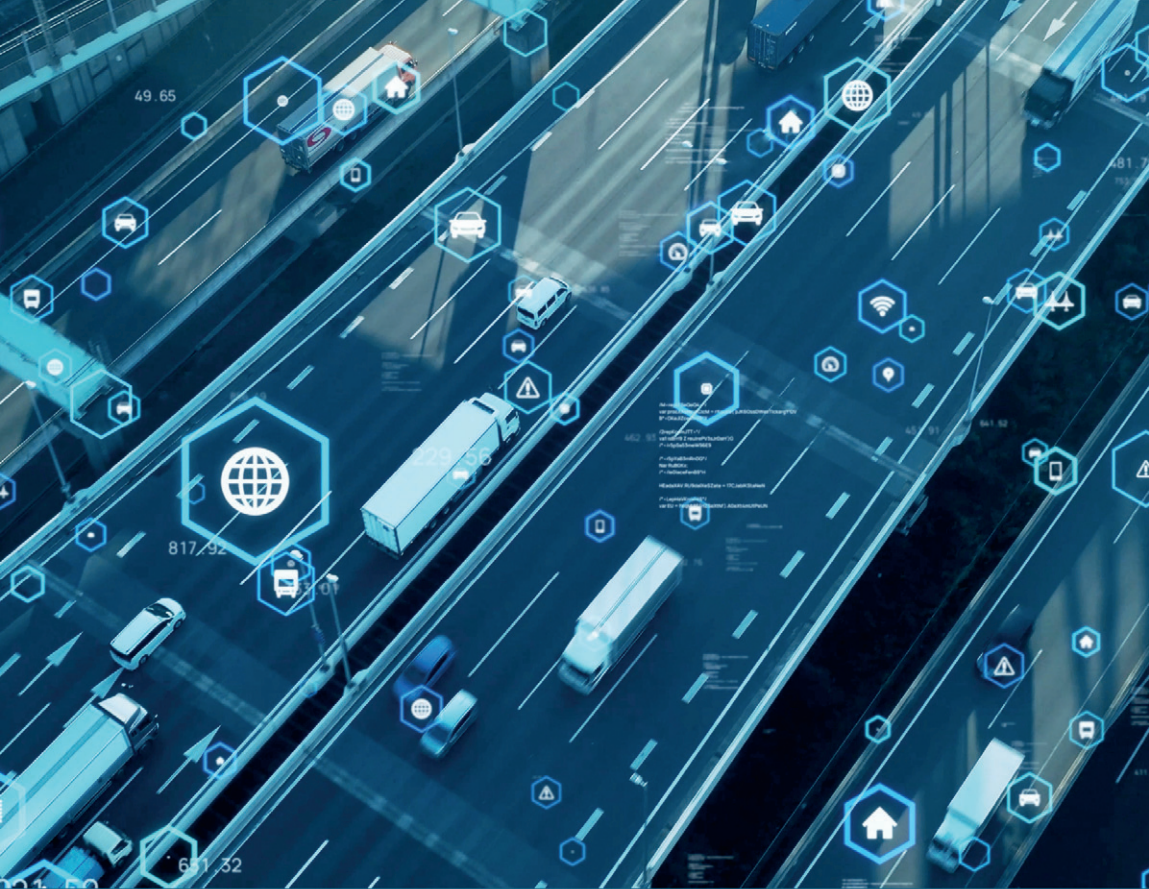




Transformation of Supply Chain Ecosystems

**Technological Innovations
and Collaborations**

Edited by

Anamika Pandey and Fadi Al-Turjman

Transformation of Supply Chain Ecosystems

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Transformation of Supply Chain Ecosystems: Technological Innovations and Collaborations

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INVESTOR IN PEOPLE

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List of Abbreviations

Chapter 1

AI	Artificial Intelligence
AM	Additive Manufacturing
AR	Augmented Reality
CC	Cloud Computing
CPS	Cyber-Physical Systems
IoT	Internet of Things
ML	Machine Learning
VR	Virtual Reality

