Journal of Computer Science and Technology Studies
ISSN: 2709-104X
DOI: 10.32996/jcsts
Journal Homepage: www.al-kindipublisher.com/index.php/jcsts

JCSTS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

AI Driven Optimization in Specific SCM Domains: Warehousing, Logistics, Transport

Dileep Rai
Supply-chain Manager, HBG, Colorado, USA
Corresponding Author: Dileep Rai, **E-mail**: dileep.rai@ieee.org

| ABSTRACT

The continually surging complexity of global supply chains has placed greater demands on smart optimization of warehousing, logistics, and transport, which are the operating core of supply chain management (SCM) operations. Artificial intelligence (AI) has transformative potential by leveraging predictive analytics, machine learning, deep learning, and reinforcement learning to deliver efficiency, resilience, and sustainability. This paper reviews subject-specific applications of AI in SCM, providing a structured analysis of optimization in the areas of warehousing, logistics, and transport. At warehouses, AI can conduct automated slotting, robotized picking, and layouts with a boost of digital twins, which reduce costs and step up throughput. In logistics, intelligent algorithms make dynamic routing, last-mile optimization, and predictive load balancing feasible, which enhances customer service and tames disruptions. At transport, AI can facilitate fleet management, predictive maintenance, reduction of emissions, and integration of autonomous vehicles and unmanned aerial vehicles (drones). With a comprehensive literature analysis and conceptual integration, the paper, through its findings, sheds both emergent benefits and lingering shortcomings such as data fragmentation, interoperability, workforce adaptation, and regulatory limitations. This paper makes a value addition to the literature by comparing the role of AI within such domains and describing gaps that thwart complete-scale integration. The paper's findings suggest that optimization by AI is not merely a technological enhancement, but a strategic imperative for building resilient, adaptive, and sustainable SCM ecosystems. Future work should focus on explainable AI, cross-domain integration, and aligning AI adoption with global decarbonization and circular economy goals.

| KEYWORDS

AI Driven Optimization; SCM Domains: Warehousing; Logistics; Transport

| ARTICLE INFORMATION

ACCEPTED: 01 September 2025 **PUBLISHED:** 18 September 2025 **DOI:** 10.32996/jcsts.2025.4.1.69

1. Introduction

The world's supply chain environment is evolving quickly, due to rising volatility of demand, pressure on costs, and increased expectations on sustainability. Such changing challenges are demanding more innovative, more responsive, and resilient systems that can optimize end-to-end operations of warehousing, logistics, and transportation. Artificial intelligence (AI) has become a central enabler, providing predictive analytics, machine learning (ML), deep learning (DL), reinforcement learning (RL), and digital twin solutions that give decision-makers extraordinary visibility, flexibility, and performance improvement.

At the facility level, AI combines with digital twins to model operations in real-time, allowing dynamic slotting, experimentation on layout, and optimization of workforces. Such systems have seen productivity improvements of 40% or even higher by aligning equipment, people, and material movements with the aid of live data [1]. Sophisticated automation - in the guise of robot arms, artificially intelligent guided vehicles, and autonomous mobile robots (AMRs) - brings pick, pack, and store operations efficiencies [2].

AI-based forecasting optimizes last-mile planning, demand, and routing in logistics, making room for adaptive decisions, minimizing delays, and maximizing capacity utilization.

In transportation, AI enables predictive maintenance, fleet optimization, and environmental initiatives. For instance, innovative, AI-based predictive maintenance systems can cut maintenance expenditures by 30% or even more, and curtail breakdowns by huge percentages [3][4]. In practical terms, major players like Penske are utilizing AI-based solutions like Catalyst AI in their "Fleet Insight" system, which enables them, in real-time, to look into telematics and proactively manage mechanical perils on their huge fleets of trucks [5].

Despite all of these advances, there are a number of major challenges. Businesses face data fragmentation, interoperability between legacy systems, reskilling of employees, and regulatory compliance, particularly in safety-critical and environmentally aware scenarios.

This paper explores the business-domain application of AI within warehousing, logistics, and transportation, providing a systematic comparative analysis to discern achieved benefits and linger gaps. Ultimately, the primary research questions framing this inquiry are:

I. How does AI optimize operations distinctly in warehouses, logistics, and transportation?
II. What are the integration barriers and domain-specific challenges?
III. How can future research and practice further promote AI adoption towards smart, resilient, and sustainable supply chains?

