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Review

Revolutionizing Supply Chains: Unleashing the Power of AI-Driven Intelligent Automation and Real-Time Information Flow

Mohammad Shamsuddoha [1,*], Eijaz Ahmed Khan [2], Md Maruf Hossan Chowdhury [3] and Tasnuba Nasir [4]

[1] Department of Management and Marketing, College of Business and Technology, Western Illinois University, Stipes Hall 418I, 1 University Circle, Macomb, IL 61455, USA
[2] College of Business, Law & Governance, James Cook University, Townsville, QLD 4814, Australia; eijaz.khan@jcu.edu.au
[3] UTS Business School, University of Technology Sydney (UTS), Sydney, NSW 2007, Australia; maruf.chowdhury@uts.edu.au
[4] School of Business, Quincy University, Quincy, IL 62301, USA; t.nasir59@quincy.edu
* Correspondence: m-shamsuddoha@wiu.edu

Abstract: Artificial intelligence (AI) and smart automation are revolutionizing the global supply chain ecosystem at an accelerated pace, providing tremendous potential for resilience, innovation, efficacy, and profitability. This paper examines how AI, machine learning (ML), and robotic process automation (RPA) influence supply chain operations to adjust to the risks and vulnerabilities. It focuses on how AI and other relevant technologies will enhance forecasting to predict actual demand, expedite logistics, increase warehouse efficiency, and promote instantaneously making decisions. This study utilizes thematic analysis to find AI-driven supply chain applications, including logistics optimization, forecasting demand, and risk mitigation, among 383 peer-reviewed articles (2017–2024). It provides a strategic framework for dealing with vulnerabilities, operational excellence, and resilient solutions. Additionally, the research investigates how AI contributes to supply chain resilience by predicting disruptions and automating risk mitigation strategies. This paper identifies critical success factors and challenges in adopting intelligent automation by analyzing real-world industry implementations. The findings will propose a strategic framework for organizations aiming to leverage AI to achieve operational excellence, agility, and real-time information flow for effective decision-making.

Keywords: artificial intelligence (AI); intelligent automation; resilient supply chains; real-time decision-making; operational excellence

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1. Introduction

The rapid rise of automated and artificial intelligence has transformed the global supply chain. In light of advantageous innovations that additionally make supply chain processes durable, extremely creative, and effective [1], firms manage resources, knowledge, and fundamental needs distinctively. Real-time decision-making, machine learning, and seamless automation can substitute conventional, human-driven supply chain operations. Beyond sourcing to delivery, the entire supply chain transformation can be achieved with artificial intelligence-powered automated systems [2]. However, existing studies mainly focus on particular AI applications for specific problems. Supply chain problems change frequently and need immediate solutions to run smoothly. The post-COVID-19 time is

really tough for businesses to comprehend and address resilience, sustainability, and real-time decision-making challenges in supply chains. This study attempts to fill this gap by analyzing 383 recent relevant publications to provide a strategic framework for AI adoption.

In order to remain successful in a global and unpredictable marketplace, businesses must capitalize on these innovations. Real-time communication is required to improve this kind of scenario better. This study offers practical recommendations for leveraging AI technologies for sustainable and agile operations as supply chains worldwide grow increasingly complex and resilience and environmental responsibility require additional attention after the pandemic. The current supply chain demands quick and precise decision-making. This study uniquely incorporates conceptual frameworks like Industry 4.0 and real-world findings from global studies to offer a roadmap to companies aiming to implement AI for resilient, productive, and profitable supply chain operations. It instantaneously reduces risks and enhances productivity by allowing businesses to respond quickly to marketplace modifications, logistics difficulties, and consumer preferences [3]. AI-based systems could offer this chance for growth [4]. Real-time technology enables companies to adapt to changing conditions through predicting demands, monitoring inventories, and mitigating risks. This development is noteworthy considering the post-pandemic world, where supply chain robustness has become crucial for business.

Supply chains are quickly embracing RPA, AI, and machine learning to achieve more efficiency and productivity [5]. These advances transform the supply chain using robotic warehouses and consumer demand projections. AI effectively processes enormous quantities of statistical information to assist businesses in recognizing trends, ineffectiveness, and smart decisions [1]. Machine learning (ML) algorithms use historical and current information to enhance delivery routes, specific points, and consumer feedback [6]. Nowadays, orders and inventory updates from RPA-empowered human resources are processed for essential activities [7]. Innovations like these significantly influence the entire supply chain. Artificial intelligence-powered purchasing platforms evaluate market trends and vendor performance to minimize costs [8]. Intelligent automation optimizes production scheduling and distribution of resources, minimizing waste and boosting efficiency [9]. Logistics, which is a complex and highly resource-intensive area, has become better through constant surveillance and AI-enabled scheduling of routes. Robots are quicker and more precise than human beings, so they have transformed the management of warehouses. Such developments make distribution networks smarter, leaner, and more adaptable, enabling them to tackle challenges.

Numerous companies confront difficulties integrating logistics intelligence with robotic procedures [10] due to implementation expenses, data privacy challenges, and unknown transformation. A few studies addressed AI algorithm unfairness and human labor replacement concerns. Compliance challenges, particularly in global supply chains, impede ultimate performance. AI-driven automated processes during production appear inevitable since their advantages outweigh their downsides. There is a significant research gap regarding finding a structured review of relevant knowledge and their progress in managing continuously changing supply chain operations with many challenges. This study attempts to consolidate 383 pieces of relevant literature and examine them to extract key findings for implementation by academicians, policymakers, and industry people. This research investigates whether AI-driven smart automation changes supply chain management.

This study intends to achieve the following objectives:

I. Assess the effect of AI-powered automation on critical supply chain processes like procurement, production scheduling, and distribution.
II. Identify technological, ethical, and regulatory constraints in implementing AI technologies.

III. To outline a framework for intelligent automation in the supply chain phases for greater efficiency and sustainability.

2. Background and Theoretical Framework

The supply chain is critical for global commerce success to satisfy billions of customers located in remote to peri-urban and urban areas. AI-driven optimization can assist complicated supply chain operations, enhance resilience, and achieve sustainability in dynamic markets. Due to global supply chain complexity and consumer demands, organizations must improve efficiency, agility, and resilience. AI transforms operations, decision-making, and market adaptation [11]. This part introduces AI-driven technologies and their applications in supply chain management, provides theoretical frameworks for understanding their effects, and defines the scope of this review.

2.1. Intelligent Automation in Supply Chains

AI is a simulated algorithm of human intelligence using a technological platform [12]. AI technologies gather relevant information, identify and perceive patterns, and perform assigned responsibilities [13], which are usually accomplished by humans while maintaining supply chain processes and sub-processes. Supply chain and logistical bottlenecks and uncertainties are the main aspects that must be effectively solved through AI technologies.

2.2. Key AI Applications Used to Resolve the Below Major Problems

I. **Logistics Optimization:** Logistical scores are related to warehouse, transportation, inventory, procurement, packaging, reverse logistics, demand forecasting and planning, material handling, and last-mile delivery [14]. In this list, many repetitive tasks are dealt with by human beings. For instance, AI can take orders, handle similar materials, and manage inventory so that companies can save money and increase efficiency [8]. Another example is the ML algorithm that competently forecasts the latest traffic situations and advises adjusting alternative delivery routes and schedules [15].