Chapter 2

AI	Artificial Intelligence
BT	Blockchain Technology
EPOS	Electronic Point of Sale
GPS	Global Positioning System
GPT-4	Generative Pre-Trained Transformer 4
IOT	Internet of Things
M2M	Machine-to-Machine
ML	Machine Learning
NLP	Natural Language Processing
RFID	Radio Frequency Identification
SC	Supply Chain
SCM	Supply Chain Management
SME	Small Medium Enterprises
WMS	Warehouse Management System

Chapter 3

AML	Anti-money Laundering
DLS	Distributed Ledger Technology

KYC	Know Your Customer
P&G	Proctor and Gamble
SME	Small and Medium Enterprises

Chapter 4

3D	Three-Dimensional
4D	Four-Dimensional
AGV	Automated Guided Vehicles
AI	Artificial Intelligence
AMR	Autonomous Mobile Robots
BDA	Big Data Analytics
CAD	Computer-Aided Design
CDP	Carbon Disclosure Project
GPS	Global Positioning System
HVAC	Heating, Ventilation, and Air Conditioning
IoT	Internet of Things
RFID	Radio Frequency Identification
SC	Supply Chains
SCM	Supply Chain Management
SSC	Sustainable Supply Chain
SSCM	Sustainable Supply Chain Management
WMS	Warehouse Management System

Chapter 5

ESG	Environmental, Social, and Governance
GSCM	Green Supply Chain Management
LSCM	Logistics and Supply Chain Management
SDG	Sustainable Development Goal
SSCM	Sustainable Supply Chain Management
TBL	Triple Bottom Line

Chapter 6

CSP	Corporate Social Performance
CSR	Corporate Social Responsibility
EP	Environmental Performance
FP	Financial Performance

SSCM	Sustainable Supply Chain Management
TBL	Triple Bottom Line

Chapter 7

AI	Artificial Intelligence
AR	Augmented Reality
RFID	Radio Frequency Identification
SCM	Supply Chain Management
SCP	Supply Chain Performance
VR	Virtual Reality

Chapter 8

ABDC	Australian Business Deans Council
AHP	Analytical Hierarchy Process
AR	Augmented Reality
CB	Collective Behavior
iOS	iPhone Operating Systems
IoT	Internet of Things
PLS-SEM	Partial Least Squares Structural Equation Modeling
R&D	Research and Development
SCM	Supply Chain Management
SCOM	Supply Chain and Operations Management
SLR	Systematic Literature Review
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
VR	Virtual Reality

Chapter 9

AI	Artificial Intelligence
BDA	Business Data Analytics
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
ESG	Environmental, Social, and Governance
IoT	Internet of Things
QR	Quick Response
RFID	Radio Frequency Identification

SAP	System Applications and Products in Data Processing
SCM	Supply Chain Management

Chapter 10

IoT	Internet of Things
ITS	Intelligent Transportation Systems
RFID	Radio Frequency Identification
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle

Chapter 11

AGV	Automated Guided Vehicle
AI	Artificial Intelligence
AMR	Autonomous Mobile Robots
COVID-19	Coronavirus Disease – 19
IoT	Internet of Things
RPA	Robotic Process Automation
SCM	Supply Chain Management
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
SSCC	Sustainable Supply Chain Cube
UPS	United Parcel Service

Chapter 12

FAO	Food and Agriculture Organization
FSC	Food Supply Chain
FSCM	Food Supply Chain Management
PFSC	Perishable Food Supply Chain
SC	Supply Chain
SSCM	Sustainable Supply Chain Management

Chapter 13

EE	Energy Efficiency
ESCA	Ethical Supply Chain Activities
ESG	Environmental, Social, and Governance
GL	Green Logistics

GP	Green Purchase
GSC	Global Supply Chain
GSCM	Global Supply Chain Management
GW	Green Warehousing
MNCs	Multinational Corporations
OR	Organizational Reputation
SDG	Sustainable Development Goals
SGP	Sustainable Green Practices
SP	Sustainable Practices
SRI	Socially Responsible Investment
SRP	Socially Responsible Practice
SS	Social Sustainability
SSCP	Sustainable Supply Chain Practices
TA	Technology Adaptation

