**Topic: Industry 4.0**

 Written by: Ms Wilma Dias

 Designation: Assistant Professor, Christ College, Pune

 Contact No. – 7892726186

 Email ID – Wilma.dias@christcollegepune.org

**Abstract**

The Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), big data analytics, and cyber-physical systems (CPS) are just a few of the cutting-edge technologies that make up Industry 4.0. These technologies work in concert to create environments for production that are intelligent, autonomous, and responsive. Adaptive decision-making, real-time data exchange, and predictive maintenance are all capabilities of the linked systems that are replacing traditional manufacturing processes in this new era.The main tenets of Industry 4.0—connectivity, data analytics, automation, and human-machine cooperation—are examined in this abstract. The foundation for data generation and transmission is a web of interconnected equipment, systems, and devices that is established by connectivity. Big data's potential is harnessed through data analytics to produce valuable insights, streamline procedures, and facilitate defensible decision-making. Automation, powered by AI and robotics, improves accuracy, efficiency.

**Keywords**: Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), big data analytics, and cyber-physical systems (CPS)

**Chapter’s Objectives:**

* To discuss the importance of skills required to be prepared for industry 4.0
* To look at strategies for finding new innovative ways in sustaining and establishing in a business
* To list the basic evolution of an industry
* To evaluate complete solutions to build the skills

**INTRODUCTION**

Nowadays most businesses have come up as a result of disruptive innovation. Most the businesses are striving to survive and most are sustainable. Industry 4.0 has been described as the most reinvented era where Industry 4.0 has completely changed how companies create, produce, and market their goods. The manufacturing process is now heavily reliant on technologies like the Industrial Internet of Things (IIoT), cloud connectivity, AI, and machine learning. Products, facilities, and assets that are connected and intelligent are produced using a unified and integrated manufacturing method.

Today's Industry 4.0 projects also seek to foster beneficial interactions between humans and technology. A win-win situation is created for both your workforce and your bottom line when the accuracy and speed of 4.0 tools are combined with the creativity, talent, and invention of your people. Your manufacturing operations become more effective and productive, and your teams are freed up from many tedious and repetitive tasks, allowing them to work together with smart technologies and better prepare themselves for the changing technological landscape and the AI-powered future of work.

**DEFINITION OF INDUSTRY 4.0**

The Fourth Industrial Revolution or Industry 4.0 conceptualises rapid change to technology, industries, and societal patterns and processes in the twenty-first century as a result of growing interconnectedness and intelligent automation. McGinnis, Devon (27 October 2020). ["What Is the Fourth Industrial Revolution?"](https://www.salesforce.com/blog/what-is-the-fourth-industrial-revolution-4ir/). *The 360 Blog from Salesforce*. Retrieved 22 January 2023.

Through ongoing automation of traditional manufacturing and industrial practises, the use of cutting-edge smart technology, extensive machine-to-machine communication (M2M), and the internet of things (IoT), fundamental changes are occurring in how the global production and supply network functions. Increasing automation, better communication and self-monitoring, and the deployment of intelligent devices that can analyse and diagnose problems without requiring human interaction are all outcomes of this integration.

Exhibit 1.1

The Global Lighthouse Network started out with 16 sites in 2018, and by 2022, it had expanded to 103 sites. Companies using AI make up over 60% of the lighthouses currently in operation.

These businesses have made advancements across KPIs that fuel growth thanks to Industry 4.0. These KPIs cover all five impact categories and include customization, lead-time reduction, productivity, agility, and sustainability KPIs. Productivity KPIs include manufacturing output. Agility KPIs include lead-time reduction.

**FIRST INDUSTRIAL REVOLUTION**

The 18th century saw the start of the First Industrial Revolution, which later extended to other parts of the world. The phrase "Industrial Revolution" was originally used by English economic historian Arnold Toynbee to refer to Britain's economic growth between 1760 and 1840, despite earlier use of the phrase by French writers. Between 1780 and 1849, contemporary Europe underwent an unparalleled economic transformation that included the beginnings of the great industrial revolution and a broader increase in commercial activity.

ADVANTAGES OF FIRST INDUSTRIAL REVOLUTION

New work mechanisms emerged with the First Industrial Revolution, and the mechanisation and division of labour that came with industry increased productivity. Making use of new sources of energy, factories and workshops developed the industry.

The railway arrived, along with the steamship and steel industries, and it led to the creation of new machinery that accelerated technological advancement, particularly in the textile industry. The inventions of the telephone and telegraph marked a significant advancement in communication and transportation methods.

DISADVANTAGES OF FIRST INDUSTRIAL REVOLUTION

Competition between industrial production and the self-employed was one of the main negative effects that the revolution brought with it. The artisans lost their ability to work from home and instead had to report to the factory for a certain period of time without having any say in how much money they made.

The bourgeoisie and the proletariat, for example, emerged as new social classes. Because businesses paid low salaries and machines had taken over most of man's labour, there were several injustices committed against the working class. Worker life were made miserable by excessive work hours and fines.

