Enhancing Road-Based Supply Chain Efficiency in the US: Integrating AI/ML-Based C^{3}I Systems with IoT-Enabled Trucks

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Abstract **- This paper explores the integration of AI/ML-based C^{3}I systems with IoT-enabled trucks to enhance the efficiency of road-based supply chains in the US. By examining the components and benefits of these technologies, as well as their implementation strategies and real-world applications, this paper provides a comprehensive overview of how these advancements can transform supply chain logistics. The author has been at the forefront of crafting an IoT sensor-based Fleet and Transportation Management System for one of the top 10 telematics companies. It utilizes AI and ML to provide strategic and operational insights within a logistics environment for the complete paradigm ranging from SMB to enterprise level companies. The discussion covers operational benefits such as reduced downtime and optimized routing, and strategic advantages including improved decision-making and increased resilience against disruptions. Ultimately, the goal is to highlight how these innovations can drive significant improvements in the performance and reliability of road-based supply chains, leading to lower costs and better profits.**

Keywords *- Artificial Intelligence, Machine Learning, Internet of Things, Supply Chain Management, C^{3}I Systems, Logistics, Freight Trucking, Sensor data, Data management,*

1. Introduction

The US road-based supply chain is a cornerstone of the national economy, facilitating the movement of goods across vast distances and supporting a myriad of industries. As global competition intensifies, enhancing the efficiency of these supply chains becomes increasingly critical. The advent of advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT) offers unprecedented opportunities to optimize logistics operations. Command, Control, Communications, and Intelligence (C^{3}I) systems, initially developed for military applications, should now be adapted for commercial use to streamline supply chain processes. This paper explores the integration of AI/ML-based C^{3}I
systems with IoT-enabled trucks, demonstrating how these innovations can significantly improve operational efficiency, reduce costs, and bolster the resilience of road-based supply chains in the US.

1.1 Background

The US road-based supply chain is a critical component of the national economy, underpinning a vast array of industries by facilitating the movement of goods across the country. The efficiency of these supply chains directly impacts economic performance, as timely delivery of products is essential for maintaining competitive market positions. Road-based logistics have been instrumental in establishing the US as a global superpower, supporting both domestic and international trade. The trucking industry, in the supply chain. As such, enhancing the efficiency of road-based supply chains not only boosts economic productivity but also fortifies the nation's position in the global market.

1.2. Role of Technology in Supply Chains

The advent of advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT) have the potential to revolutionize supply chain management [1]. These technologies enable more precise forecasting, enhanced monitoring, and real-time decision-making. Command, Control, Communications, and Intelligence (C^3I) systems, originally developed for military applications, are now being adapted for commercial use to further improve supply chain operations. AI and ML, for instance, can analyze vast amounts of data to optimize routes and predict maintenance needs, while IoT devices provide real-time tracking and condition monitoring of goods. By leveraging these technologies, businesses can achieve significant improvements in efficiency, cost savings, and overall operational effectiveness [2].

1.3. Purpose of the Paper

This paper explores the integration of AI/ML-based C^3I systems with IoT-enabled trucks to enhance the efficiency of road-based supply chains in the US. By examining the components and benefits of these technologies, as well as their implementation strategies and real-world applications, we aim to provide a comprehensive overview of how these advancements can transform supply chain logistics. The discussion will cover the operational benefits, such as reduced downtime and optimized routing, and strategic advantages, including improved decision-making and increased resilience against disruptions. Ultimately, the goal is to show how these innovations can drive significant improvements in the performance and reliability of road-based supply chains.

2. Understanding C^3I Systems in Supply Chain

2.1 Definition of C^3I Systems

C^3I systems form the backbone of military operations and encompass Command, Control, Communications, and Intelligence functions, provide a continuum for effective decision-making and operational management [3]. These systems integrate various technological and procedural components to enhance the coordination and efficiency of all types of operations but are especially pertinent for logistics and supply chain operations. The command function involves strategic decision-making and the establishment of policies and objectives. Control focuses on monitoring and managing ongoing activities to ensure they align with strategic goals. Communications facilitate the seamless exchange of information among different parts of the supply chain, while intelligence involves the analysis of data to generate actionable insights. Together, these functions enable organizations to respond quickly and effectively to changes and challenges in the supply chain environment [4].