Chapter 14

AI	Artificial Intelligence
HVAC	Heating, Ventilation, and Air Conditioning
SDG	Sustainable Development Goals
SSCM	Sustainable Supply Chain Management
SSCP	Sustainable Supply Chain Practices
TBL	Triple Bottom Line

Chapter 15

EMS	Environmental Management System
ESG	Environmental, Social, and Governance
ETI	Ethical Trading Initiative
GRI	Global Reporting Initiative
ISO	International Organization for Standardization
IT	Informational Technology
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
SAI	Social Accountability International
SSCM	Sustainable Supply Chain Management
SSDM	Soft Systems Dynamic Methodology
TBL	Triple Bottom Line

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About the Editors



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Foreword

Technological advancements and collaborative strategies have brought about profound changes in the intricate networks of the supply chain ecosystem. The book “Transformation of Supply Chain Ecosystems: Technological Innovations and Collaborations” is a timely treatise on the theme and will be a vital resource for professionals, scholars, and practitioners. The authors examine the unimaginable opportunities that are emerging due to the convergence of technologies such as AI, blockchain, metaverse, advanced data analytics and IoT.

A comprehensive coverage of all the issues involved in creating a sustainable supply chain ecosystem is clearly brought out in the chapters on collaboration across various stakeholders, such as retailers, logistics firms, suppliers, consumers, and manufacturers.

This synergy between technological innovation and collaborative efforts is the distinctive feature of this book. The book is an excellent integration of theory and practices of SCM as the contributing authors include leading academicians, practitioners, and industry consultants who have shared their experiences, case studies, and given valuable suggestions which will help to navigate this new ecosystem in SCM.

The authors have covered it all from the Retail, Automobile, Logistics, Food, Healthcare, and Tea sectors. I am confident that this book will trigger creative solutions and increase collaborative endeavors in this interconnected world to transform supply chain systems.

I congratulate Dr Anamika Pandey and Dr Fadi Al-Turzman for the great research that has gone into this book and the seamless manner in which the authors have woven the themes of technological prowess and human collaboration.



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Preface

The 21st century has seen a rapid increase in technological advancements and globalization, significantly impacting all aspects of business operations. SCM is one area where significant transformation has been recorded and evolved from a linear style supply chain to a dynamic supply network ecosystem. The book “Transformation of Supply Chain Ecosystems: Technological Innovations and Collaborations” aims to explore such changes precipitated by technological innovation and sustainable collaborations.

The traditional supply chain relies on historical data to investigate operations and implement improvements. In contrast, real-time technology-driven supply chains provide accurate information to predict concerns and implement urgent safety steps. Technology makes effective planning, sourcing, and logistical management possible, whether controlling inventories or tracking shipments, attaining last-mile delivery with drones, or preserving better security with blockchain.

Technology-supported logistics and SCM benefit companies by enhancing customer service and operational efficiency. Businesses can use technology to detect swings in demand and avoid shortages and surpluses. Thus, technology implementation is critical in today’s competitive world. Machine learning, blockchain, cloud computing, AI, augmented or virtual reality, robots and automation, IoT, metaverse, and 3D printing are advanced technologies that potentially disrupt the supply chain processes and functions. Thus, understanding these technologies is critical for efficient and effective supply chain business.

Contemporary supply chains do not merely entail activities such as acquisition, manufacturing, or even supply. They have intricate chains comprising many stakeholders ranging from manufacturers, suppliers, retailers, and consumers. A more interconnected and collaborative supply chain ecosystem is required due to robust efficiency measures, transparency, and resilience in case of disruption. Technological innovation and advancements are the core of this transformation, facilitating supply chains to be more flexible, customer-oriented, transparent, and responsive. This book entails a holistic approach and framework for developing a robust supply chain and logistics ecosystem based on cutting-edge technologies. The advent of newer methodologies and technologies and the intersection of supply chain and technology impact each domain.