II. **Demand Forecasting:** AI applications observe and understand patterns through statistical, mathematical, and logical calculations of historical information, consumer perceptions and buying processes, and market volatility to forecast possible future demand precisely [16]. These features help organizations avoid overstocking or understocking, optimize inventory costs, and enhance customer satisfaction through prompt service actions.

III. **Warehouse Management:** Cutting-edge innovations like robotic deployments in the supply chain process along with AI integration efficiently maintain just-in-time (JIT) inventory, precise order picking, labeling, and packaging for the final destinations [17]. These technologies improve current operations by increasing accuracy, minimizing labor hours and costs, and quickly moving the products toward the following destinations.

IV. **Risk Mitigation:** AI is also able to monitor real-time information from diverse internal and external sources to recognize potential disruptions, such as supply delays from suppliers, natural calamities like cyclones, floods, and snow piling, and geopolitical events like wars and bilateral relationships [18]. AI contributes to supply chain resilience, and the right supplier selection and evaluation [19] are carried out by predicting potential risks and suggesting risk mitigation strategies for the possible scenarios.

V. **Procurement and Production Planning:** AI systems examine previous supplier performance, track market fluctuations, and streamline vendor selection [20]. For example,

Siemens optimizes production schedules using AI within its facilities to minimize downtime and improve the utilization of resources.

VI. **Customer Experience Enhancement:** AI chatbots and simulated assistants deliver immediate feedback on the status of an order, delivery schedules, and return procedures, boosting consumer satisfaction while decreasing administrative workload [21,22].

The above-listed issues are among the many problems that exist in real-life supply chain operations. This study focuses on the key areas to find gradual development through smart technologies and their implications in various operations.

2.3. AI and Automation in Supply Chains: Innovations and Impact

Worldwide supply chains' complicated nature and the need for effectiveness and resilience have contributed to rapid AI and smart automation deployment [23]. These innovations transform supply chains with remarkable agility, decreased expenses, and immediate decision-making. The below section highlights artificial intelligence-driven supply chain innovations, conceptual frameworks for their execution, and the limitations of the current review, considering the recent literature. AI is an umbrella term for machine technologies that can acquire knowledge, reason, and resolve problems like humans. AI and smart automation combine operations, data analysis, and mathematical modeling to manage the supply chain. These modern technologies eliminate inefficiencies, reduce risk associated with operations, and strengthen decision-making.

2.4. Theoretical Framework

2.4.1. AI's Impact on Supply Chains

Theoretical frameworks demonstrate how AI and smart automation can change the efficiency of supply chains.

I. **Industry 4.0:** Industry 4.0 integrates AI, IoT, and big data analytics to develop intelligent, interconnected supply chain networks [24]. This structure encourages automation, instant exchange of information, and real-time decision-making to render supply chains more adaptable and effective [25].

II. **Industry 5.0:** In Industry 5.0, humans collaborate with artificial intelligence and robotics to develop viable, human-centric, and robust manufacturing processes. It improves industrial innovative thinking, customization, and durability [26].

III. **Digital Twin Models:** Digital twins are used to generate digital replicas to maximize supply chain activities. Such AI-powered models allow businesses to anticipate consequences, simulate situations, and decide on data-driven choices, thereby lowering risks and enhancing productivity [27].

IV. **Resilience Frameworks:** AI enables supply chain resilience strategies to resolve risks and interruptions. These frameworks enable the supply chain people to respond almost in real time to avoid unexpected circumstances using continuous tracking of the scenarios [28].

V. **Sustainability and Circular Economy Models:** Sustainability and circularity have received much attention due to their positive outcomes for industry [29]. In this case, AI helps enhance the product life cycle by utilizing existing resources. It also helps minimize waste when managing sustainable supply operations. AI with circularity models enables closed-loop systems to utilize unused resources (wastes), reducing ecological effects and expenses [30].

2.4.2. Scope of Cutting-Edge Technologies

The application of intelligent automation is the primary emphasis of this review, as well as precisely how it can be deployed in optimizing operations and immediate choice-making in supply chain activities. The main ideas in this study involve the following:

I. **Technological Adoption Across Functions:** First, business functions need to be assessed, and the feasible areas for technological adoption need to be identified. Within this scope, the assessment highlights how AI applications increase operational excellence in manufacturing, transportation, shipping, and purchasing [31].
II. **Implementation Challenges:** The second challenge is implementation due to biases, ethical issues, budget constraints, and employee skills needed for this transformation [32]. This review also involves ethical concerns, laws and regulations, and technological boundaries to optimize the adoption of AI technologies. Ethical issues concern employing discrimination algorithms, credit scoring, and voice and facial recognition systems against certain groups based on race, gender, or socioeconomic status. Business houses can overcome these challenges by deploying automated intelligence. For illustration, regular algorithm audits and programming that emphasizes diversity may assist in minimizing biases, while robust data governance structures ensure that privacy regulations are strictly enforced. Initiatives for workforce retraining can also address the social consequences of AI adoption by urging flexibility and diversity.
III. **Real-Time Information Flow:** AI can function with real-time information to suggest alternative or revised decision-making that will be aligned with customer preferences and market dynamics [33]. For example, an AI system can efficiently analyze real-time sales data and perceive an unpredicted spike in demand for a particular product in a retail supply chain. Such capability will automatically regulate inventory replenishment schedules and delivery routes.
IV. **Critical Success Factors:** This study highlights the critical success factors that make AI adoption profitable, such as continuous staff training, committing to adopt technological infrastructure, and active leadership support [34]. For example, a transportation logistics company can utilize AI for shipping route optimization by consistently training drivers and staff. It can also assist in handling critical situations like natural calamities of cyclones, snowfalls, and flood situations and advise alternative routes to maintain supply chain efficiency.

This study comprehends how AI-driven technologies support vibrant supply chain operations through theoretical perceptions and real-life action. It also intends to provide hands-on recommendations for achieving operational excellence and resilience in dealing with international market dynamics. The global supply chain has become progressively competitive and chaotic in investigating these significant issues.

3. Methodology for Review

3.1. Literature Selection

This study identified the available relevant literature using a systematic approach [35] to represent AI and automated processes precisely in managing the supply chain. Researchers collected peer-reviewed articles from the Web of Science, Google Scholar, and Scopus databases. The keywords searched for included “AI in the supply chain”, “intelligent automation”, “machine learning in logistics”, “real-time decision-making”, and “robotic process in the supply chain”. The application of Boolean operators to narrow results included “AI AND supply chain” and “intelligent automation OR real-time logistics”. To remain pertinent, publications were required to focus on AI developments in supply chains, especially its commercial implications and instant decision-making abilities. For a

review of the most recent advances, 2019 and 2024 publications were prioritized. However, significant publications during that time were taken into account as they contributed crucial insights into supply chain sub-processes like transportation, warehousing, and inventory management. After an initial search, redundant articles were removed and scrutinized for relevancy according to abstracts.