2.2 Components of C^3I Systems

2.2.1 Command

Involves strategic decision-making to guide overall supply chain operations. It includes setting objectives, policies, and strategies to achieve desired outcomes.

2.2.2 Control

Focuses on monitoring and managing ongoing activities to ensure alignment with strategic goals. It involves tracking performance metrics, identifying deviations, and implementing corrective actions.

2.2.3 Communications

Facilitates information exchange among different parts of the supply chain. Effective communication ensures that relevant data is shared promptly and accurately, enabling coordinated actions.

2.2.4 Intelligence

Involves data analysis and insights generation to inform decision-making. By leveraging advanced analytics, organizations can gain a deeper understanding of their operations and make informed decisions to enhance efficiency [5].

2.3 Importance in Extreme Situations

C^3I systems are crucial in extreme situations such as war and disaster management, where timely and accurate information is essential. These systems enhance situational awareness, coordination, and response efficiency, enabling effective management of resources and operations under challenging conditions. Lessons learned from these extreme applications can be applied to regular supply chains to improve resilience and operational efficiency. For instance, the ability to quickly gather and analyze data can help supply chain managers anticipate disruptions

and develop contingency plans. Similarly, robust communication networks can ensure that all stakeholders are informed and aligned, reducing the impact of unforeseen events on supply chain performance.