In the coming decades, a company’s profitability will be determined by its logistics and supply chain ecosystem and new-age perspectives on stakeholder behavior. The book focuses on innovative techniques for logistics optimization, analytics for efficient stock and inventory management, strategic business creation over the complete

value chain, supply chain financing, sustainable practices for warehouse management and transportation environment monitoring, multimodal-based logistics and supply chain systems and processes and development of interactive system visualization, and user-interface techniques for logistics and supply chain.

This book has outlined the contributions of experts in designing and implementing supply chain systems, like inventory and transport management, warehouse operations, analyzing customer preferences, sustainable supply chain practices, demand forecasting, supply chain planning and financing, predictive analysis, and automation, contributing their knowledge to identify the different attributes of the above domain. The chapters of the book are designed and organized pragmatically to enhance the reader's experience and interest. It also reflects upon a few untouched supply chain and logistics segments, such as hyper-automation, data security, metaverse, sustainable practices, use of explainable AI (XAI), blockchain, etc., for robust supply chain ecosystems. The book explores the concepts of IoT, blockchain, AI, hyper-automation and analytics, and their impact on shaping the future world. These technologies are not just incremental improvements to supply chain processes but revolutionary changes that redefine the role of supply chains. For example, IoT enables precise monitoring and tracking of goods throughout the supply chain, leading to better decision-making, cost reduction, and streamlined SCM.

As technology accelerates the supply chain processes, networking and collaborations are essential for the effectiveness of the system. More integrated collaborative models are replacing the traditional repository-based approach to SCM. For example, a higher level of partnership among suppliers, manufacturers, logistics providers, and retailers within the supply chain can drive efficiency gains, leading to cost savings and increased resilience. They will have better chances to avoid or overcome disruptions together by sharing information or pooling resources so that their business continuity remains unaffected even when something happens.

Sustainability is another relevant issue to the SCM of companies in today's world. The firms are under pressure to ensure sustainable practices in the supply chain processes due to the growing realization of their impact on the environment. This book examines how technology and collaboration can be used to achieve environmental conservation objectives, from implementing carbon-efficient logistics to ensuring fair trade supplies. Promoting social responsibility, minimizing environmental impact, and ensuring economic viability are all parts of sustainable supply chain practices. These promote fair labor conditions, efficient resource use, and ethical sourcing. Tools for real-time monitoring, such as IoT, blockchain for transparent and secure transactions, and AI optimization logistics for forecasting demand make this transformation an essential technological innovation. They also boost the efficiency of a supply chain, reduce waste, and strengthen its resilience to possible shocks. If sustainability is combined with advanced technology such as the IoT, companies can build robust and responsible supply chains to ensure long-term ecological balance and protect social equity while enhancing economic growth.

Technology and collaboration are the central themes of this book. We demonstrate how leading companies use these two aspects to drive their supply

chain transformations through multiple cases and examples drawn from practice. For example, it integrates data sharing and collaborative planning between Walmart and Procter & Gamble, serving as a model for strategic alliances with considerable benefits. The partnership between Maersk and IBM on the TradeLens blockchain platform also demonstrates the combination of technological innovation and collaborative effort.

Across the chapters, we look into various aspects of supply chain transformation, including procurement, production, distribution, and logistics. In each of these, we discuss how technology can improve them, thereby providing practical insights and implementation strategies. For instance, in procurement, supplier selection assistance AI-based platforms are completely changing while smart factories enabled by IoT enhance efficiency and flexibility in production.

To this end, the objective of this book is to create a single resource for Supply Chain Professionals, Business Leaders, and Academics. Our goal is to fill this gap by giving valuable insights into practical applications along with strategies for leveraging technology and collaboration in supply chain operations. We hope to demonstrate the tangible benefits of embracing innovation and collaboration by presenting real-world case studies and examples. We are grateful for the inputs, findings, and activities of the contributors, researchers, and practitioners who added value to this book. Their ideas have been pivotal in generating an insightful and useful source.

