

# Impact of COVID-19 Coronavirus on Industry Standards 4.0 and 5.0

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## Abstract

In 2019, the coronavirus that spread worldwide lasted until the middle of 2022. There was a kind of recession that had a huge impact on all types of industries. It also influenced subsequent industry-standard developments. The first Industrial Revolution 1.0 was started in the 18th century. i.e. this first Industrial Revolution began with the discovery of the power of “steam”. Clothing production was increased because all handlooms were converted to steam-powered machinery. Later in 1825, steam engines were used in Trains. Industry-standard 2.0 began, after the invention of electricity in the 19th century and industries gained momentum. Businesses were launched at lightning speed. Electricity was the impetus for many inventions. Then in the 20th century, a major industrial revolution, i.e. Industry Standard 3.0 took place after the invention of computers. Computers were used in all factory offices and houses. From budgeting to all kinds of science, physics, and economics, computer applications have increased and made human work easier. The computer industry grew at lightning speed and gave birth to this third industrial revolution. In the 1970s/1980s, computer networks and Internet technologies paved the way for the fourth industrial standard 4.0. The world has shrunk to the size of a palm. After the year 2000, Artificial Intelligence, IoT, Big data analytics, and robotics gave birth to the industrial standard 5.0.

**Keywords:** Industrial revolutions, Coronavirus, Industry-standard 4.0 and 5.0, water power, steam power, electric power.

## 1.0 Introduction

In manufacturing industries, selecting the right and qualified people for the right jobs is very difficult. In 2019, coronavirus was also spread all over the world and killed around 8 million people. This has made one thing clear to us. We should use robots in manufacturing industries, instead of always depending on human power for production. Do not mistake that the upsurge of the robot revolution will eliminate humans from the manufacturing industry. Robots will improve efficiency, and accuracy and increase productivity. People can also work along with robots with artificial Intelligence. Industry 5.0 aims to merge cognitive computing capabilities with human intelligence and creativities in collaborative operations.

Industry 4.0 is the fourth revolution that has occurred in the manufacturing field. This industrial revolution emerged from the third revolution with the adoption of computers and automation. It has been enhanced with smart and autonomous systems fuelled by data and machine learning. Industry 4.0 follows three preceding technological transformations: steam power, which was the transformative force of the nineteenth century; electricity, which transformed much of the twentieth century, and the beginning of the computer era in the 1960s / 70s [1].

Industry 5.0, also known as the Fifth Industrial Revolution, is a phase of industrialization that emphasizes collaboration between humans and advanced technology to improve workplace processes. It builds on the foundations of Industry 4.0, which introduced smart technologies like artificial intelligence (AI), cloud connectivity, and real-time data analytics. Industry 5.0 prioritizes a human-centric approach, focusing on sustainability and social value. It also aims to help industries solve societal challenges like climate change, resource preservation, and social stability.

The Industry standard 6.0 based on standard 5.0 is a workplace improvement process and part of Lean Management. The 6.0 also referred to as "5.0+ Safety", assists in maintaining productivity and safety in the workplace.

### 1.1 Literature review

Literature reviews are indispensable. Literature reviews help strengthen the field of study, identify research gaps, evaluate relevant literature, and discover new technical principles.