A total of 383 publications representing a wide variety of industries and geographical regions were chosen for a comprehensive review. After reviewing the 383 papers, this study incorporated 58 references in this paper based on their most relevant, high-quality, and impactful studies, matching thematic discussions. We excluded redundant papers or those with overlapping findings among the initial 383 articles, and we selected the most recent (last five years) papers from comprehensive and renowned journals for themes that included multiple related articles. Articles were chosen to represent diverse businesses and perspectives while being additionally pertinent to major themes like efficiency in supply chains, AI-driven automated processes, and sustainability. This streamlined approach ensures the review's rigor and readability while minimizing repetition and maintaining focus. Table 1 presents the high frequency of key terminology in the supply chain and technology, emphasizing the growing significance of keywords, which include "Supply Chain", "Artificial Intelligence", and "Automation". Emerging technologies like blockchain, AI, ML, and the Internet of Things are becoming more statistically significant. The concepts of "Sustainability" and "Resilience" are the main focus of manufacturing regarding agility and environmental repercussions.

Table 1. Frequency of key terms in supply chain and technology discussions.

SL	Word Name	Count	SL	Word Name	Count
1	Artificial Intelligence	54	7	Resilience	8
2	Automation	32	8	Sustainability	20
3	Supply Chain	60	9	Machine Learning	15
4	Logistics	18	10	Robotic Process Automation	10
5	Digitalization	24	11	Internet of Things (IoT)	8
6	Blockchain	12	12	Smart Technologies	9

A thematic approach [36] was used to find and categorize key themes from the selected literature. Key supply chain operations, AI, and its theoretical frameworks have been identified by reviewing the process in detail. Predicting demands, logistics effectiveness, management of risk, and sustainable advancement were utilized to structure the subject matter under primary ideas. Similar categories were applied to technological and ethical difficulties. The themes that were identified suited the research aims, enabling a comprehensive assessment of AI-driven adaptive automation's effect on supply chains with a systematic operational framework. Table 2 demonstrates the breakdown of publications across different academic publishing platforms, including Elsevier, MDPI, and Emerald, which are at the highest level in publication quantity. The number of articles is 383, encompassing contributions through multiple databases, including Google Scholar, Web of Science, PubMed, ResearchGate, and relevant sources. Among the 383 articles, the study scrutinizes similar contents and avoids redundant research studies. This paper finally cites 58 articles in the reference list, which covered most of the discussion points below in Table 2.

Table 2. Distribution of article counts across academic publishers and journals.

SL	Publisher/Journal	Article Count	SL	Publisher/Journal	Article Count
1	Elsevier	60	9	PubMed	25
2	MDPI	50	10	ResearchGate	15
3	Emerald	45	11	Innovative Engineering Sciences Journal	10
4	Wiley	40	12	Academia.edu	10
5	Springer	35	13	Google Scholar	10
6	SSRN	30	14	Bioinformatics Journal	5
7	IEEE	25	16	JSTOR	3
8	Taylor & Francis	20	Total	All Publishers	383

Figure 1 displays a word cloud [37] showcasing key terms in supply chain and technology interactions. The dominant key terms, "Supply chain", "Management", and "Artificial intelligence", highlight their essential relevance to current business practices. Additionally, the figure points out that concepts like "Technology", "Optimization", and "Resilience" demonstrate the industry's commitment to leveraging technology to promote productivity, agility, and innovation.

Figure 1. Word cloud representation of key themes in supply chain and technology.

Table 3 outlines the research databases from 2017 to 2024 and beyond, showing the advancement of crucial issues in the supply chain and technology. It describes changes in focus between early automation and digitization breakthroughs to embracing AI, ML, IoT, robotics, and predictive analytics. Industry 4.0 and 5.0 technologies are also major concerns for companies that want technology transformation. Recent developments such as post-COVID-19 resilience, environmental sustainability, and future advancements [38,39] involving AI-driven optimization and automated [32] forecasting in subsequent-generation logistics networks are also highlighted in the table.

Table 3. Evolution of key themes in supply chain and technology (2017–2024+).

Year Span	Theme	Description/Focus
2017–2021	Augmented Supply Chains	Focuses on early advancements in automation and digitization in supply chain management.
2019–2024	Intelligent Automation and Supply Chain Digitalization	Explores the integration of AI and robotics in automation processes across various industries.
2020–2024	Disruptive Technologies in Global Supply Chains	Highlights the impact of Industry 4.0 technologies like IoT, AI, and Blockchain on logistics and operations.
2021–2022	Resilience and Adaptation in Supply Chains Post-COVID-19	Discusses supply chain resilience, driven by lessons from the pandemic, with AI and other cutting-edge tools.
2022–2024	Sustainability and Green Supply Chain Management	Focused on applying AI and IoT for environmental sustainability and green supply chain practices.
2023–2024	AI-Driven Enhancements for Supply Chain Efficiency	Articles covering AI-driven efficiency optimization, robotics, and intelligent automation in SCM.
2024+	Future of Smart and Digital Supply Chains	Research on predictive analytics, generative AI, and cognitive tools shaping next-gen supply chain systems.

3.2. Key Themes Based on Publication Year

From the above table, the key observations on dominant themes based on year-to-year databases help to understand the focus and trends in research agendas based on industry requirements to solve contemporary issues.

I. **Dominant Themes**:
   a. Automation and Robotics (2019–2024): Representing significant research on improving efficiency and productivity.
   b. Resilience and adaptation (2020–2022): Focused on lessons from the COVID-19 pandemic.
   c. Green and Sustainable Practices (2022–2024): Shift towards eco-friendly and circular economy solutions.
   d. AI in Optimization and Collaboration (2023–2024): Use of generative AI and predictive analytics for SCM.

II. **Year Distribution**:
   a. **Pre-2020**: Focused on early adoption of Industry 4.0 technologies and theoretical discussions on digitization.
   b. **2020–2022**: Shift towards resilience post-pandemic, emphasizing technology-driven adaptation.
   c. **2023–2024**: Explores future trends like generative AI, smart platforms, and broader Industry 5.0 implications.

This overview effectively identifies trends, clusters themes, and sets a foundation for deeper exploration into specific article clusters or years. Considering that "AI Automation" dominates in publication counts and focuses on effectiveness using machine learning and robotics, Table 4 shows major trends and priorities in supply chain research. The capacity for resilience, sustainability, a distributed ledger (blockchain), and generative AI highlights recently emerging issues, including minimizing risks and ecological effects, transparency, and using advanced techniques to make prompt but accurate decisions.

Table 4. Key themes and focus areas in supply chain management research.

Theme	No. of Articles	Key Focus Areas
AI and Automation	95	Includes predictive analytics, robotics, and machine learning for supply chain efficiency.
Resilience and Risk Mitigation	45	Explores tools to manage disruptions and risks, especially post-COVID-19.
Sustainability and Green SCM	50	Focuses on reducing environmental impact and embracing circular economy practices.
Blockchain and IoT	35	Enhances transparency and traceability in supply chains.
Generative AI and Future Trends	35	Explores Industry 5.0, digital twins, and generative AI for decision-making.