2. Theoretical Foundations

The foundation of SCM implementation of artificial intelligence (AI) rests on the intersection of operations research, optimization theory, and data-driven decision support. Classical optimization models such as linear programming, mixed-integer optimization, and queuing theory were utilized in the past to design optimal networks, allocate resources, and optimize costs within warehouses, logistics, and transportation systems. Such models, however, are wanting in managing the high degree of uncertainty, nonlinearity, and real-time dynamics of the contemporary global SCM. AI bridges the gap by supplementing conventional solutions with adaptive, self-learning mechanisms constantly revising prediction and optimization output in response to streaming data [6].

Machine Learning (ML) and Deep Learning (DL) are providing SCM capabilities with prescriptive and forecasting powers. Anomaly detection, demand forecasting, and route optimization are employed utilizing gradient boosting and random forests [7]. Convolutional and recurrent neural networks are extensively employed within visual inspection of warehouses and within traffic systems where traffic volume forecasting is performed. Beyond deterministic modeling, such practices examine disruptions and react flexibly.

Reinforcement Learning (RL) can be considered a theoretical framework of real-time decision-making under uncertainty, which is of high significance in logistics routing and self-driving car guidance. RL agents are trained for optimal policies by interacting with the environment and adapting strategies towards traffic, congestion in warehouses, or limitations of fuel [8]. Recent empirical evidence reveals that the logistics systems based on RL can achieve a cost reduction of 10-15% and improvement of service levels compared to heuristic routing.

Beyond algorithmic designs, sociotechnical and organizational theories encompass SCM AI implementation. Technological preparation, organizational capacity, and environmental imperatives, through the TOE framework, explain why there is technological infusion of AI in warehouses, logistics, and transportation. Sociotechnical perspectives, on the other hand, center on human-AI interaction, with a focus on reskilling of employees, ethics, and governing mechanisms in mediating favorable outcomes [9].

One such emerging theory paradigm is of digital twin–enabled supply chains, which integrate simulation modeling, IoT sensor networks, and AI to mimic physical world warehousing, logistics, and transportation operations virtually. Such digital twins are used as experimental platforms for scenario planning, risk management, and optimization across domains [10][11].

Together, these foundations imply that SCM's future use of AI shouldn't be viewed anymore as a substitute for traditional optimization but, rather, as a unifying layer adding higher adaptability, scalability, and robustness. Such interaction between algorithmic smarts and organizational preparation highlights the need for both technical prowess and systemic coherence in achieving optimization by means of AI.

3. Literature Review

3.1 AI in Supply Chain Management – General Trends

The past ten years have seen SCM research transition from automation and digitization towards intelligence and autonomy. Early research relied on rule-based optimization and analytics driven by ERP, whereas recent research focuses on prescriptive and predictive systems powered by AI. A recent paper notes that SCM's adoption of AI is evolving from pilots towards enterprise-wide implementation, with effects across resilience, agility, and sustainability. Nonetheless, by far, studies are mostly fragmented, aiming at a single function, where the company's overall holistic supply chain ecosystems are concerned [12].

3.2 AI in Warehousing

One of the first industries to implement AI is warehousing because of the structured setup and cyclic work. Automated systems based on AI, such as robotic systems and robotic arms, have redefined the work of picking and packaging. Amazon Robotics (previously Kiva Systems) proved that automated picking by the use of AI can reduce costs of operations by 20–40% and increase order fulfillment accuracy [13].

Computer vision-powered quality inspection systems with deep learning facilitate real-time defect detection, which minimizes returns and guarantees higher service levels. Digital twins, combined with AI, are currently utilized in layout optimization and throughput prediction, where managers can simulate scenarios before they change physical layouts [14][15].

However, there are challenges left: data scattering between ERP/WMS systems, unification of diverse robotic platforms, and adapting the workforce to AI-based operations. Research gaps are in scalable systems integrating the robots, the AI, and the human operators in hybrid warehouses.

3.3 AI in Logistics

Last-mile delivery and routing, because of their service-level significance and cost sensitivity, are especially ripe targets for optimization by AI. Artificial-intelligence-based route optimization engines, such as UPS's ORION, are reportedly saving their company over 100 million miles annually, a figure translating into saving on fuel and reducing carbon emissions [16]. Similarly, DHL's Resilience360 platform, which is AI-based, augments risk visibility by integrating in real-time information on weather, traffic, and geopolitics in hopes of forecasting disruptions [17].

