourth industrial revolution. It is characterized by, among others,

1. even more automation than in the third industrial revolution,
2. the bridging of the physical and digital world through cyber-physical systems, enabled by Industrial IoT
3. a shift from a central industrial control system to one where smart product define the production steps
4. closed-loop data models and control systems and
5. personalization/customization of products.

Industry 4.0 serves a role to help integrate and combine the intelligent machines, human actors, physical objects, manufacturing lines and processes across organizational stages to build new types of technical data, systematic and high agility value chains.

Definition

Industry 4.0 is powered by the Industrial Internet of Things (IIoT) and cyber-physical systems – smart, autonomous systems that use computer-based algorithms to monitor and control physical things like machinery, robots, and vehicles. Industry 4.0 makes everything in supply chain “smart” – from smart manufacturing and factories to smart warehousing and logistics. It also inter-connects with back-end systems, like enterprise resource planning (ERP), to give companies an unprecedented level of visibility and control. Ultimately, Industry 4.0 is a major part of any company’s digital transformation. [9]

According to Mckinsey Digital: Industry 4.0 seen as a digitization of the manufacturing sector, with embedded sensors in virtually all product components and manufacturing equipment, ubiquitous cyber physical systems, and analysis of all relevant data.

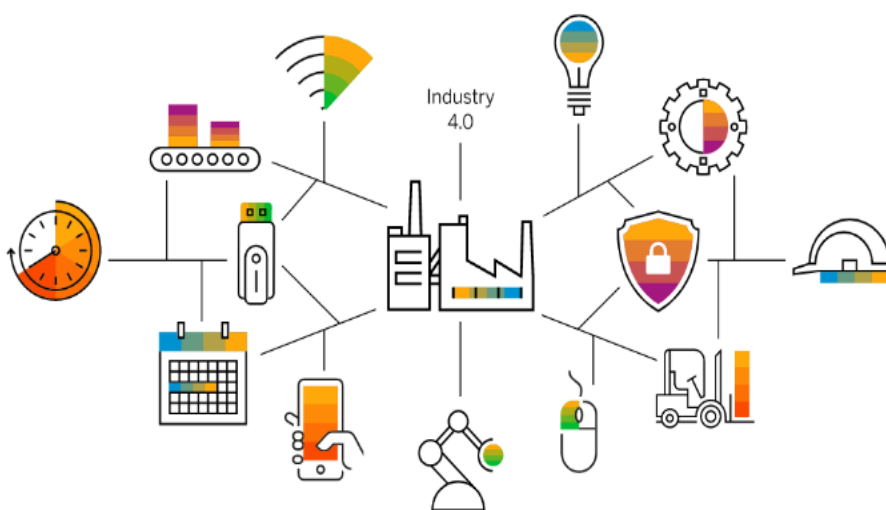


Figure 1: Industry 4.0

Steps To Transformation

A holistic, integrated strategy can help manufacturers attain the full promise of Industry 4.0. Here are four actionable measures to get that effort underway:

1. Start with a vision
2. Focus on business objectives
3. Determine the right tech enablers for business
4. Work within a partner ecosystem that provides visibility.

Technologies

Industry 4.0 is built on nine technology pillars. These innovations bridge the physical and digital worlds and make smart and autonomous systems possible. Businesses and supply chains already use some of these advanced technologies, but the full potential of Industry 4.0 comes to life when they are used together.