This study systematically reviews 383 publications from 2017 to 2024 and highlights how cutting-edge technologies are being utilized in managing supply chains to improve efficiency, sustainability, and resilience. Considering an increased focus on robustness post-COVID-19 and environmental logistics practices, the main trends identified are developments in Industry 4.0 and 5.0 technologies and their compatibility with humans.

4. Results

4.1. Real-Time Decision-Making

AI can deal with enormous data sets and offer real-time analytics, revolutionizing supply chain decision-making [1]. Intelligent networks analyze supply chain efficiency and detect vulnerabilities. These understandings allow real-time process improvement and bottleneck mitigation. For example, Procter & Gamble uses AI to operate its worldwide supply network in real time [40]. Again, Dragicevic and Pereau (2024) [41] reveal how ML facilitates climate-resilient supervisory decisions in agricultural supply chains, demonstrating its capability to enhance resource efficiency and mitigate ecological effects. However, this study encompasses this understanding by highlighting predictive analytics' role in mitigating unpredicted disruptions, an area not extensively addressed in the prior literature. Such systems predict supplier delays and problems with shipping and consequently modify manufacturing timelines and inventory allotment to maintain uninterrupted operations.

Table 5 demonstrates how large corporations deploy AI solutions in different ways to make a positive impact. In retail, AI tools predict demand and optimize inventories to respond rapidly to changing buyer preferences. AI assists in predicting the maintenance and allocation of resources in production by simulating operational scenarios. Every industry has to adapt AI tools to various technological and administrative circumstances. Amazon predicts demand by employing predictive analytics to maximize inventory management and reduce shortages of goods. Walmart leverages symbiotic robotic systems for warehouse management to speed up fulfillment and reduce errors and inefficiencies [42]. However, this review highlights a broader impact by assimilating sustainability metrics, signifying a dual advantage in operational and environmental performance. FedEx reduces costs and delivers quicker, artificial intelligence-driven optimization of routes and instantaneous delivery modifications [43]. Siemens uses AI-based scheduling and predictive maintenance to maximize the production process and reduce interruptions [44]. Ultimately, AI-driven international supply chain surveillance enables Procter & Gamble to generate decisions in real time, optimize operational agility, and cope with disruptions. The comparative analysis indicates that large businesses like Amazon and Siemens benefited while SMEs with limited resources struggle to implement the same strategies, which needs to be examined through future research for scalable AI solutions. Table 1 demonstrates the major

applications of AI-driven automated processes across supply chains in order to illustrate their advantageous impact.

Table 5. Case examples of AI solutions and their positive impacts.

Company	Application Area	AI Solution	Impact	Ref.
Amazon	Demand Forecasting	Predictive analytics for customer demand	Improved inventory management and reduced stockouts	[45]
Walmart	Warehouse Management	Symbotic robotic systems for sorting and distribution	Enhanced fulfillment speed and reduced errors	[42]
FedEx	Logistics and Distribution	AI-powered route optimization and real-time delivery adjustments	Cost savings and faster delivery times	[43]
Siemens	Production Planning	AI-based scheduling and predictive maintenance	Increased efficiency and minimized downtime	[44]
Procter & Gamble	Real-Time Decision-Making	AI-driven global supply chain monitoring	Improved operational agility and disruption management	[40]

The above uses and practical application instances demonstrate how AI-driven smart automation improves logistics agility and resilience. These technological developments empower businesses to adapt to changing economic circumstances and remain competitive in the worldwide market.

4.2. Challenges and Barriers to Adoption

The widespread implementation of AI-driven automated processes in the supply chain is attractive yet riddled with challenges. These pertain to technical skills and moral, regulatory, and organizational concerns. Table 6 below highlights these problems and their resolution strategies.

Table 6. Overview of challenges and barriers to AI adoption in supply chains.

Category	Specific Challenges	Impact	Potential Solutions
Technical [46]	High implementation costs	The financial strain on SMEs	Government subsidies, phased implementation strategies
	Lack of infrastructure	Incompatibility with existing systems	Investment in data standardization and interoperable platforms
	Complexity of AI integration	Inefficient AI models due to poor data quality	Establishing robust data management systems
Ethical [47]	Bias in AI algorithms	Discriminatory decisions in supplier selection and forecasting	Regular AI audits and diversity-focused algorithm design
	Data privacy concerns	Risk of data breaches and non-compliance with laws	Advanced encryption and adherence to privacy laws (e.g., GDPR)
	Workforce displacement	Job losses in traditional roles	Reskilling and upskilling programs for employees
Regulatory [48]	Inconsistent global data sharing regulations	Difficulty in cross-border supply chain operations	Harmonization of international data-sharing laws
	Industry-specific compliance requirements	Increased operational costs for adhering to regulations	Developing transparent and auditable AI systems
	Cross-border trade policies	Complexity in navigating tariffs and customs regulations	AI systems designed to account for trade policy variations
Organizational [49]	Resistance to change	Employee reluctance to embrace AI	Comprehensive change management and employee engagement initiatives
	Lack of skilled personnel	Inability to develop and maintain AI systems	Partnerships with educational institutions and AI training programs
	Leadership challenges	Hesitancy in investing in AI-driven transformation	Awareness campaigns to educate senior management on AI's potential

The table summarizes the challenges and barriers to AI adoption in supply chains, along with their impacts and potential solutions:

I. **Technical Challenges**:
Small and medium enterprises (SMEs) involve high costs, which are compounded by incompatible bureaucratic and autocratic systems and highly complex AI models.
Solutions: Government subsidies, step-by-step implementation, and data standardization and structuralization tools are required to solve such problems. SMEs frequently lack the resources to implement and incorporate AI technologies. An affordable, subscription-based AI tool, gradual execution, and government subsidies will solve these issues. Collaboration with larger corporations or business consortia can also help SMEs adopt AI more easily and quickly both technically and financially through the sharing of knowledge and resources.

II. **Ethical Concerns**:
Recent debatable issues include AI biases, data privacy violations, and human job displacement.
Solutions: The above problem can be solved through AI algorithm audits, data governance, and continuous training programs for associated employees.

III. **Regulatory Constraints**:
Such constraints are related to diverse regional laws, strict government and sustainable compliance, and trade complications that hinder technology adoption.
Solutions: To solve the above regulatory problems, we need transparent ecosystems, efficient trade processes, and AI regulatory placement.

IV. **Organizational Barriers**:
Some organizational barriers include resistance to change, skill shortages, imperfect leadership, and late response to the transformation.
Solutions: To solve the inter-organizational barriers, the firm needs to practice change management, provide on-time employee training, and find appropriate leaders and awareness initiatives.

4.3. Framework Components

4.3.1. Technology Selection

Effective AI implementation requires choosing appropriate tools and infrastructure. Technology preference depends upon the supply chain requirements, scalability, and structure compatibility [50]. For example, Siemens mitigated potential interruptions and ensured easier transitions by simulating and optimizing procedures for integration utilizing digital twin models at the time of full-scale implementation. Table 7 lists the main technology selection specifications for the following questions.