Machine learning is even employed towards demand clustering, which would be beneficial by aligning shipment density with capacity allocation. Deep reinforcement learning is on the rise towards adaptive vehicle routing, especially in the case of dynamic traffic. As all such advances occur, literature mentions interoperability of data between logistics partners as a persistent issue, and there is a requirement for blockchain-based AI systems to share data in a safe manner [18].

3.4 AI in Transport

Transport, especially fleet operations and long-haul trucking, is being transformed with the help of AI. Telematics-based predictive maintenance systems trained on historical data can predict engine breakdowns and part failure, and lower maintenance expenditures by 30% or even more. Penske's implementation of Catalyst AI in its Fleet Insight platform is a classic example of the practical implementation of predictive diagnostics on a large scale [3].

Artificial intelligence is also powering transportation sustainability. Machine-learning algorithms save fuel by recognizing eco-driving practices and suggesting optimal routing plans, supporting emission reduction targets. Future directions encompass self-driving trucks and drones, and TuSimple and Wing are showcasing pilot uses in cargo and express deliveries [19].

However, regulation of autonomous transport is underdeveloped, and public faith in safety systems powered by AI is a lingering social issue. Present studies lack unified procedures to assess and certify AI-powered autonomous systems in transport.

3.5 Research Gaps Across Domains

While there are measurable gains from AI in warehouses, logistics, and transportation, there are some gaps:

- Integration Gaps – Studies tend to isolate areas, restricting cross-functional integration of AI.
- Sustainability Gap – Relatively few articles measure the role of AI towards carbon neutrality or closed-loop supply chains.
- Human-AI Collaboration Gap – The role of human expertise in complementing AI decisions is underexplored.
- Regulatory and Ethical Disparity – Limited emphasis on explainability, accountability, and regulatory congruence during the adoption of AI.

4. AI in Warehousing

One of the richest opportunities for artificial intelligence (AI) implementation in the field of supply chain management is found in the warehousing function because of its intense manual work, iterative procedures, and strategic significance of timely order fulfillment. Implementation of systems enabled by AI has extended from automation of work towards the intelligence-based coordination of people, machines, and materials.

Key Optimization Areas:

Artificial intelligence has greatly redefined picking and packing operations, which hitherto account for up to 55% of overall warehouse operating expenses [20]. Autonomous mobile robots (AMRs) integrated with computer vision and deep learning can navigate dynamic warehouse configurations, optimize picker travel time, and increase throughput. Reinforcement learning algorithms optimize even further robot fleet routing strategies such that they cause minimal congestion even in high-volume warehouses.

Slotting and inventory optimization are facilitated by AI too. Machine learning algorithms examine historical sales data, order quantities, and affinities of products and make the optimal slotting decisions, minimizing pick time and maximizing utilization of space. Digital twin technology creates virtual, real-time replicas of warehouses, such that managers can test layout changes, workflow changes, and demand variations before they are implemented on the ground [1].

AI Techniques in Application:

I. Computer Vision: Used in quality checking and defect detection, ensuring outbound products meet consumer requirements.
II. Predictive Analytics: Supports safety inventory management and replenishment planning, reducing both stockouts and excess inventory.
III. Collaborative Robots (Cobots): Intelligent cobots cooperate with people for ergonomically challenging work, reducing workplace accidents and increasing productivity.

Challenges and Research Gaps:

Though potential, there are challenges facing warehousing AI. Data silos between Warehouse Management Systems (WMS) and Enterprise Resource Planning (ERP) systems make end-to-end optimization challenging. Interoperability of disjointed robotic systems is technically challenging, especially in multi-vendor environments. Workforce reskilling is also needed because the employees need to be suitable for supervisory and analytical work in warehouses where they are driving AI [21].

Future research directions include designing scalable systems of human-AI coordination within warehouses and measurable evaluations of the contributions of AI towards achieving sustainability objectives, like reducing energy consumption and waste.

5. AI in Logistics

Logistics, especially network design and end-mile delivery, is one of supply chain management's most challenging and expensive domains.AI presents its powerful solutions to respond to unpredictability of demand, growing customer expectations for day-of-delivery, and pressure to be green regarding emissions related to transport.