1. Benjamin Meindl et.al mentioned in their research paper, “*Evolution of ten years of research and future perspectives. Technological Forecasting and Social Change*” that technologies in industrial quality control have grown rapidly over the past ten years. Their objective was to understand how this literature has evolved and propose future research opportunities. They focussed on four smart dimensions of Industry 4.0: Smart Manufacturing, Smart Products and Services, Smart Supply Chain, and Smart Working. They performed a machine learning-based systematic literature review. Their analysis included 4,973 papers published from 2011 to 2020. They conducted a chronological network analysis considering the growth of these four dimensions and the connections between them.
2. Alejandro German frank et.al...mentioned in their paper “ Industry 4.0 technologies: Implementation patterns in manufacturing companies” that Industry 4.0 has been considered a new industrial stage in which several emerging technologies were converging to provide digital solutions[2]. However, there was a lack of understanding of how companies implement these technologies. Thus, they aimed to understand the adoption patterns of Industry 4.0 technologies in manufacturing firms. They proposed a conceptual framework for these technologies, which they divided into front-end and base technologies. Front-end technologies consider four dimensions: Smart Manufacturing, Smart Products, Smart Supply Chain, and Smart Working, while base technologies consider four elements: the Internet of Things, cloud services, big data, and analytics. They performed a survey in 92 manufacturing companies to study the implementation of these technologies. Their findings showed that Industry 4.0 is related to a systemic adoption of front-end technologies, in which Smart Manufacturing plays a central role. Their research results also showed that the implementation of the base technologies was challenging for these companies since big data and analytics are not highly implemented
3. Rajiv Agarwal, Anvesh Jamwal, et.al mentioned in their paper “ Industry 4.0 technologies for manufacturing sustainability: A systematic review and future research directions “ that the recent developments in manufacturing processes and automation had led to the new industrial revolution termed “Industry 4.0”[3]. Industry 4.0 can be considered as a broad domain which includes: data management, manufacturing competitiveness, production processes, and efficiency. The term Industry 4.0 includes a variety of key enabling technologies i.e., cyber-physical systems, Internet of Things, artificial intelligence, big data analytics, and digital twins which can be considered as the major contributors to automated and digital manufacturing environments. Sustainability can be considered

as the core of business strategy which is highlighted in the United Nations (UN). Industry 4.0 technologies help to achieve sustainability in business practices.

4. Rozella Pozzi, et.al. mentioned in their paper .” *The impact of Industry 4.0 and its opportunities are expected to be significant for manufacturers*”, that a lack of empirical studies creates the need for academic contributions on the critical success factors of Industry 4.0 implementations and their resultant improvements for manufacturing businesses[4]. This research uses case studies of eight implementations of Industry 4.0 technologies in Italy to supplement existing literature. An original data set was constructed using a purposely defined research protocol using plant visits and structured interviews.
5. Ting Zheng, Marco Ardolino, Andrea Bacchetti, Marco Perona. “*The applications of Industry 4.0 technologies in manufacturing context: a systematic literature review*. Industry 4.0 (I4.0)” encompasses many digital technologies affecting manufacturing enterprises [5]. Most research on this topic examines the effects in the smart factory domain, focusing on production scheduling. However, there was still a lack of comprehensive research on the applications of I4.0 enabling technologies in manufacturing life-cycle processes. This paper was thus intended to provide a systematic literature review answering the following research question: What are the applications of I4.0 enabling technologies in the business processes of manufacturing companies? The study analyses 186 articles and the results show that production scheduling and control is the process most often investigated, while there is also an increasing trend in circular supply chain management. Moreover, there was an extensive combined use of IoT, Big Data Analytics, and Cloud, whose applications cover a wide range of processes.
6. Bojana Bajic et.al..their paper “*Implementation Challenges and Opportunities: A Managerial Perspective*” . They mentioned that Industry 4.0 is a concept aimed at achieving the integration of physical parts of the manufacturing process via networks and driven by Industry 4.0 technology categories used for prediction, control, maintenance, and integration of manufacturing processes [6]. Industry 4.0, which is expected to greatly impact manufacturing systems in the future, is attracting attention in both industry and academia. Although academic research on Industry 4.0 is growing exponentially, evidence of Industry 4.0 implementation in practice is still scarce. Moreover, the challenges the industry faces when implementing the Industry 4.0 concept seem to be even less addressed.

## 1.2 Historical evolution of Industry standards

### Industry 1.0

Period: 1760-1870

Technology: Water power

Country/ countries of origin: England

### Industry 2.0

Period: 1870- 1970

Technology: Electric power, vacuum tubes

Country/ Countries of origin: England,

Germany, USA, France, etc..

### Industry 3.0

Period: 1970-2010

Technologies: Electronics, computers, Internet, Automation, and digitization.

County/ Countries of origin: USA, UK, Germany and Japan

### **Industry 4.0**

Period: 2010-2017

Technologies: IoT, robotics, nanotechnologies, Artificial Intelligence, , Cloud technologies, blockchain, Cloud technologies, Digital twins, Cyber securities, Bio technologies, etc..

### **Industry 5.0**

Period: 2017-to date

Technologies: Combination of Industry 4.0 's advanced technologies with human skills and creativity.