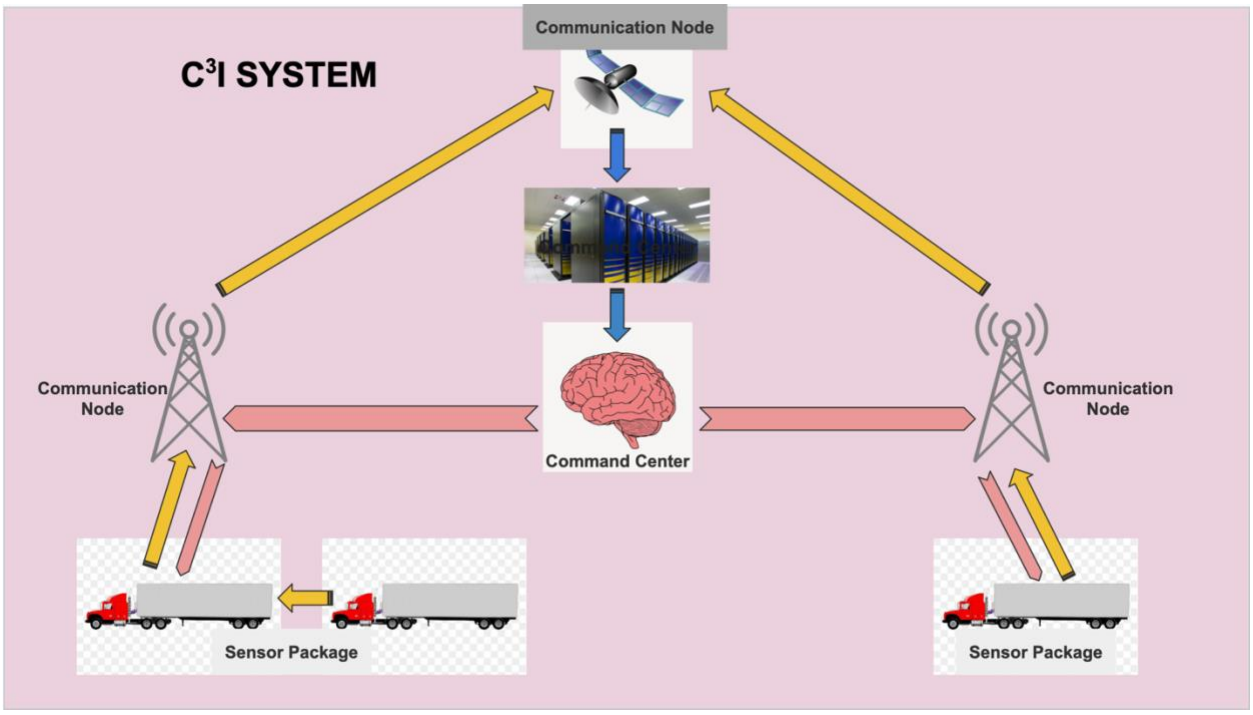

Figure 1: C3I Connectivity and Intelligence in Increasing Efficiencies

3. Integration of AI/ML in C3I Systems

3.1 Role of AI and ML

AI and ML play a critical role in enhancing decision-making by providing predictive analytics and automation. These technologies can analyze vast amounts of data to identify patterns, forecast demand, optimize routes, and manage inventory. For example, AI algorithms can predict the best routes for deliveries based on real-time traffic data, while ML models can identify maintenance needs before they become critical, reducing downtime and repair costs [6]. By integrating AI and ML into C3I systems, supply chain managers can make more informed decisions, improve operational efficiency, and enhance overall supply chain performance.

3.2. Key AI/ML Technologies

3.2.1 AI Algorithms

Used for demand forecasting and route optimization to ensure efficient logistics operations. AI algorithms can process large datasets to predict future demand accurately, allowing companies to adjust their supply chains proactively.

3.2.2 ML Models

Employed for predictive maintenance and risk management, helping to preemptively address potential issues. ML models can analyze data from various sources to identify potential risks and suggest mitigation strategies, ensuring smooth and uninterrupted supply chain operations [7].

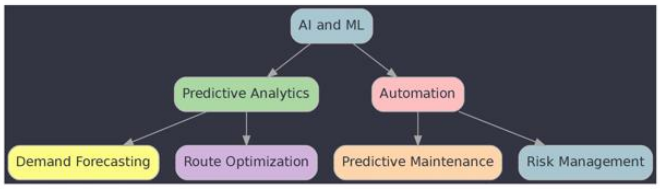

Figure 2: Enhancing Efficiencies with AI/ML

4. Case Studies

4.1 Example 1: Integration of AI/ML-Based C^{3}I Systems

A logistics company integrated AI/ML-based C3I systems with IoT-enabled trucks to enhance their operational efficiency and reduce costs. The result was a notable 20% increase in delivery efficiency and a 15% reduction in operational costs. Here's how they achieved these improvements:

4.1.1 AI Based Routing Optimization

Advanced AI algorithms analyzed real-time traffic data, road closures, and historical delivery times to determine the most efficient routes for deliveries. This minimized travel time and fuel consumption, ensuring that trucks took the best possible paths to their destinations and avoided traffic congestion and delays.

4.1.2 AI Based Scheduling Optimization

AI was used to optimize delivery schedules by predicting demand patterns and considering factors such as driver availability and vehicle maintenance schedules. This reduced idle times and ensured that deliveries were made promptly, maximizing resource utilization.

4.1.3 Predictive Maintenance using ML Models.

Machine Learning (ML) models were employed to analyze data from sensors installed on the trucks, monitoring the condition of critical components such as the engine, brakes, and tires. These models predicted potential failures before they occurred, allowing for proactive maintenance, reducing unexpected breakdowns, and extending the lifespan of the trucks.

4.1.4 Risk Management with ML Models

By identifying patterns in sensor data, ML models assessed the risk of component failures. This risk assessment enabled the company to prioritize maintenance tasks based on urgency, ensuring critical issues were addressed first. It led to implementation of IoT-Enabled Trucks.

4.1.5 Real-Time GPS Tracking

IoT devices with GPS technology provided continuous real-time tracking of truck locations, allowing the company to monitor fleet movements. Dispatchers could see the exact position of each truck, enabling informed decisions about route adjustments and delivery schedules.

4.1.6 Environmental Monitoring

Additional IoT sensors monitored environmental conditions, such as temperature and humidity, within the trucks. This was especially important for transporting perishable goods, ensuring that cargo remained within required conditions throughout the journey.

4.1.7 Data Integration and Communication

4.1.7.1 Data Collection

IoT devices collected a wealth of data, including speed, fuel consumption, engine performance, and environmental conditions. This data was transmitted in real-time to a central management system for analysis.

4.1.7.2 Communication Networks

Robust communication networks facilitated the seamless exchange of data between trucks and the central system, ensuring quick and reliable data transmission for real-time monitoring and decision-making.

4.1.8 Results and Benefits

4.1.8.1 Increased Delivery Efficiency

The integration resulted in a 20% increase in delivery efficiency through optimized routing and scheduling, reducing travel times and ensuring timely deliveries.