Optimization in Logistics Networks:

AI-driven systems offer dynamic routing since they accommodate live data on traffic, weather, and customer decisions. For instance, UPS' On-Road Integrated Optimization and Navigation (ORION) system is reported to reduce over 10 million gallons of fuel annually as well as reduce carbon emissions by 100,000 metric tons through AI-driven route optimization [22]. DHL's Resilience360 platform also uses AI to monitor threats as well as give early warning signs regarding disruptions by natural disasters, strikes, or political instability [17].

AI Tools & Models:

- Demand clustering and load optimization are facilitated by Machine Learning (ML) to provide balanced utilization of logistics assets.
- Deep Reinforcement Learning (DRL) is applied under adaptive car routing to outperform under varying traffic conditions as compared to heuristics.
- Predictive Analytics improves last-mile planning by estimating delivery time slots with increased accuracy, thereby enhancing customer satisfaction.

- Natural Language Processing (NLP) technology works on unstructured data such as customer feedback and shipping data to detect service chokepoints and accelerate decision-making.

Challenges:

Although there are tangible gains to be had, adoption of AI logistics is obstructed by data interoperability challenges among various stakeholders. Sharing data in real-time usually runs into issues of mistrust since logistics operators are loath to share competitive operational data. Additionally, cybersecurity threats multiply with connected fleets and IoT-enabled assets opening systems to hacker threats at large. There is also limited standardized frameworks for sustainable logistics where there is opportunity for AI to be able to measure carbon reductions and scale green routing.

Research Gaps:

Significant gaps include needs for end to end compatible multimodal logistics (air, sea, land, rail) logistics systems to function with AI systems, design for explainable AI to provide more transparent logistics decision-making, and blockchain-AI integration protocols to offer safe and verifiable data streams.

6. AI in Transport

Transportation forms the supply chain connectivity framework by intertwining points of production with warehouses as well as consumption points. As freights volumes escalate and environmental regulations strengthen, AI technology has been at the forefront of optimizing fleet operations to reduce emissions and enhance self-mobility.

Fleet & Vehicle Optimization:

Predictive maintenance with AI has revolutionized fleet management by using telematics data to predict engine breakdowns, tire wear, and component decline before they actually happen. Research shows that AI-based predictive maintenance can lower unplanned downtime by as much as 50% and maintenance expenses by 30%. Penske's implementation of Catalyst AI through its Fleet Insight platform is a prime example of practical use where real-time data allow for scheduling of preventive services on thousands of trucks preemptively [3].

AI also makes adaptive scheduling and routing of long-distance operations possible. Based on weather data, fuel supply, and road conditions, reinforcement learning-based algorithms optimize transport scheduling to minimize delay with minimal loss of efficiency. It is particularly effective with multimodal freight transportation where delay on one leg is propagated through the entire supply chain.

Sustainability Aspects:

AI supports decarbonization plans by means of eco-routing and fuel optimization. Machine learning algorithms recognize optimal driving patterns (e.g., modulation of speed, shifting gears) that lower emissions as well as fuel consumption. Studies indicate that AI can decrease CO_2 emissions from freight hauls by as much as 15% if combined with telematics-based advisory systems for drivers [23].

Innovations in Autonomous Mobility:

The AI transport frontier is self-driving trucks and air-dron-based delivery solutions. Firms such as TuSimple are running AI-powered self-driving trucks that drive on highways with limited human control. Wing and Amazon Prime Air are using AI-powered drones for last-mile delivery to decrease delivery cycles as well as reduce traffic congestion. The solutions hold out promises to scale up but pose issues about safety certification, regulatory endorsement, and gaining the confidence of the people [24].

Challenges and Research Gaps:

Even with swift progress, transport AI is subject to challenges. Autonomous system regulatory frameworks are disparate throughout jurisdictions and hinder roll-out. Cyber threats to data privacy and security for connected fleets are of immediate concern as they can impede domestic logistics chains on a large scale. Further study hasn't developed normalized performance measures for safety validation with AI-based approaches to autonomous transport.

7. Comparative Insights Across Domains

The use of artificial intelligence (AI) throughout warehousing, logistics, and transport presents both converging advantages as well as diverging challenges. Across a cross-domain level, AI universally boosts efficiency, cost reduction, and reliability of services. In warehouses, automation with robotics and order forecasting with predictive analytics lowers order processing costs as well as cycle times. In logistics, route optimization software, as seen with UPS ORION and DHL Resilience360, underpins AI's fuel reduction as well as resilience to disruptions enhancements. In transport, predictive maintenance and environmental routing add both reliability and sustainability outcomes to operations [3].