Table 7. Criteria for technology selection.

Criterion	Description
Functionality	Can the tool handle core supply chain tasks like forecasting and routing?
Scalability	Does the technology support long-term business growth?
Integration	Is the AI tool compatible with existing systems?
Vendor Support	Does the provider offer robust customer support and regular updates?

Based on the above questions, the concerned firm should consider the below valid matters to accept or deny the transformations.

I. **Functionality:** Examine whether AI tools can predict demand, process optimization, and manage inventories.

II. **Scalability:** The selected technology should assist expansion as the business grows or transforms.
III. **Integration Capabilities:** Technological tools must flawlessly integrate with existing enterprise resource planning (ERP) applications and other connected platforms to ease the process and reduce further investments.
IV. **Vendor Support:** Choosing a technological provider vendor is vital so a firm can rely on post-deployment support and updates. So many companies have suffered because they did not consider post-purchase support, which is inevitable in any technological deployment.

4.3.2. Integration Roadmap

The integration of AI into supply chains should follow a phased approach to minimize disruption and optimize resource allocation [51]. A typical roadmap may include the following stages:

I. **Assessment and Pilot Testing:** Starts with recognizing the main issues existing supply chain operations face and pilot testing AI resolutions on a small scale.
II. **Incremental Deployment:** Gradual deployment of expanding AI adoption in different domains like procurement, operations (production), and distribution stages (wholesale and retail).
III. **Monitoring and Adjustment:** After deploying specific technology, the firm utilizes real-time data to refine AI models (algorithms) based on problems that arose from the new system. Such adjustment is a continuous process that ensures alignment with operational goals.
IV. **Full-Scale Implementation:** Implement AI solutions and integrate them into routine workflows across the entire supply chain.

4.3.3. Change Management

The adoption process of AI can often be hindered by organizational resistance to transformation. Businesses should develop a data-driven culture and engage employees in the change process to overcome obstacles [52]. Essential strategies consist of the following:

I. **Leadership Commitment:** Firm senior leaders should always think ahead of other general employees. Leaders and senior executives should act as champions for the AI initiative, adopting the changes with confidence and active employee drive and engagement.
II. **Continuous Training Programs:** Supply chain operations are frequently changeable based on changes in domestic and international perspectives. Companies must provide their employees with the essential skills and teachings to work efficiently alongside AI tools like automated data extraction, analysis, and solid interpretation based on diverse processes.
III. **Vibrant Communication:** Companies need to explain the benefits of AI-driven automation, highlighting how it improves compared to replacing human roles. They might need repetitive training sessions to convince employees of the upcoming results.
IV. **Cross-Functional Lineups:** The companies need to involve backward and forward stakeholders from various sub-processes/departments while executing new technological processes to confirm their support and collaboration.

4.3.4. Metrics for Success

Developing precise metrics to evaluate the efficiency of AI-driven technology is crucial [53]. These metrics tend to reflect and are compatible with the objectives of the business

in order to provide quantifiable information on how to enhance performance. Table 8 highlights the key performance indicators (KPIs), which are as follows:

I. **Cost Savings:** Reduction in operational costs due to increased efficiency.
II. **Lead Time Reduction:** Shorter delivery times and improved order fulfillment.
III. **Customer Satisfaction:** Enhanced customer experience due to accurate demand forecasting and timely deliveries.
IV. **Sustainability Metrics:** Decreased carbon footprint, reduced waste, and recycling.

Table 8. Key performance indicators.

KPI	Description
Cost Savings	Reduction in production and logistics expenses.
Lead Time Reduction	Shorter time from order placement to delivery.
Customer Satisfaction	Improvement in Net Promoter Score (NPS) and customer retention rates.
Sustainability Metrics	Decrease in greenhouse gas emissions and material waste.

4.4. Sustainability Considerations

Supply chains could become more environmentally friendly due to AI-driven automation because it minimizes greenhouse gas emissions and optimizes resource utilization. Every phase that comprises the AI process of implementation needs to consider sustainable factors:

I. **Energy Competence [54]:** Utilize AI to optimize energy usage in the production house, warehouses, transportation, and many other areas. For example, when the production floor is not producing anything or is producing a lot, AI will help to reduce the unnecessary consumption of machines and lighting to save energy and money.
II. **Waste Reduction [55]:** Waste reduction is vital nowadays as waste can be converted to byproducts for renewable energy generation. Deploying AI tools like IBM Watson for Renewable Energy, WindAI (Siemens Gamesa), and Aurora Solar can accurately predict the demand and supply of energy. Such tools can help minimize overproduction and underproduction, ultimately optimizing energy budgets and consumption.
III. **Sustainable sourcing [56]:** Sustainable sourcing leverages AI for efficient supplier selection that considers environmental and ethical criteria. For instance, SAP Ariba, EcoVadis, C3 AI Supply Chain Suite, FairSupply, and GHGSat applications can assist firms in sourcing sustainable raw materials or products they are looking for.
IV. **Carbon Footprint Monitoring [57]:** AI-enabled supply chain operations can reduce carbon emissions. For instance, Carbon Analytics, Microsoft Sustainability Calculator, and GHGSat are widely used applications utilized by organizations that would like customers' appreciation through tracking their carbon footprint. Another example is the declaration of airlines' carbon footprints using comparative fare analyses. Also, an AI-based smart delivery system [58] can help stakeholders through image processing and computer vision.

This strategic structure assists businesses in implementing automation based on AI throughout their supply networks, thereby enhancing efficiency and preserving a sustainable future. This strategy combines technological developments with ethical and ecological obligations to prepare businesses for performance within a fast-changing business atmosphere.

5. AI-Driven Supply Chain Transformation: Key Findings and Challenges

AI, predictive analytics, RPA, and ML continue to enhance the effectiveness of worldwide supply chains, maintaining strong resilience and sustainable outcomes. Implementation necessitates established frameworks to overcome high expenses, integration difficulties,

and ethical concerns, notwithstanding continuous optimization. Below are the key findings for AI-driven SCM transformations.