Due to the peasants' decision to abandon that way of life, there were frequent migrations to the city, which resulted in a number of epidemics and diseases like cholera.

**SECOND INDUSTRIAL REVOLUTION**

The United Kingdom, Germany, the United States, as well as France, the Low Countries, Italy, and Japan, all saw fast economic expansion during the Second economic Revolution. It came after the First Industrial Revolution, which started in Britain in the late 18th century and extended to the rest of Western Europe. With the outbreak of the Second World War, it came to an end.

**THIRD INDUSTRIAL REVOLUTION**

We are now living through the Third Industrial Revolution after another century. We observe the rise of yet another, as of the moment, untapped energy source in the second half of the 20th century. nuclear power

The third industrial revolution saw the development of electronics, telecommunications, and computers, naturally. Through the use of new technologies, the third industrial revolution made space exploration, research, and biotechnology possible.

In the world of business, two significant innovations—Programmable Logic Controllers, or PLCs, and robots—helped usher in a period of advanced automation.

**Fourth Revolution**

Industry 4.0 is seen by many as the fourth Industrial Revolution, however a sizable number of people continue to disagree. We would have to acknowledge that Industry 4.0 is a revolution that is currently taking place if we were to think about it that way. It's happening to us every day, but we don't yet know how big it is.

Industry 4.0 began with the one thing that everyone uses on a daily basis—the Internet—at the beginning of the third millennium. With the development of virtual reality worlds and our ability to defy the rules of physics, Industry 4.0 can be seen as a shift from the first industrial revolution, which was based on technological phenomena.

The world is shaped by the four industrial revolutions. They form the foundation of world economy. The goal of programs and projects being carried out over the world is to assist people.

Technical advancements, shifts in international markets, and the effects of climate change are just a few of the difficulties the industrial world is dealing with today. The game-changing technologies to address these difficulties are automation and digitalization. The huge amount of data generated by the Industrial Internet of Things (IIoT) must be gathered, understood, and used. This is exactly what the Digital Enterprise is achieving by fusing the physical and digital worlds.

Industry 4.0 is the incorporation of intelligent digital technologies into manufacturing and industrial processes is known as industry 4.0. Among the technologies it incorporates are industrial IoT networks, AI, Big Data, robots, and automation.

The effort to digitize production and operations is greatly aided by the following technologies:

1. Industrial Internet of Things (IIoT): IIoT enables communication and cooperation between people, machines, and data in the industrial industry. In essence, it applies IoT to industrial processes, which involves sensors, equipment, and data being seamlessly connected and interfaced. Every aspect of the manufacturing process can be linked with IOT components, generating data that can be used to improve shop floor efficiencies.
2. Artificial intelligence (AI): Tools improved with machine learning promise cutting-edge outcomes for an Industry 4.0-enabled smart factory. AI firms may use the data produced by a connected factory to improve machine operations, alter workflow in real-time, and monitor operations to detect problems and arrange repair before the failure affects client orders.
3. Big Data & Analytics: Because every aspect of the industrial activity is being tracked and producing data, the amount of data to sort through is exponential. Fortunately, big data analytics systems may make use of cutting-edge cloud-based data stream tools to process data quickly and provide decision-makers with the knowledge they need to make improvements across the whole value chain.
4. Cloud computing: This size and speed of analytics necessitates flexible storage options and burstable processing power. This flexibility and capacity are made possible by cloud-based information repositories, which also serve as the company's single source of truth. Additionally, cloud-based systems offer remote access to and monitoring of all data and machine operating systems, providing excellent visibility into processes and efficiencies.
5. Visualization: After gathering, archiving, and analyzing data to provide insights, it's time to make visualizations that will make it easier for the team to see the same findings consistently. When cloud environments and shop floor interfaces are integrated, digital twins of operations and processes can be created using cutting-edge visualization techniques like mixed reality, which combines virtual reality constructions with augmented reality overlays.
6. Simulations: It is now simpler than ever for both factory and field people to run simulations thanks to the advancement of mixed reality simulations and machine learning AI models. Prior to the factory's digitization, switching over a product line and maximizing its speed and productivity required some guesswork and was never ideal. Manufacturing operations may more precisely optimize equipment for product runs, save expenses and waste, and save time and money on production with the help of today's Industry 4.0 technologies.
7. Cybersecurity: With Industry 4.0, every point of contact on the floor is connected and digitized, which increases the need for strong cybersecurity. Protection is required for connected systems such as manufacturing equipment, computers, data analytics, and the cloud. Manufacturers are also asked to adhere to ever-tougher criteria for a variety of end markets.