1. Big data and AI analytics
2. Horizontal and vertical integration
3. Cloud computing
4. Augmented reality (AR)
5. Industrial internet of things (IIoT)
6. Additive manufacturing/3D printing
7. Autonomous robots
8. Simulation/digital twins
9. Cybersecurity

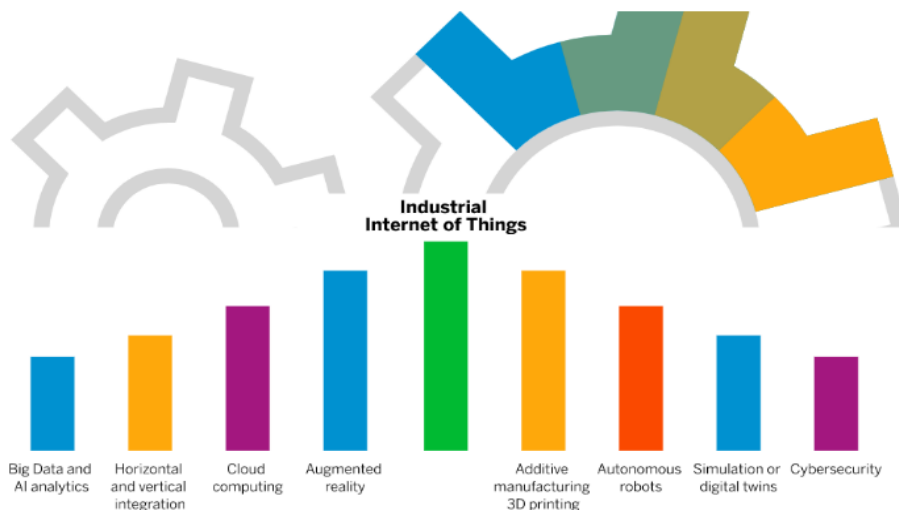


Figure 2: Industry 4.0 Technologies

Challenges

The most challenging aspects for the organizations that wish to adopt this new approach are required skills and qualifications of workers e.g. problem-solving skills, failure analysis, the ability to deal with constant changes and completely new tasks. Other challenges are to protect critical industrial systems and manufacturing lines and systems data from cyber security threats increases dramatically. A slow or unstable internet connection with frequent outages can have significant impacts on remotely factory operation monitoring for both individuals and businesses.

Benefits

Industry 4.0 provides a new way of doing business and a new source of creating value, especially for traditional manufacturing companies. One of the biggest disruptions of Industry 4.0 is the ever-increasing value and importance of data. Here are some benefits companies are experiencing:

1. Radical improvement in productivity and automation: Businesses are making data-driven decisions across their operations, improving forecast accuracy, supporting on-time delivery, and building profit-optimized plans.
2. Resiliency and agility no matter what the market or economy bring: Companies are shaping the future digital supply chain based on state-of-the-art planning.
3. Confidence to explore new business models and seize opportunities quickly.
4. Green and sustainable solutions without sacrificing profitability.

Case Study: Smart Factory

This case study is written from the experience gathered during Industry 4.0 implementation of a leading lead-acid battery manufacturing company in Bangladesh. This company exports battery abroad and they have footprint around 50 countries. This company is pioneer in this industry in Bangladesh and producing batteries for all kinds of vehicle, solar, industrial battery and for IPS/UPS (instant/uninterrupted power supply). The company is supplying its product in the local market to serve the people keep away from darkness and safely movement on road in Bangladesh and overseas over 70 years. As it is very older company and some of its existing machines were not performing as expected. The company decided to automate the machine to increase performance, product quality improvement and change the work culture in the factory premises by implementing Industry 4.0 tools like IIOT (Industrial Internet of Things).

METHODOLOGY AND ARCHITECTURE

To improve production environment, machine performance, product quality, remotely production monitoring and to save human working hours the company has applied various methodologies includes:

1. Identify the areas company wants to improve the process: The company chose the areas considering importance of production process, product quality measure, meet the compliance and cost saving approach. Curing chamber, mixing chamber, power station and Effluent Treatment Plant (ETP) area were selected.
2. Technology partner selection and IIOT implementation: Company's partner selection process was followed by the team; right partner was chosen who had prior experience to implement such project.
3. Information gathering from machine and live monitoring from remote: There were huge manual intervention to pull the information from machine as most the machine had no built-in real time monitoring system.
4. Product quality improvement and meet the regulatory compliance: Product quality was the one of main goal to implement Industry 4.0. Government and environment protection agency visit factory to check the compliance, it was challenge for the company to meet compliance.