I. Implementing AI technologies, including predictive analytics, RPA, and ML modeling, is the key to transforming supply chain operations globally.
II. Improved Operational Efficiency: AI improves demand forecasting, stock management, transport and logistics, production scheduling, and resource optimization. The research demonstrates how AI's dynamic adaption enhances resilience and agility, supporting Industry 4.0 and 5.0 paradigms, but cost barriers and algorithmic biases need to be considered while making critical AI strategies.
III. Real-Time Decision-Making: By leveraging real-time information, AI enables quicker responses to supply chain interruptions. For instance, AI and predictive analytics can assist in finding potential bottlenecks like raw material supply delays and recommend proactive movements to uphold operational continuity.
IV. Adaptive Optimization: Adaptive optimization is critical to success. For example, Amazon and Walmart deploy robotic decision-making and automated maintenance prediction to improve itineraries and simplify operations.
V. Supply Chain Resilience: AI anticipates disruptions and enhances risk mitigation, providing reliability in existing operations.
VI. High Implementation Costs: Implementing AI systems involves substantial infrastructure, equipment, and expertise expenditures. In this case, the industry needs to evaluate short- and long-term gains to understand overall impacts.
VII. Integration Challenges: Integrating AI with current systems and harmonizing information throughout supply chains face difficulties. To address these challenges, standard data structures and protocols may enhance system interoperability. Progressive deployment approaches like pilot projects minimize operational interruptions. Instant feedback from real-time tracking tools enables seamless adjustments. The industry needs to adopt relevant talents and tools to overcome such scenarios. This will help maintain existing operations and help customers deal with industry viewpoints.
VIII. Ethics: Responsible AI approaches must be implemented to address issues such as information confidentiality, algorithm bias, and job displacement.
IX. Institutional Resistance: Institutional barriers, such as unwillingness to adapt and inadequate talent, restrict AI adoption. Thus, the industry must address such resistance before implementing technological transformations.
X. Regulatory Constraints: Federal and local laws need to be examined when implementing AI-enabled technologies to operate local and global supply chains. The utilization of artificial intelligence in supply chains confronts global regulatory challenges. The EU's General Data Protection Regulation (GDPR) requires stringent confidentiality of information, whereas the U.S. prioritizes innovation-friendly regulations with less stringent criteria. However, China prioritizes centralized and quick technological implementation. These regulatory distinctions may lead to information exchange, legal compliance, and the integration of technology that is complicated in cross-border supply networks. It implies global partnerships, regulatory uniformity, and cross-border conformity strategies.
XI. Strategic Frameworks: Resolving technical, ethical, and managerial difficulties in adopting artificial intelligence is crucial.
XII. Sustainability Practices: AI offers an opportunity to encourage environmentally friendly supply chains by optimizing resource use and decreasing waste.

Implications for Practice

This research provides policymakers as well as practitioners with several practical recommendations, which are as follows:

I. Systematic Implementation: Prior to full-blown AI implementation, businesses would conduct trials to assess AI and other technology's feasibility and effectiveness. This would help reduce the risks of losing unnecessary investment.
II. Talent Development: Education and skill development are necessary to establish a data-driven environment and ensure employees can utilize AI technologies.
III. Regulatory Clarity: To resolve legislative ambiguity, policymakers must develop clear standards regarding exchanging information and ethical AI practices, particularly in global supply chains.
IV. Impact on Sustainability: AI may assist organizations in meeting their sustainability goals by creating more effective transportation routes, reducing waste, and minimizing the use of energy.
V. Collaborative Adoption: Cooperation among businesses and tech vendors could promote AI implementation by presenting businesses with practical and affordable alternatives.
VI. Research Gaps: The long-term consequences of AI for supply network robustness throughout worldwide crises, especially for SMEs compared to multinational companies, demand additional research.
VII. Ethical and Social Dimensions: Businesses must deal with ethical problems, avoid job relocation, and ensure fair utilization of AI technologies throughout organizations.

Thus, businesses are encouraged to begin AI with small trials to determine its feasibility. A data-driven workplace necessitates training for workers to utilize AI technologies. To minimize constitutional ambiguity, policymakers must regulate data exchange using ethical AI, especially for cross-border supply chains. AI can enhance supply chain sustainability by improving energy savings, efficient transportation modes, and fuel- and time-efficient transport routes and eliminating waste to assist companies in meeting sustainability goals. Partnerships among companies and technology providers could promote the adoption of AI by offering viable alternatives. This review demonstrates AI's supply chain potential and the long-term effects of adopting AI to achieve resilience, especially during global crises. Future studies need to examine how AI, ML, blockchain, and the IoT enhance supply chain trust and transparency.

6. Conclusions

This study underlines the possible transformation of AI-driven smart automation in modern supply chain operations. This research reveals that AI, ML, RPA, and predictive analytics improve demand forecasting, advance logistics efficiency, and strengthen resilience to concurrent supply chain disruptions. AI-powered sustainability strategies strengthen supply chain responsiveness while decreasing adverse environmental effects. This study confirms that AI know-how enhances productivity and efficiency and strengthens supply chain resilience and sustainability. AI has transformative potential in overcoming supply chain disruptions, addressing real-time decision-making and operational adaptability. To promote global AI adoption, policymakers need to develop clear regulations. Employee education for AI integration should be considered at the top of the mind. Businesses and academia may collaborate to create innovative AI tools for diverse supply chain scenarios. Companies should not delay too much as futuristic transformation is happening now, and they have to act faster to sustain the intense competition. AI technologies, such as ML, RPA, predictive analytics, customer service bots, HR bots, management advisory AI (legal assistance), deep learning AI (self-driving and image and speech recognition), and natural

language process (NLP) (translator and virtual assistant) have already proven precious in enhancing productivity, efficiency, resilience, and on-time or real-time decision-making. Synthesizing sustainability and resilience viewpoints renders this study distinctive in validating AI-driven supply chain efficiencies. The results recommend balancing operational and ecological requirements. AI is all about algorithms, and the industry should sort out its daily repetitive tasks and apply such technology to receive efficient help. Once a company streamlines AI technology with essential business functions like forecasting demand, sales, and productions, optimizing logistical optimization, and optimizing production schedules, AI responds dynamically to avoid or deal with disruptions, a much better way to protect the company.

However, AI adoption is accompanied by technological, ethical, and institutional challenges, which require a master plan and framework to direct successful implementation. While this research provides actionable understanding, quite a few areas still need further exploration. The lack of scalable choices for SMEs, for instance, limits the widespread adoption of AI technologies. In addition, the seamless integration of AI between countries is complicated because of disparities between worldwide regulatory frameworks. This study reveals the technological insights for making the supply chain smoother than whatever it is now, facing concurrent challenges. Real-life experiments are missing here as this paper reviews the recent phenomena and assists further research in finding their authentic directions. Also, AI's long-term economic and social impacts on business models and workforce transitions need to be addressed in subsequent studies to ensure sustainable adoption.

Future research can determine AI's long-term effect on supply chain resilience, particularly during worldwide disruptions such as wars, bilateral relationships, embargos, pandemics, and terrorist and other geopolitical conflicts. Cross-industry comparisons can also help reveal sector-wise benefits and challenges in adopted AI premises. Although this paper detects critical success factors for AI adoption, its industry-specific emphasis could limit generalizability across smaller companies with limited resources, demanding future research on scalable solutions. Furthermore, the supply chain labor market, strategies to mitigate job dislodgment, workforce transitions, and knowledge transformation remain critical areas for future study.

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References

1. Rane, N.; Desai, P.; Rane, J.; Paramesha, M. Artificial intelligence, machine learning, and deep learning for sustainable and resilient supply chain and logistics management. In *Trustworthy Artificial Intelligence in Industry and Society*; Deep Science Publishing: London, UK, 2024; pp. 156–184.
2. Dash, R.; McMurtrey, M.; Rebman, C.; Kar, U.K. Application of artificial intelligence in automation of supply chain management. *J. Strateg. Innov. Sustain.* **2019**, *14*, 43–53.