#### **1.4 Impact of COVID-19 on Industry 4.0 and 5.0**

The coronavirus 2019 (COVID-19) pandemic has further fueled the development of Industry 4.0. This has also led to the rapid 5th industrial revolution.

I reviewed 100 research papers published in the last four years ie from January 2020 up to July 2024 in the domain of Industry standard 4.0 and 5.0. I found that only very few research papers were published in the year 2021 as shown in the bar charts. It was only in the year 2021 that the impact of the second wave of the coronavirus was greater. It seemed that the next level of industry standards might have come if the coronavirus had not spread. It seems that the coronavirus has limited the growth of the industry standards. The impact of the coronavirus on publishing research papers in the year 2021 in this sector is evident.

The impact of the coronavirus is reverberating not only in the IT sector but also in the medical sector. Therefore industry 5.0 is now progressing at breakneck speed in all sectors. Different Industry 4.0 and 5.0 technologies including AI and Robotics being inspected to manage the rate of transmission of COVID-19 globally.

#### **1.5 Various technologies used in Industry 4.0 and 5.0**

##### **1.5a. Industry-standard 5.0**

Besides AI technology, returning to human power is the main aim of Industry Standard 5.0. AI-based Robots help humans increase productivity by using the latest technologies. We could also say Industry standard 5.0 is a combination of digitalization, automation, and human capabilities to create a more sustainable and interactive working environment Some technologies that are enabling this transformation include:

1. Digital twin
2. Robotics
3. Collaborative robots
4. Cyber-Physical systems
5. Additive manufacturing
6. Cloud computing
7. Fog computing

Etc...

##### **1.5b. Industry-standard 4.0**

The integration of intelligent digital technologies into manufacturing and industrial processes. Some examples of Industry 4.0 technologies include:

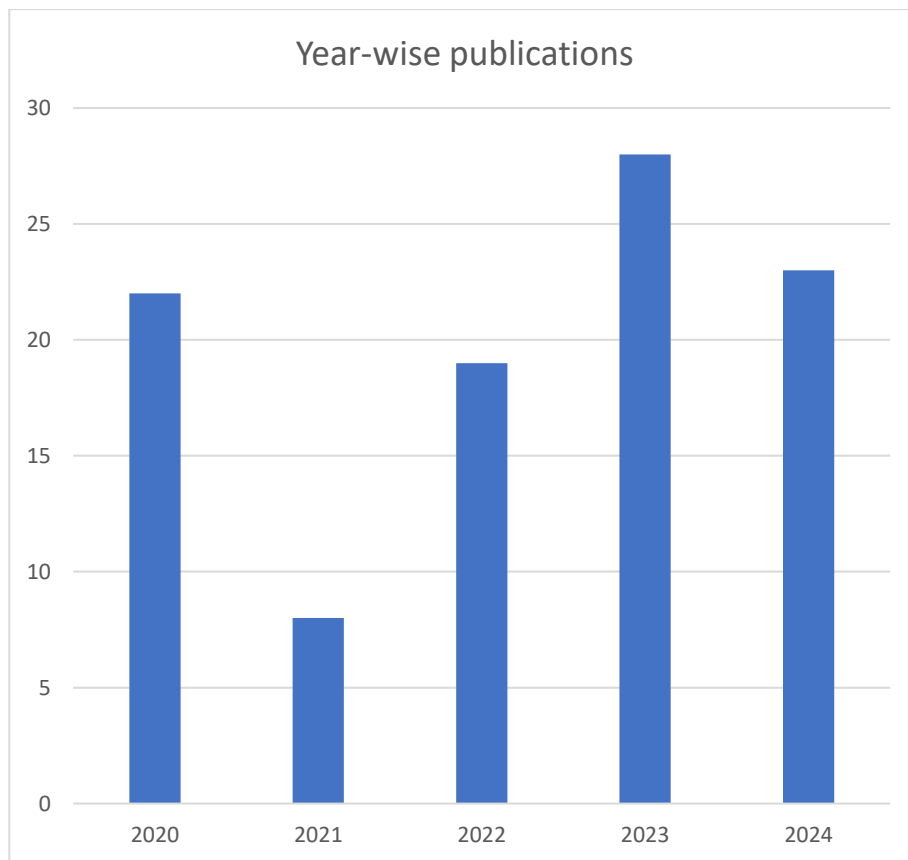
1. **Internet of Things (IoT) sensors**: These sensors enabling better monitoring and predictive maintenance by collecting real-time data from machines and devices