IT infrastructure is a key component in digital transformation for manufacturers seeking to take advantage of Industry 4.0. The IIoT is an important technology that allows physical devices to connect and interact with one another and their surroundings via embedded electronics. The company considered IIoT architecture, which consists of Sensing, Network, Data Processing, and Application layers, allows for the seamless data collecting, analysis, and utilization of data. The system implementation architecture is shown below:

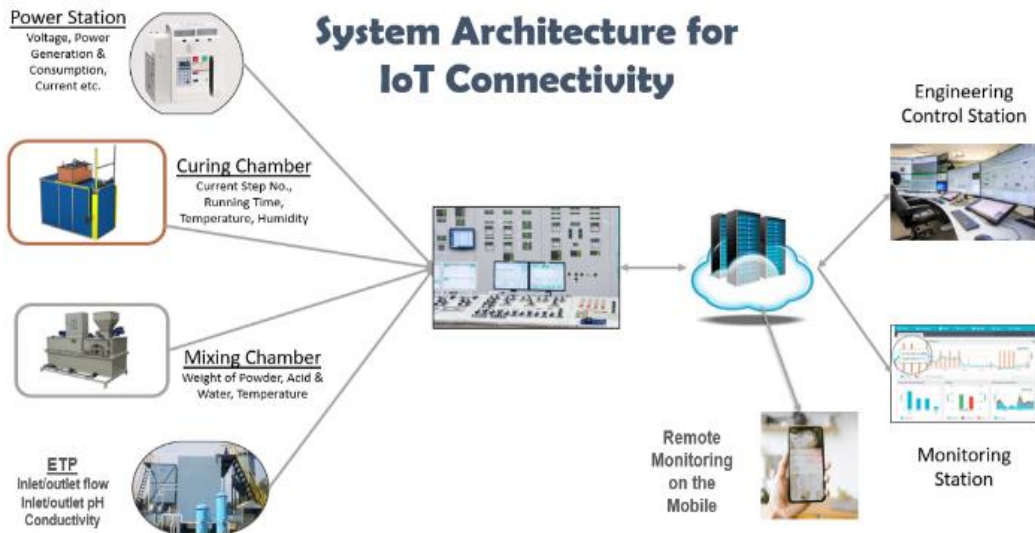


Figure 3: System Architecture

Monitoring

Industry 4.0 tools like Industrial IoT provides insights across factory's device network. After implanting IIoT management platforms, company management team were avail to monitor operations in real-time from their desk, remote teams keep eyes on manufacturing and processes, and can monitor asset location, fulfillment, job completion, operational uptime and many other factors from their mobile. IIoT capability also enables instant alerts on specified conditions, simplified analysis and reporting, leading to a range of benefits.

1. Rapid insights — IIoT implementation help the company management to get manufacturing process visibility across the company network
2. Faster response times — Team able to provide rapid response from remote and provide necessary instructions to the operators at any point in the manufacturing process
3. Remote monitoring and control — Managers are able to control the machine from remote, such as adjusting machine parameter, flow and volume, troubleshooting, and remotely rebooting systems etc.

Outcomes

Industrial IOT implementation gives the company great relief from manual record keeping of machine data. Top management and managers able to oversee the production environment from remote through mobile app. The company decreased maintenance costs significantly and increased its production efficiency and as well product quality. It gives the opportunity to monitor equipment health remotely to prevent sudden machine breakdown. This company boosted their revenue earning significantly than previous years with standard profit margin.

CONCLUSION

Embracing Industry 4.0 yields numerous advantages, including heightened productivity, superior quality control, enhanced flexibility, and the agility to respond to manufacturing conditions. The concept of Industry 4.0 is essential for manufacturing industry and has already had a massive impact on the world's economy. In the near future, it will set the rules of the game and dictate how to stay competitive for big and small businesses alike. So, it's fair to conclude that the future looks promising for those industries that will grasp these advances in technology to benefit from a wide array of opportunities.

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