3. Shamsuddoha, M.; Nasir, T. Principal Lessons Learned from COVID-19: Prescriptive and Long-Lasting Strategies for Sustainable Supply Chain Improvement. In *Advanced Technologies and the Management of Disruptive Supply Chains: The Post-COVID Era*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 81–105.
4. Himeur, Y.; Elnour, M.; Fadli, F.; Meskin, N.; Petri, I.; Rezgui, Y.; Bensaali, F.; Amira, A. AI-big data analytics for building automation and management systems: A survey, actual challenges and future perspectives. *Artif. Intell. Rev.* **2023**, *56*, 4929–5021. [CrossRef] [PubMed]
5. Stevens, W. Robotic Process Automation in Supply Chain. *Eur. J. Supply Chain Manag.* **2023**, *1*, 1–10.
6. Giuffrida, N.; Fajardo-Calderin, J.; Masegosa, A.D.; Werner, F.; Steudter, M.; Pilla, F. Optimization and machine learning applied to last-mile logistics: A review. *Sustainability* **2022**, *14*, 5329. [CrossRef]
7. Tomar, P.; Grover, V. Robotic Process Automation: The Tangible and Human Shift in Business Process Efficiency. In *Intelligent Computing and Optimization for Sustainable Development*; Chapman and Hall/CRC: Boca Raton, FL, USA, 2024; pp. 238–251.
8. Helo, P.; Hao, Y. Artificial intelligence in operations management and supply chain management: An exploratory case study. *Prod. Plan. Control.* **2022**, *33*, 1573–1590. [CrossRef]
9. Nižetić, S.; Djilali, N.; Papadopoulos, A.; Rodrigues, J.J. Smart technologies for promotion of energy efficiency, utilization of sustainable resources and waste management. *J. Clean. Prod.* **2019**, *231*, 565–591. [CrossRef]
10. Yarlagadda, V.K. Cutting-edge developments in Robotics for Smart Warehousing and Logistics Optimization. *Robot. Xplore USA Autom. Dig.* **2024**, *1*, 61–79.
11. Thilagavathy, N.; Venkatasamy, R. Artificial intelligence (AI) technologies adaptation in business management. *Artif. Intell. (AI)* **2023**, *18*, 2485–2495.
12. Dong, Y.; Hou, J.; Zhang, N.; Zhang, M. Research on how human intelligence, consciousness, and cognitive computing affect the development of artificial intelligence. *Complexity* **2020**, *2020*, 1680845. [CrossRef]
13. Dwivedi, Y.K.; Hughes, L.; Ismagilova, E.; Aarts, G.; Coombs, C.; Crick, T.; Duan, Y.; Dwivedi, R.; Edwards, J.; Eirug, A.; et al. Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *Int. J. Inf. Manag.* **2021**, *57*, 101994. [CrossRef]
14. Chen, W.; Men, Y.; Fuster, N.; Osorio, C.; Juan, A.A. Artificial intelligence in logistics optimization with sustainable criteria: A review. *Sustainability* **2024**, *16*, 9145. [CrossRef]
15. Boukerche, A.; Wang, J. Machine learning-based traffic prediction models for intelligent transportation systems. *Comput. Netw.* **2020**, *181*, 107530. [CrossRef]
16. Simon, H.A. Artificial intelligence: An empirical science. *Artif. Intell.* **1995**, *77*, 95–127. [CrossRef]
17. Manaviriyaphap, W. AI-Driven Optimization Techniques in Warehouse Operations: Inventory, Space, and Workflow Management. *J. Soc. Sci. Multidiscip. Res. (JSSMR)* **2024**, *1*, 1–20.
18. Aljohani, A. Predictive analytics and machine learning for real-time supply chain risk mitigation and agility. *Sustainability* **2023**, *15*, 15088. [CrossRef]
19. Belhadi, A.; Kamble, S.; Fosso Wamba, S.; Queiroz, M.M. Building supply-chain resilience: An artificial intelligence-based technique and decision-making framework. *Int. J. Prod. Res.* **2022**, *60*, 4487–4507. [CrossRef]
20. Ogundipe, O.B.; Okwandu, A.C.; Abdulwaheed, S.A. Optimizing construction supply chains through AI: Streamlining material procurement and logistics for project success. *GSC Adv. Res. Rev.* **2024**, *20*, 147–158. [CrossRef]
21. Rani, Y.A.; Balaram, A.; Sirisha, M.R.; Nabi, S.A.; Renuka, P.; Kiran, A. AI Enhanced Customer Service Chatbot. In Proceedings of the at the 2024 International Conference on Science Technology Engineering and Management (ICSTEM), Coimbatore, India, 26–27 April 2024.
22. Putha, S. AI-Driven Wealth Management Solutions in Banking: Enhancing Portfolio Optimization and Client Advisory Services. *Aust. J. Mach. Learn. Res. Appl.* **2022**, *2*, 417–455.
23. Belhadi, A.; Mani, V.; Kamble, S.S.; Khan, S.A.R.; Verma, S. Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the effect of supply chain dynamism: An empirical investigation. *Ann. Oper. Res.* **2024**, *333*, 627–652. [CrossRef] [PubMed]
24. Hofmann, E.; Sternberg, H.; Chen, H.; Pflaum, A.; Prockl, G. Supply chain management and Industry 4.0: Conducting research in the digital age. *Int. J. Phys. Distrib. Logist. Manag.* **2019**, *49*, 945–955. [CrossRef]
25. Mubarik, M.S.; Khan, S.A. Future of Digital Supply Chain Management. In *The Theory, Methods and Application of Managing Digital Supply Chains*; Emerald Publishing Limited: Leeds, UK, 2024; pp. 163–178.
26. George, A.S.; George, A.H.; Baskar, T. The Evolution of Smart Factories: How Industry 5.0 is Revolutionizing Manufacturing. *Partn. Univers. Innov. Res. Publ.* **2023**, *1*, 33–53.
27. Ivanov, S.; Nikolskaya, K.; Radchenko, G.; Sokolinsky, L.; Zymbler, M. Digital twin of city: Concept overview. In Proceedings of the 2020 Global Smart Industry Conference (GloSIC), Chelyabinsk, Russia, 17–19 November 2020.
28. Ejjami, R.; Boussalham, K. Resilient supply chains in Industry 5.0: Leveraging AI for predictive maintenance and risk mitigation. *IJFMR-Int. J. Multidiscip. Res.* **2024**, *6*.