4.1.8.2 Reduced Delays

Real-time tracking and monitoring allowed the company to identify and address potential delays promptly. If a truck encountered heavy traffic, the system could suggest alternative routes.

4.1.8.3 Reduction in Operational Costs.

The project led to a 15% reduction in operational costs due to reduced fuel consumption from optimized routing and lower maintenance costs from predictive maintenance.

4.1.8.4 Improved Resource Utilization

Optimizing schedules and routes allowed better utilization of existing resources, reducing the need for additional trucks and drivers.

4.1.9 Conclusion.

The integration of AI/ML-based C^3I systems with IoT-enabled trucks significantly transformed the company's logistics operations. AI and ML improved routing, scheduling, and predictive maintenance, while IoT devices provided real-time tracking and monitoring. These combined technologies resulted in a 20% increase in delivery efficiency and a 15% reduction in operational costs, demonstrating the powerful impact of advanced technologies on supply chain management.

4.2 Example 2

A logistics company implemented Integration of Machine Learning (ML) models for predictive maintenance in their fleet of IoT-enabled trucks. This strategic move resulted in a remarkable 30% decrease in unexpected breakdowns, significantly enhancing the reliability and efficiency of their operations.

4.2.1 Data Collection and IoT Integration

4.2.1.1 Sensor Installation: The company installed IoT sensors on their trucks to continuously monitor the condition of various components, including the engine, brakes, tires, and transmission systems.

4.2.1.2 Real-Time Data Collection: These sensors collected real-time data on parameters such as temperature, vibration, pressure, and wear and tear. This data was transmitted to a central database for analysis.

4.2.2 Machine Learning Model Development

4.2.2.1 Data Analysis: Historical maintenance records and real-time sensor data were analyzed to identify patterns and correlations between certain conditions and component failures.

4.2.2.2 Model Training: The company developed and trained ML models using this historical and real-time data to predict the likelihood of component failures. These models were designed to detect early warning signs of potential issues.

4.2.3 Predictive Maintenance Implementation

4.2.3.1 Condition Monitoring: The ML models continuously analyzed the sensor data to monitor the condition of truck components in real-time.

4.2.3.2 Failure Prediction: When the models detected conditions that indicated a high probability of failure, they generated alerts for preemptive maintenance.

4.2.3.3 Maintenance Scheduling: The system scheduled maintenance tasks based on the predicted failure times, ensuring that components were serviced or replaced before they could fail unexpectedly.

4.2.4 Results and Benefits

4.2.4.1 Reduction in Breakdowns: The predictive maintenance approach led to a 30% decrease in unexpected breakdowns. This reduction minimized disruptions in the logistics operations and improved overall fleet reliability.

4.2.4.2 Cost Savings: By preventing unexpected breakdowns, the company reduced repair costs and avoided the expenses associated with emergency repairs and towing services.

4.2.4.3 Operational Efficiency: With fewer breakdowns, the trucks spent more time on the road, improving delivery times and customer satisfaction. This efficiency also allowed for better utilization of the fleet, reducing the need for spare vehicles.

4.2.5 Enhanced Decision-Making

4.2.5.1 Data-Driven Insights: The ML models provided data-driven insights into the health of the fleet, allowing the company to make informed decisions about maintenance and operations.

4.2.5.2 Optimized Inventory Management: By predicting maintenance needs, the company could better manage their inventory of spare parts, ensuring that necessary components were available when needed without overstocking.

4.2.6 Scalability and Future Applications

4.2.6.1 Scalability: The predictive maintenance system was scalable, allowing the company to easily expand the solution to additional trucks and other types of vehicles in their fleet.

4.2.6.2 Future Integration: The success of the predictive maintenance system opened up possibilities for integrating other advanced technologies, such as AI-driven route optimization and automated maintenance scheduling, further enhancing operational efficiency.

4.2.7 Conclusion. The implementation of ML models for predictive maintenance in IoT-enabled trucks significantly improved the reliability and efficiency of the logistics company's operations. By reducing unexpected breakdowns by 30%, the company achieved substantial cost savings, enhanced operational efficiency, and provided better service to their customers. This example demonstrates the powerful impact of combining ML with IoT technology in the logistics industry, highlighting the potential for further innovations and improvements.