2. **Robotics and automation:** Productivity can be increased by Intelligent robots by performing repetitive tasks with precision and speed.
3. **Additive manufacturing (3D printing):** This technology allows for rapid prototyping and customization of products.
4. **Artificial intelligence (AI) and machine learning:** Large amounts of data can be analysed by AI algorithms to optimize production processes, detect anomalies, or predict maintenance needs.
5. **Cloud computing:** Cloud-based platforms enable real-time collaboration between different stakeholders in the manufacturing process.
6. **Big data analytics:** Advanced analytics techniques can extract valuable insights from vast amounts of data collected during production.

**1.6. Survey on Industry 4.0 and 5.0 from 2020 to 2024 till date**

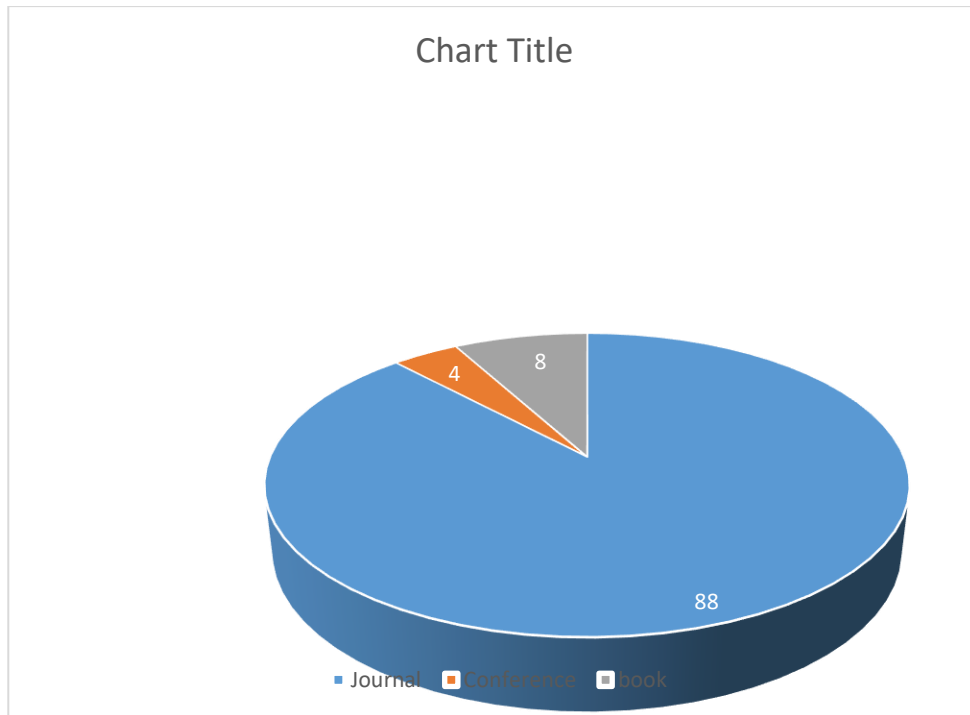
**1.6a. Year-wise publications in reputed journals after the year 2019**