In your exploration of the new supply chain ecosystem, we recommend opening up the culture of creativity and cooperation that is necessary in today's fiercely competitive global environment. Of course, it reflects more than just current trends. Instead, it actually serves as a guide to what lies ahead in SCM. Therefore, by harnessing technological innovations for better operations and building strong partnerships with their suppliers, businesses can develop strong, sustainable, resilient, and efficient supply chains that drive long-term success.

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Chapter 1

Technological Transformation in Supply Chain and Inventory Management in Industry 5.0

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Abstract

Purpose: This chapter highlights the roles of current technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, and robots in the supply chains and inventory management in Industry 5.0 (I-5.0).

Need for the Study: This chapter is relevant to the current study as it presents the potential of new technologies in increasing efficiency, reducing costs and risks, and providing a creative approach to managing the supply chain.

Methodology: This research provides a comprehensive methodological framework of how AI, IoT, blockchain, and robots can be used to enhance the supply chain performance, decrease cost, and minimize risks. Methods such as qualitative analysis, case studies, as well as frameworks help in analyzing the integration process in its entirety.

Findings: The authors concluded that disruptive technologies had a strong potential to change traditional inventory systems to intelligent supply chain systems, converting to I-5.0. In this context, reference to actual case studies demonstrates how AI, IoT, blockchain, and robotics change the concept of inventory management.

Practical Implications: The discussion of this chapter aims to present handy insights regarding the use of disruptive technology as well as potential issues and opportunities. It gives excellent information and recommendations to business people and students studying I-5.0, among other things, with regard

to the ever-evolving world. Such awareness allows them to understand better how to manage and apply these revolutionary technologies at their workplaces.

Keywords: Industry 5.0; supply chains; disruptive technologies; inventory control; artificial neural networks; Internet of Things (IoT); blockchain

1. Introduction

Industry 4.0 is to be followed by Industry 5.0 (I-5.0) as the next revolutionary phase where I-5.0 is complemented by IT. In I-5.0, robots get to the level of super intelligence by using advanced tools like the internet, big data, and Artificial Intelligence (AI) to enhance their operating skills. But I-5.0 is taking it a step further. I-5.0 is more than just machines doing all of the job. It is about humans and machines working together. Previously, the emphasis was on making things fast and automatic, but today, it's on producing things that are good for both people and the environment.

During the worldwide outbreak, everyone began to think more about how we create things and care for the environment. This is where I-5.0 comes into play. It's a method of producing goods that are not just smart but also considerate of the environment and the people who work in factories.

The distinguishing feature of I-5.0 is its desire to make things more individualized. That implies designing things to meet the demands of each individual better. It's also about manufacturing products that don't affect the environment by decreasing waste and using energy more efficiently. The big idea behind I-5.0 is to focus on improving things for everyone rather than just making money (Grabowska et al., 2022). The emphasis is on prioritizing employee well-being and environmental sustainability while producing outstanding products. This approach allows businesses to achieve profitability while benefiting society and the environment.

I-5.0 is about improving things for the planet rather than just making goods. It's like a new way of doing things that could make everyone's life better. I-5.0 symbolizes a substantial transformation in how industries work, emphasizing the convergence of digital technologies and human-centric approaches to revolutionize production and supply chain systems (Kumar et al., 2023). The integration and usage of disruptive technologies are at the heart of this change, accelerating supply chain and inventory management breakthroughs. Through machine learning (ML), AI supports predictive analytics and real-time decision-making, optimizing inventory and minimizing risks by automating tasks with greater accuracy and speed (Gupta, Modgil, et al., 2022). Meanwhile, the Internet of Things (IoT) provides interconnected networks that allow devices and machines to communicate seamlessly.

The pillars of supply chain and inventory management are fundamental to any industry, influencing efficiency, cost-effectiveness, and customer satisfaction. Introducing disruptive technologies such as AI, IoT, blockchain, and digital analytics has significantly transformed the landscape of these critical activities.