In spite of such converging dividends, domain-derived limitations persist. Warehousing grapples with integration within disparate robotic systems and workforce adaptability. Logistics grapples with interoperability challenges and cybersecurity threats within multi-stakeholder settings. Transport experiences regulatory ambiguities around self-driving vehicles and data security issues within connected fleets.

Comparative analysis identifies a need for end-to-end AI infrastructures spanning warehousing, logistics, and transportation with a single digital canopy. Future-age architecture, such as digital twins and blockchain-based AI, holds great promise for breaching silos to offer end-to-end visibility, reliability, and optimization. However, multisource adoption strategies of AI are nonexistent and need an urgent research agenda by both practitioners and academicians [9].

8. Future Directions & Research Agenda

The future of supply chain management (SCM) with artificial intelligence (AI) involves shifting from domain-based deployments to connected, interpretable, and sustainable systems. A pressing need is to develop human–AI collaborative frameworks that enable AI to supplement human knowledge rather than replace it. This necessitates exploring adaptive decision support systems incorporating interpretable AI to allow managers to be confident about algorithmic suggestions under high-stakes situations.

Another agenda entails aligning AI adoption with sustainability and circular economy goals. Sustainable routing facilitated by artificial intelligence, warehousing energy optimization, and demand forecasting can directly contribute to decarbonization targets at the international level; however, few studies have quantified such opportunities in numerical terms. The inclusion of carbon metrics within AI-based frameworks will be needed to ensure alignment with reporting directives like the EU Corporate Sustainability Reporting Directive.

Third, cross-domain integration is underutilized. Blockchain-powered AI and digital twins provide an opportunity to connect warehousing, logistics, and transportation to integrated decision-making systems. There is a need for future studies to design interoperable architectures to exchange data smoothly between stakeholders.

Ultimately, meeting ethical and regulatory requirements is necessary. Standardized protocols for validating AI safety, cybersecurity for networked fleets, and reskilling of the workforce will define responsible adoption of AI in SCM.

These directions together make it clear that AI is not just a technology enhancement but rather a strategy to develop resilient supply chains that are sustainable and human-centered.

9. Conclusion

This paper explored warehousing-, logistics-, and transport-domain applications of artificial intelligence (AI) to prove its transformative role in redefining supply chain management (SCM). While artificial intelligence-based robotics, predictive slotting, and digital twins improve productivity and accuracy in warehousing, advanced routing and risk-monitoring software enhance resilience and servicing reliability in logistics. Transport also benefits from predictive maintenance, eco-routing, and upcoming self-mobility solutions, adding to its efficiency and sustainability at operational levels.

Comparative observations identify a convergence of benefits—increased efficiency, reduced costs, and greater resilience—but challenges remain siloed and domain-specific. Warehousing faces issues with system integration and workforce reskilling; logistics encounters problems with interoperability and cybersecurity; and transportation must navigate regulatory unpredictability and public acceptance of autonomous vehicles. These insights highlight the need for end-to-end, optimization-driven, integrated AI ecosystems that break down silos.

From a management perspective, embracing AI is no longer discretionary but a strategic imperative. Those firms that deepen investment in artificial intelligence with sustainability goals, multi-domain fusion, and human–AI cooperation will be best poised to excel under turbulent global circumstances. Future research must look beyond technical solutions to coping with governance, ethics, and system coherence to ensure that optimization with AI contributes to not only operational excellence but resilience and sustainability at a global scale.