5. IoT-Enabled Trucks in Supply Chain Efficiency

5.1 Overview of IoT Technology

IoT devices collect and transmit data in real-time, providing valuable insights into various aspects of the supply chain. These devices can monitor the location, condition, and performance of trucks and their cargo, enabling supply chain managers to make informed decisions based on real-time data. By integrating IoT technology into trucking operations, companies can achieve greater visibility, control, and efficiency across their supply chains [8].

5.2 Applications in Trucking

5.2.1 Real-Time Tracking: IoT-enabled trucks can be tracked in real-time, allowing for better fleet management and route adjustments. This capability helps reduce delays, optimize fuel usage, and improve overall delivery performance.

5.2.2 Monitoring Conditions: Sensors monitor environmental conditions and vehicle health, ensuring that goods are transported under optimal conditions. For instance, temperature sensors can ensure that perishable goods are kept within the required temperature range throughout the journey [9].

5.3 Benefits of IoT-Enabled Trucks

5.3.1 Improved Transparency and Visibility: Real-time data provides insights into the status and location of shipments, enhancing transparency. This visibility allows companies to quickly identify and address any issues that arise during transportation.

5.3.2 Enhanced Safety and Compliance: Monitoring systems ensure that safety standards are met, and regulatory compliance is maintained. For example, IoT devices can track driver behavior and vehicle performance to ensure that safety protocols are followed, and maintenance is conducted as needed **[10]**.

5.4 Performance Metrics

Early adopters of IoT-enabled trucks have reported significant improvements in both efficiency and revenue. According to Dey et al., companies using IoT-enabled trucks have seen a 25% increase in operational efficiency and a 10-15% rise in revenues due to optimized logistics and reduced downtime. These improvements demonstrate the tangible benefits of integrating IoT technology into trucking operations, highlighting its potential to transform the supply chain landscape.

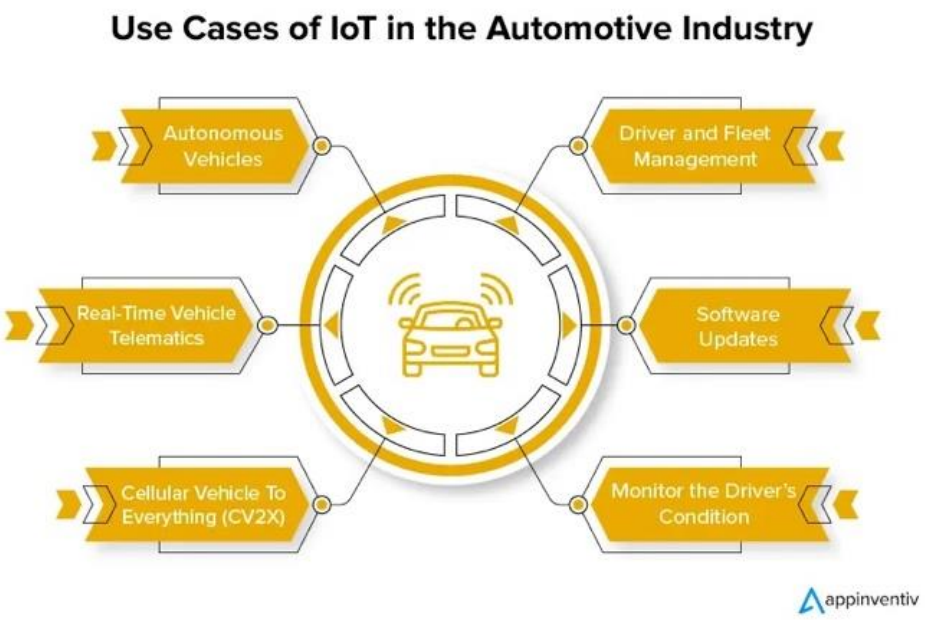

Figure 3. Visual representation of IoT implementations in the industry showcases the enhanced tracking, monitoring, and decision-making capabilities enabled by this technology

6. Integrating AI/ML-Based C^{3}I Systems with IoT-Enabled Trucks

6.1 Synergy between AI/ML and IoT

AI/ML enhances IoT data analysis by providing predictive insights and automating decision-making processes. By combining the real-time data collection capabilities of IoT devices with the analytical power of AI and ML, companies can achieve a more comprehensive and proactive approach to supply chain management [11]. This integration allows for real-time decision-making, enabling supply chain managers to respond quickly and effectively to changing conditions and emerging challenges.