IoT devices play a crucial role in Supply Chain and Inventory Management by gathering real-time data on product locations, movements, and statuses (Phase & Mhetre, 2018). This information promotes openness and provides proactive measures with the ability to respond to possible interruptions. Blockchain technology provides transparency, security, and traceability in supply chain transactions (Raja Santhi & Muthuswamy, 2022). Its decentralized ledger architecture creates an indelible record for each transaction, dramatically lowering the risk of fraud and errors and boosting participant confidence.

Advanced and big data analytics use massive datasets to provide organizations with actionable insights. In turn, such observations assist in setting up better strategic approaches and decision-making as inventory, patterns are identified, and customers' behavior is analyzed. The chain of supply mainly focused on the inventory of the I-5.0 is adapting those new technologies to enhance the business function productivity and to redesign the clients' experience totally.

These technologies help the firms to be competitive in the ever-changing environment of business by offering customized services as well as offering a solution on the flow of goods, services, and information that in turn responds directly to market fluctuations. This kind of integration is rather vital to have a more flexible and adaptable I-5.0 framework. This chapter focuses on the different dynamics of I-5.0. Supply chains also underline the necessity of disruptive technologies for altering the practices regarding the inventory management. This chapter then goes further setting out the best practices including the use of new technologies like robotics, blockchain, IoT, and AI.

It is not limited to how they make an impact such as the following: cost reduction, productivity enhancement, protection against risks, and many others related to supply chain management (SCM).

Furthermore, this chapter, fully devoted to disruptive technologies, does not only stress on the radical changes occurring in relation to the industry's common stock practices but also supports it with real-life instances. This is followed by stressing inherent issues and possible solutions associated with the process of acceptance and application of such technologies in relation to I-5.0 supply chains. Despite all the prospective benefits of disruptive technologies implementation in supply chain and inventory management, the overall implementation requires extensive considerations, funds, and proper personnel. However, for these technologies to deliver on their intended promise, organizations have challenges to do with data privacy, compatibility, and trying to incorporate the technologies into their existing systems.

1.1 Overview of the Industrial Revolutions

1.1.1 Industry 1.0

The first Industrial Revolution that started in the late of the 18th century signified the change from agrarianism to industrialization. This period also marked the use of machines and utilization of steam in industries. The factories developed, and this brought about the concept of producing goods in large quantities and this

boosted efficiency. Thus, they migrated to urban sectors mainly in the search for employment, and this led to increased urbanization.

1.1.2 Industry 2.0

The Second Industrial Revolution, also occurring in the later half of 19th and early 20th century, arose on the back of the first. It brought people into a new age with electricity utilizing new technological inventions. The peculiarities of the past few decades included the emergence of assembly lines and mass production. Also, new industries were developing, for instance, steel, oil, and chemicals industries were established. These changes resulted to great social and economic revolutions, rise of the middle income earners, better standards of living.

1.1.3 Industry 3.0

The Third Industrial Revolution or what has been termed as the Digital Revolution started in the mid-20th Century. They included a change in the type of electronics from mechanical and analog to digital electronics. The computer and the internet changed the industries also making information more available and updating automation and manufacture. During this period, information technology and telecommunications were also given more importance and changed the way of communication and work.

1.1.4 Industry 4.0

The current Industrial Revolution we are in now, that is, the Fourth Industrial Revolution also referred to as Industry 4.0 began mainly in the early 20th century. It is identified by increased integration of the digital, physical, and biological domains. Thus, the key technologies that form this revolution include the IoT, AI, robotics, and big data. Industry 4.0 is concerned with smart factories in which machines and systems are interlinked to enhance the manufacturing activities. This can be done to increase productivity, responsiveness, and adaptation to the customer's requirement in production.

1.1.5 Industry 5.0

The rising consecutive version of the Industrial Revolution is called the 5th Industrial Revolution or I-5.0, which is based on the human and more specifically on the cooperation man-machine. This age implies the use of human muscles and brains along with the hi-tech products. I-5.0 is an effort to help manufacturing become more environmentally friendly and, at the same time, focus on people more. Assisting production and solving difficult problems with help from robots and AI, the future will be characterized by made-to-order goods and services that will be ethical and sustainable.