2020 - 22  
 2021 - 08  
 2022 - 19  
 2023 - 28  
 2024 - 23



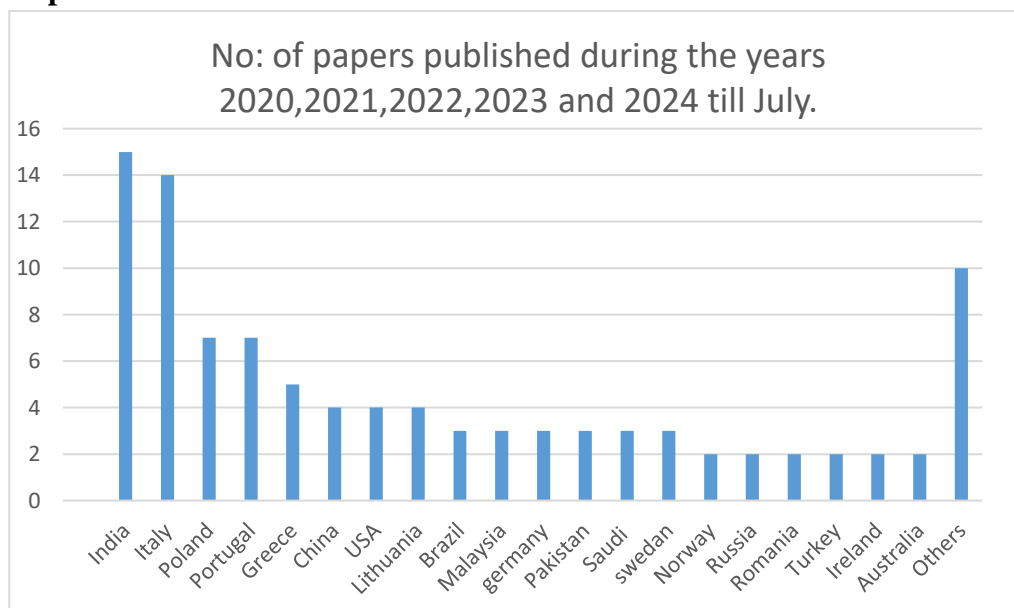
**Fig.1. Journal publications on year-wise**

As shown in the above bar chart, The no: of research papers published in the domain “ Industry standard 4.0 and 5.0” when the coronavirus spread out was in its peak, i.e., in the year 2021, was too low, compared to other years.



**Fig.2. No: of papers published in journals/ Conference proceedings and books**

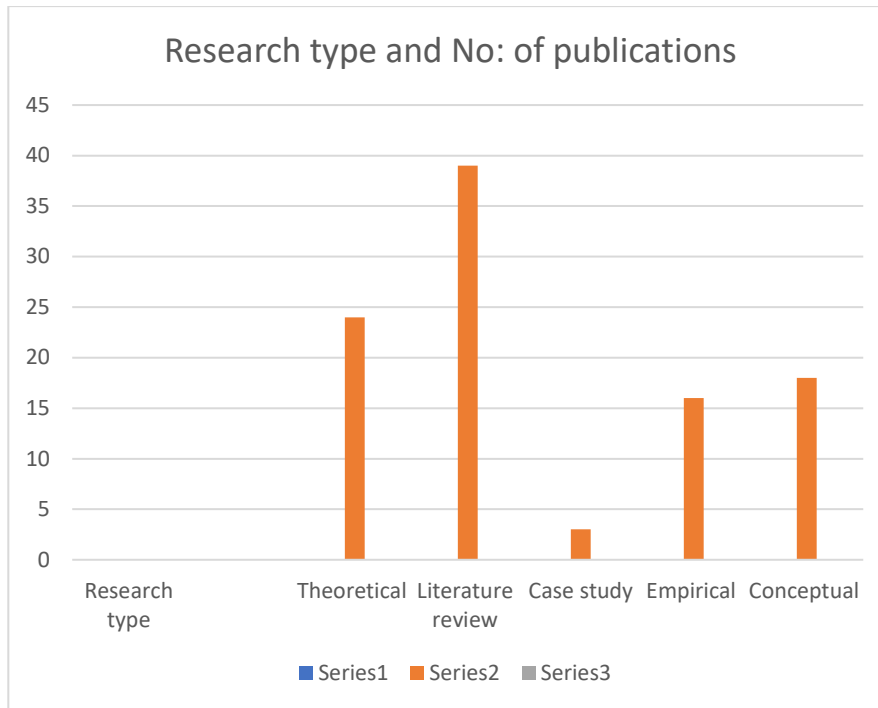
**Country -wise publications**



**Fig. 3 Country-wise publications**

**1.7 Research type**

Theoretical	24
Literature review	39
Case study	03
Empirical	16
Conceptual	18



**Fig.4. Research types**

As shown in the above chart, more literature review papers are published in the last 4 years.

### 1.9 Conclusion

The international business environment has been reshaped. The reason for that is the enormous changes in industrial standards. However, in the years 2020 and 2021, which is the Corona period, there were some impacts in this industrial revolution. Industrial research units were also affected. I have proved in this article that the year 2020 published very few research papers. We are now at the beginning of industry standard 6.0. In the future, the industry will accelerate to 7.0, 8.0. As shown in the above graph, When the coronavirus peaked in 2021, the number of research papers published was deficient, compared to other years.

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