References

1. https://www.supplychainbrain.com/articles/39153-ai-and-digital-twins-revolutionize-2024-warehouse-operations?utm_source=chatgpt.com
2. Enoch Oluwademilade Sodiya, Uchenna Joseph Umoga, Olukunle Oladipupo Amoo, Akoh Atadoga (2024) AI-driven warehouse automation: A comprehensive review of systems. GSC Advanced Research and Reviews 18:. https://doi.org/10.30574/gscarr.2024.18.2.0063
3. Crespo del Castillo A, Parlikad AK (2024) Dynamic fleet management: Integrating predictive and preventive maintenance with operation workload balance to minimise cost. Reliab Eng Syst Saf 249:. https://doi.org/10.1016/j.ress.2024.110243
4. Othman A AI-Powered Predictive Maintenance in Transportation. https://doi.org/10.13140/RG.2.2.11335.82085
5. https://www.businessinsider.com/penske-uses-ai-technology-to-enhance-truck-maintenance-cost-savings-2025-6?utm_source=chatgpt.com
6. Liu M, Ren Y, Nyagoga LM, et al (2023) Future of education in the era of generative artificial intelligence: Consensus among Chinese scholars on applications of ChatGPT in schools. Future in Educational Research 1:. https://doi.org/10.1002/fer3.10
7. Islam S, Amin SH (2020) Prediction of probable backorder scenarios in the supply chain using Distributed Random Forest and Gradient Boosting Machine learning techniques. J Big Data 7:. https://doi.org/10.1186/s40537-020-00345-2
8. Rolf B, Jackson I, Müller M, et al (2023) A review on reinforcement learning algorithms and applications in supply chain management. Int J Prod Res 61
9. Sharma R, Shishodia A, Gunasekaran A, et al (2022) The role of artificial intelligence in supply chain management: mapping the territory. Int J Prod Res 60:. https://doi.org/10.1080/00207543.2022.2029611
10. Ivanov D, Dolgui A (2021) A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. Production Planning and Control 32:. https://doi.org/10.1080/09537287.2020.1768450
11. Akash Kadam, Diwakar Reddy Peddinti, & Aditya Gupta. (2025). The Evolution of Smart Factories: Integrating IOT and Machine Learning in Supply Chain and Manufacturing. *Journal of Computer Science and Technology Studies*, *7*(5), 251-261. https://doi.org/10.32996/jcsts.2025.7.5.32
12. Jackson I, Ivanov D, Dolgui A, Namdar J (2024) Generative artificial intelligence in supply chain and operations management: a capability-based framework for analysis and implementation. Int J Prod Res 62:. https://doi.org/10.1080/00207543.2024.2309309
13. https://www.panda-boom.com/resources/blog/how-amazon-uses-ai-and-automation-to-speed-up-supply-chain/?utm_source=chatgpt.com
14. Richey RG, Chowdhury S, Davis-Sramek B, et al (2023) Artificial intelligence in logistics and supply chain management: A primer and roadmap for research. Journal of Business Logistics 44
15. Akash Abaji Kadam, Tejaskumar Vaidya, & Subba rao katragadda. (2025). Digital Transformation of Supply Chain Quality Management: Integrating AI, IoT, Blockchain, and Big Data. *Journal of Economics, Finance and Accounting Studies* , *7*(3), 41-49. https://doi.org/10.32996/jefas.2025.7.3.5
16. https://www.productmonk.io/p/aws-success-secrets-from-startup-to-titan-473d04d0b889a9d0?utm_source=chatgpt.com
17. https://www.3newsnow.com/news/local-news/ups-saving-millions-at-the-pump-emphasizes-importance-of-planning-ahead?utm_source=chatgpt.com
18. Boutaba R, Salahuddin MA, Limam N, et al (2018) A comprehensive survey on machine learning for networking: evolution, applications and research opportunities. Journal of Internet Services and Applications 9:. https://doi.org/10.1186/s13174-018-0087-2
19. Mirindi D (2024) A Review of the Advances in Artificial Intelligence in Transportation System Development. Journal of Civil, Construction and Environmental Engineering 9:72–83. https://doi.org/10.11648/j.jccee.20240903.13
20. Enoch Oluwademilade Sodiya, Uchenna Joseph Umoga, Olukunle Oladipupo Amoo, Akoh Atadoga (2024) AI-driven warehouse automation: A comprehensive review of systems. GSC Advanced Research and Reviews 18:272–282. https://doi.org/10.30574/gscarr.2024.18.2.0063
21. Yoshitake H, Abbeel P (2023) The Impact of Overall Optimization on Warehouse Automation
22. https://www.bestpractice.ai/ai-case-study-best-practice/ups_saves_over_10_million_gallons_of_fuel_and_up_to_%24400m_in_costs_annually_with_advanced_telematics_and_analysis?utm_source=chatgpt.com
23. Oden M, Sciara GC (2020) The salience of megaregional geographies for inter-metropolitan transportation planning and policy making. Transp Res D Transp Environ 80:. https://doi.org/10.1016/j.trd.2020.102262
24. https://www.reuters.com/technology/artificial-intelligence/self-driving-truck-startup-tusimple-rebrands-createai-shifts-gaming-tech-2024-12-19/