The phase-by-phase breakdown of I-5.0, along with its advantages and disadvantages, is thoroughly examined in [Table 1.1](#) and [Table 1.2](#). These tables offer a detailed exploration of the various stages of I-5.0, emphasizing the synergy between human creativity and cutting-edge technologies like AI and robotics.

Table 1.1. Industrial Revolution and Characteristics.

Industrial Revolution	Time Period	Key Innovations	Impact
Industry 1.0	Late 1700s	Locomotives, advancement of railways transport.	Moving from the handmade products to steam- and water-powered machinery; introduced efficiency in the manufacturing.
Industry 2.0	Late 1800s	Structures that hold commodities; iron, fuel, power, vehicles, telephones, production lines.	Acceleration of industrialization moving to more significant urbanization, new technologies developed at a high rate.
Industry 3.0	Mid 1900s	Internet, computers, digital controlling, and monitoring devices in a factory.	Move from analogue/mechanic to digital; brought in the Information Age.
Industry 4.0 (I-4.0)	Present	IoT, AI, CPS, AM, AR/VR, CC, and cybersecurity resources.	Analyzing the relationship between people, technology, and data and information flow; IoT and physical systems integration are pressuring evolution in manufacturing; redefining demands and expectations for workforce and training.
Industry 5.0 (I-5.0)	Future	Particularly, sentient appliances working side by side with people; there is a concentration of progress in social and ecological fields.	Interaction of the human element and AI to solve social issues, fight climate change.

Source: Created by the author.

Table 1.2. Advantages and Disadvantages of Industry-5.0

Advantages of I-5.0	Disadvantages of I-5.0
<i>Creation of Higher Value Jobs:</i> Automation lets workers focus on personalized services and unique products.	<i>High Implementation Costs:</i> Using I-5.0 tech can be pricey for businesses, limiting accessibility.
<i>Improved Personalization for Customers:</i> Human-centric approach offers more customized products and services.	<i>Data Security Concerns:</i> Growing reliance on data raises worries about protecting sensitive information.
<i>Design Freedom for Workers:</i> Increased automation allows for creativity and innovation in job roles.	<i>Skills Gap:</i> Implementing I-5.0 needs skilled workers, and there’s a shortage of such expertise.
<i>Enhanced Sustainability and Resilience:</i> Emphasis on eco-friendly practices and resilient systems.	<i>Resistance to Change:</i> Some businesses resist new tech due to cultural issues, job fears, or lack of understanding.

Source: Author’s Creation.

They also highlight the benefits, such as improved efficiency, sustainability, and the capacity to tackle complex issues through human–machine collaboration.

In other words, as compared to the previous Industry 4.0, it is important to look at what 5.0 brings to the table; on the balance, there are various organizational triumphs such as humans and machines working together toward making the world a better place, but at the same time, there are impacts that companies have to consider. One major issue that may be quite daunting when implementing telemedicine or other related systems is that of expense. The other area that needs to be protected from the threats is data. It then comes to down to the problem of not having human resource readily available to manage this new technology.

Additionally, some folks might not be too keen on changing the way things are done. Overcoming these challenges is super important if businesses want to make the most of I-5.0. It introduces elements such as employment evolution, personalization, sustainability, and resilience, all of which emerge as essential drivers of SCM developments within this paradigm. As businesses face challenges, they must also understand and capitalize on transformative features to build a more resilient and adaptive supply chain in the context of I-5.0.

1.2 Understanding Supply Chains in I-5.0

Supply Chain 5.0 is transforming how goods are manufactured and delivered to you. Instead of mass-producing the same items, businesses are now designing items specifically for you! They accomplish this by combining skilled workers with

super-smart robots. This modification aims to make you, the client, extremely happy while also making things faster and better. People and robots can collaborate to create exactly what you desire.