29. Shamsuddoha, M.; Kashem, M.A. Zero Plastic Drive: A Comprehensive Review on Unveiling Innovative Sustainable Solutions for a Circular Plastics Economy. *Sustainability* **2024**, *16*, 10329. [CrossRef]
30. Kayikci, Y.; Gozacan-Chase, N.; Rejeb, A. Blockchain entrepreneurship roles for circular supply chain transition. *Bus. Strategy Environ.* **2024**, *33*, 197–222. [CrossRef]
31. Wamba, S.F.; Queiroz, M.M.; Jabbour, C.J.C.; Shi, C.V. Are both generative AI and ChatGPT game changers for 21st-Century operations and supply chain excellence? *Int. J. Prod. Econ.* **2023**, *265*, 109015. [CrossRef]
32. Rane, N.; Choudhary, S.P.; Rane, J. Acceptance of artificial intelligence: Key factors, challenges, and implementation strategies. *J. Appl. Artif. Intell.* **2024**, *5*, 50–70. [CrossRef]
33. Stone, M.; Aravopoulou, E.; Ekinci, Y.; Evans, G.; Hobbs, M.; Labib, A.; Laughlin, P.; Machtynger, J.; Machtynger, L. Artificial intelligence (AI) in strategic marketing decision-making: A research agenda. *Bottom Line* **2020**, *33*, 183–200. [CrossRef]
34. Merhi, M.I. An evaluation of the critical success factors impacting artificial intelligence implementation. *Int. J. Inf. Manag.* **2023**, *69*, 102545. [CrossRef]
35. Linares-Espinós, E.; Hernández, V.; Domínguez-Escrig, J.; Fernández-Pello, S.; Hevia, V.; Mayor, J.; Ribal, M. Methodology of a systematic review. *Actas Urológicas Españolas (Engl. Ed.)* **2018**, *42*, 499–506. [CrossRef]
36. Hamel, C.; Michaud, A.; Thuku, M.; Skidmore, B.; Stevens, A.; Nussbaumer-Streit, B.; Garritty, C. Defining rapid reviews: A systematic scoping review and thematic analysis of definitions and defining characteristics of rapid reviews. *J. Clin. Epidemiol.* **2021**, *129*, 74–85. [CrossRef]
37. Heimerl, F.; Lohmann, S.; Lange, S.; Ertl, T. Word cloud explorer: Text analytics based on word clouds. In Proceedings of the 2014 47th Hawaii International Conference on System Sciences, Waikoloa, HI, USA, 6–9 January 2014.
38. Kashem, M.A.; Shamsuddoha, M.; Nasir, T. Digital-Era Resilience: Navigating Logistics and Supply Chain Operations after COVID-19. *Businesses* **2024**, *4*, 1–17. [CrossRef]
39. Kashem, M.A.; Shamsuddoha, M.; Nasir, T. Smart Manufacturing: A Review Toward the Improvement of Supply Chain Efficiency, Productivity, and Sustainability. In *Advanced Technologies and the Management of Disruptive Supply Chains: The Post-COVID Era*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 13–33.
40. Dragicevic, A.Z.; Pereau, J.-C. Comparing climate pledges and eco-taxation in a networked agricultural supply chain organisation. *Eur. Rev. Agric. Econ.* **2024**, *51*, 354–398. [CrossRef]
41. Rodenberg, J.D.; Anitsal, I. *A Review of Machine Learning Applications: Emerging Trends and Challenges in Supply Chain Management*; Institute For Global Business Research: Nashville, TN, USA, 2023; pp. 39–50.
42. Nair, V.V. Automation and robotization. In *Modern Technologies and Tools Supporting the Development of Industry 5.0*; Routledge: London, UK, 2024; p. 41.
43. Lyster, C. Learning from FedEx: Lessons for the city. *J. Landsc. Archit.* **2012**, *7*, 54–67. [CrossRef]
44. Ramachandran, K. Intelligent manufacturing: Leveraging autonomous robotics and AI. *Int. J. Comput. Sci. Inf. Technol. Res.* **2024**, *5*, 20–32.
45. Rathod, J.; Kumar, R. Analyzing the impact of big data and business analytics in enhancing demand-driven forecasting in retailing. *Int. J. Entrep.* **2021**, *25*, 1–8.
46. Sharma, M.; Luthra, S.; Joshi, S.; Kumar, A. Implementing challenges of artificial intelligence: Evidence from public manufacturing sector of an emerging economy. *Gov. Inf. Q.* **2022**, *39*, 101624. [CrossRef]
47. Osasona, F.; Amoo, O.O.; Atadoga, A.; Abrahams, T.O.; Farayola, O.A.; Ayinla, B.S. Reviewing the ethical implications of AI in decision making processes. *Int. J. Manag. Entrep. Res.* **2024**, *6*, 322–335. [CrossRef]
48. Igbinenikaro, E.; Adewusi, O. Policy recommendations for integrating artificial intelligence into global trade agreements. *Int. J. Eng. Res. Updates* **2024**, *6*, 1–10. [CrossRef]
49. Booyse, D.; Scheepers, C.B. Barriers to adopting automated organisational decision-making through the use of artificial intelligence. *Manag. Res. Rev.* **2024**, *47*, 64–85. [CrossRef]
50. Tsolakis, N.; Schumacher, R.; Dora, M.; Kumar, M. Artificial intelligence and blockchain implementation in supply chains: A pathway to sustainability and data monetisation? *Ann. Oper. Res.* **2023**, *327*, 157–210. [CrossRef]
51. Biolcheva, P.; Valchev, E. Roadmap for Risk Management Integration Using AI. *J. Risk Control* **2022**, *9*, 13–28.
52. Lemos, S.I.; Ferreira, F.A.; Zopounidis, C.; Galariotis, E.; Ferreira, N.C. Artificial intelligence and change management in small and medium-sized enterprises: An analysis of dynamics within adaptation initiatives. *Ann. Oper. Res.* **2022**, 1–27. [CrossRef] [PubMed]
53. Kulkov, I.; Kulkova, J.; Rohrbeck, R.; Menvielle, L.; Kaartemo, V.; Makkonen, H. Artificial intelligence-driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals. *Sustain. Dev.* **2024**, *32*, 2253–2267. [CrossRef]
54. Tula, O.A.; Babayeju, O.; Aigbedion, E. Artificial Intelligence and Machine Learning in advancing competence assurance in the African energy industry. *World J. Innov. Mod. Technol.* **2024**, *7*, 83–95.

55. Shamsuddoha, M.; Kashem, M.A.; Qudrat-Ullah, H. The Sustainable Management of Plastic Contents Recycling in Bangladesh: A System Dynamics Approach. In *Managing Complex Tasks with Systems Thinking*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 325–346.
56. Moskowitz, H.; Todri, A.; Papajorgji, P.; Rappaport, S.; Deitel, Y. Sourcing and vetting ideas for sustainability in the retail supply chain: The contribution of artificial intelligence coupled with Mind Genomics. *Int. J. Food Syst. Dyn.* **2023**, *14*, 367–380.
57. Shamsuddoha, M.; Kashem, M.A.; Nasir, T. Smart Transportation Logistics: Achieving Supply Chain Efficiency with Green Initiatives. In *Data Analytics for Supply Chain Networks*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 243–258.
58. Sarkar, N.; Sarkar, K.; Saha, K.; Bhattacharjee, A.; Malo, S.; Dutta, P.K.; Bhattacharya, P. AI-Based Smart Delivery System Using Image Processing and Computer Vision. *Int. J. Innov. Technol. Interdiscip. Sci.* **2023**, *6*, 1255–1263.