**Impact of technology on the manufacturing industry transforming the global economy**

1. **Greater Flexibility across the Manufacturing Operation**: Industry 4.0 enables greater flexibility, which leads to better asset utilization and, consequently, the possibility for revenue gains. Consider automation: Autonomous mobile robots (AMR) can do routine jobs like product transportation, freeing up experienced workers for higher-value work.
2. **Increased Labor and Productivity:** Employees who feel more safe at work are better able to concentrate and complete more tasks during the day. One of the main advantages of IoT solutions on the factory floor is worker safety. Sensors placed in the workplace and worn by employees are continuously monitored to provide a safe and healthy working environment.

Many factory personnel are expanding their skill sets as a result of Industry 4.0. Workers are learning new talents to increase operational efficiency and their skill set as new technologies are introduced to the business. Imagine cobots collaborating with workers in manufacturing workflows to boost efficiency, provide more customization, enhance safety, and improve quality control.

1. **Supply Chain Visibility:** Manufacturers can view the whole supply chain and production process thanks to IoT-enabled sensors and data analytics. Supply chain optimization is possible in real-time because to this level of visibility, AI, and machine learning capabilities.

Some people are even referring to this development in supply chain management as Logistics 5.0. Through a "collaboration of digitization and human effort without compromising or neglecting competitiveness and profitability in their businesses," increased visibility is a long-term investment that enables businesses to empower their employees, account for disruptions, and reduce environmental impacts.

1. **After-sales Service:** The Industry 4.0 pillars of predictive analytics, virtual reality, and remote monitoring also apply to the consumer market after production. While a manufacturer won't be directly impacted, their customer and field service offerings could be significantly enhanced if they develop products that support IoT connectivity.Many businesses use exceptional customer service as a competitive differentiator, and connected technology used in field service is assisting in raising customer satisfaction levels. With connected devices, manufacturers can keep an eye on how their products are performing, planning maintenance before a problem emerges and avoiding any potential customer complaints.
2. **Sustainability:** When processes are emulated in the metaverse using the cloud, the amount of physical resources and even travel needed is drastically reduced, which has a positive impact on the environment. Construction and renovations at companies can be meticulously planned using digital models to reduce their negative environmental effects. Engineers can more quickly discover energy and water waste by using visualizations of processes and activities to create more efficient systems.

**Strategies Behind Industry 4.0**

Step 1: Evaluate

The first phase is all about determining preparedness and whether your company has adopted all the crucial Industry 4.0 building elements. Knowing where you are now, where you want to go, and how to get there will help you boost your chances of success and minimize rookie mistakes.

Step 2: Determine

Based on the previous failure data that is currently accessible, certain possible initiatives are chosen and then their worth and viability are assessed. Clarifying the project scope also benefits from a thorough technical and failure mode analysis. It is feasible to develop a business case and suggest technological solutions as a result of this study.

Step 3: Generating

After gaining control of your current situation and identifying potential optimization strategies, you must now put the technical solutions required to produce the necessary data into practice. IoT advancements recently have made it possible to lower connectivity costs and integrate with the current ISA 95 data architecture.

Step 4: Gathering

You must collect the data after it is generated. Many data sources could appear disparate and seem to lack sufficient information. But when it comes to Industry 4.0, merging all of the pertinent data sources provides a better and more intelligent foundation for producing insightful data.

**Conclusion**

In conclusion, the era of Industry 4.0 is one of radical change and upheaval in the fields of production and technology. Industry 4.0 has the potential to reshape industries, improve operational efficiency, and spur economic growth thanks to its emphasis on connectivity, automation, data-driven decision-making, and the integration of cutting-edge technologies like the Internet of Things (IoT), artificial intelligence (AI), machine learning, and advanced robotics.

Adopting Industry 4.0 concepts has a number of advantages, such as simplified supply chains, enhanced product quality, less downtime, and optimized production processes. However, this transition also brings with it difficulties including worries about data security, the need to upskill the workforce, and the demand for a strong infrastructure to support these cutting-edge technology.

Collaboration between governing bodies, corporations, academic institutions, and other stakeholders becomes increasingly important as industries continue to develop and adopt the principles of Industry 4.0. This cooperative strategy can promote innovation, deal with legal concerns, and make sure that the advantages of Industry 4.0 are fairly spread throughout society.

In conclusion, Industry 4.0 is positioned to fundamentally alter how we produce, use, and communicate with technology. We may open up new possibilities by embracing the promise of connected systems and intelligent equipment.

**References**

Hermann et al. (2016)'s "Industry 4.0: A Comprehensive Review and Implications for the Future"

Hermann et al. (2015)'s "The Road to Industry 4.0: Challenges and Opportunities"

By Lu et al. (2017), "A Review on the Industry 4.0: History, Components, Enabling Technologies, and Future Prospects"

Internet sites and resources: The Fourth Industrial Revolution, according to the World Economic Forum

Manufacturing USA - Industry 4.0 National Institute of Standards and Technology (NIST) - Cybersecurity for Industry 4.0

Internet sites and resources: The Fourth Industrial Revolution, according to the World Economic Forum

Manufacturing USA - Industry 4.0 National Institute of Standards and Technology (NIST) - Cybersecurity for Industry 4.0