We see a shift toward individualized production with human–robot collaboration in Supply Chain 5.0, increasing customer satisfaction and operational effectiveness. This progression incorporates technologies like big data, AI, blockchain, the metaverse, and cybersecurity (Chang et al., 2022). These innovations improve decision-making and efficiency and create trust and transparency among partners and customers. This digital revolution promotes individualized services while assuring supply chain process stability and confidence (Büyükoçkan & Göçer, 2018).

This production method is a significant departure from the previous method of mass production. Companies are now focusing on creating unique items that cater to the desires of each individual. It not only makes customers happy, but it also helps businesses produce less of something that may not be used. This reduces waste and is not only about humans and machines working together. Big data, AI, blockchain, metaverse, and cybersecurity are also at work to make it all happen. These technologies assist businesses in gathering information about what they like, predicting what they might desire, and ensuring that everything is safe and trustworthy.

Big data enables businesses to understand better their customers' preferences and how to manage their offerings (Serrato & Ramirez, 2017). AI assists in making informed judgments and saves time throughout the process. The blockchain ensures that everything is tracked and protected, while the metaverse allows you to engage with items in interesting virtual ways. Cybersecurity acts as a guardian, keeping this vital information safe from intruders.

All of these technologies work together to ensure that everyone involved in creating and delivering products can communicate and collaborate effectively. It makes the entire procedure more efficient and smoother. Thus, Supply Chain 5.0 signifies a substantial change toward producing things to improve business operations and be more environmentally friendly. It's all about delivering in a required way, reducing waste, and keeping everything secure and transparent.

2. Disruptive Technologies for SCM

The landscape of disruptive technologies in SCM has transformed, introducing legendary efficiency, visibility, and optimization across the whole process. *AI*, *IoT*, *blockchain*, and *robotics* are the four leading disruptive technologies that drastically help in transforming the supply chain dynamics.

2.1 Artificial Intelligence

AI is transforming SCM. AI allows predictive analytics, demand forecasting, and ML algorithms to optimize supply chain processes (Shoushtari et al., 2021). AI systems can predict market trends, manage inventory levels, streamline logistics, and improve decision-making through enhanced data analysis. AI-driven demand

forecasting algorithms, for example, let businesses predict consumer behavior and adjust inventory levels accordingly, reducing stockouts and overstock situations.

2.2 *IoT*

The IoT has transformed supply chain operations by connecting physical devices and assets. IoT sensors integrated with products, cars, warehouses, and equipment collect real-time data, enabling visibility and transparency from start to finish (Sallam et al., 2023). This connectivity allows proactive inventory monitoring, shipment conditions (such as temperature or humidity for perishable items), and equipment performance. IoT-enabled tracking systems provide exact location data, allowing more effective inventory management, shorter lead times, and higher dispatch accuracy.

2.3 *Blockchain Technology*

Blockchain technology has received a lot of interest in SCM due to its transparency, immutability, and increased security. This system generates a decentralized and tamper-proof ledger for methodically recording supply chain transactions. Blockchain significantly improves traceability by keeping an immutable record of each product's path, ensuring authenticity and lowering the risk of counterfeit goods (Raja Santhi & Muthuswamy, 2022).

2.4 *Robotics*

Robotics has significantly impacted supply chain inventory management. Automated technologies, such as autonomous robots and drones, improve warehouse operations by picking, sorting, and moving inventory more effectively. These robots collaborate with human workers to improve operational speed and accuracy while lowering labor expenses. Furthermore, robotic process automation (RPA) automates repetitive processes like data entry and inventory management, increasing overall operational efficiency (Yearling, 2018).

Because of the convergence of these disruptive technologies, SCM now has unparalleled capabilities. Businesses that embrace and incorporate these advances gain a competitive advantage by improving operating efficiency, lowering costs, ensuring product quality, and providing more excellent customer experiences. However, concerns about implementation costs, interoperability, and data security persist, forcing continued refinement and adaptation as technology advances.

3. Strategic Pillars Shaping I-5.0 Evolution

3.1 *Human-Centric Approach*

This strategy redefines the role of persons inside businesses, moving away from viewing people as resources and toward viewing them as critical assets.