6.2. Implementation Strategies

6.2.1 Steps for Integration: Integrating C^{3}I systems with IoT-enabled trucks involves several key steps. These include setting up the necessary hardware and software, training personnel on how to use the new systems, and establishing robust data management protocols. Companies must also ensure that their existing infrastructure is compatible with the new technology and that any necessary upgrades are made.

6.2.2 Challenges: Key challenges in this process include interoperability issues between different systems and devices, data security concerns, and resistance to change within the organization. Addressing these challenges requires careful planning, effective communication, and a commitment to continuous improvement [12].

6.3 Technological Infrastructure

6.3.1 Required Hardware and Software: Integrating AI/ML-based C^{3}I systems with IoT-enabled trucks requires a combination of sensors, communication devices, and analytics platforms. These components must be carefully selected and configured to ensure seamless operation and data flow.

6.3.2 Network and Data Management: Efficient data collection, storage, and processing systems are crucial for seamless integration. This includes establishing secure and reliable communication networks, implementing robust data management practices, and ensuring that all data is accessible and usable for analysis.

7. Case Studies and Industry Examples

7.1 Example 1

A logistics company integrated AI/ML-based C^{3}I systems with IoT-enabled trucks, resulting in a 20% increase in delivery efficiency and a 15% reduction in operational costs (ResearchGate). The company used AI algorithms to optimize routing and scheduling,

while IoT devices provided real-time tracking and monitoring of their fleet.

7.2 Example 2

Adoption of these technologies by a large retailer improved inventory management and reduced stockouts by 30% (MDPI). The retailer implemented ML models to predict demand more accurately and used IoT sensors to monitor inventory levels in real-time, enabling more responsive and efficient supply chain operations.

7.3 Lessons Learned

7.3.1 Challenges Faced: Common challenges included resistance to change from employees, high initial setup costs, and technical issues related to system integration. These challenges can pose significant obstacles to successful implementation, but they can be overcome with the right strategies and support.

7.3.2 Solutions Implemented: Effective training programs and phased implementation helped mitigate these challenges. By providing comprehensive training to employees and gradually rolling out new technologies, companies can ensure a smoother transition and greater acceptance of the changes.

8. Benefits of Integration

8.1 Operational Efficiency

8.1.1 Reduced Downtime: Predictive maintenance reduces unexpected breakdowns and associated downtime, ensuring that trucks are available and operational when needed.

8.1.2 Optimized Routing: AI-driven route optimization minimizes fuel consumption and travel time, leading to cost savings and improved delivery performance.

8.2 Enhanced Decision-Making

8.2.1 Real-Time Insights: Continuous data collection and analysis provide actionable insights that help supply chain managers make informed decisions quickly. These insights can be used to adjust routes, manage inventory, and respond to emerging issues in real-time.

8.2.2 Risk Management: Proactive risk identification and mitigation improve supply chain resilience by anticipating and addressing potential disruptions before they occur.

8.3 Customer Satisfaction

8.3.1 Improved Delivery Times: Faster and more reliable deliveries enhance customer satisfaction by meeting or exceeding delivery expectations. This is particularly important in industries where timely delivery is a critical factor in customer satisfaction and loyalty.

8.3.2 Increased Transparency: Enhanced visibility into the supply chain builds customer trust by providing accurate and timely information about the status of their orders. This transparency can lead to increased customer confidence and long-term loyalty.

9. Challenges and Solutions

9.1 Technical Challenges

9.1.1 Interoperability: Ensuring that different systems and devices work together seamlessly is a significant challenge. This requires the use of standardized protocols and robust integration frameworks that facilitate communication and data exchange between various components.

9.1.2 Solution: Developing and implementing industry-wide standards and best practices for system integration can help address interoperability issues. Additionally, working with experienced technology partners can provide the expertise needed to ensure successful integration.

9.2 Data Security and Privacy

9.2.1 Protection: Safeguarding data against breaches and unauthorized access is critical, given the sensitive nature of supply chain information. Companies must implement strong encryption, access control measures, and regular security audits to protect their data.

9.2.2 Solution: Establishing a comprehensive data security strategy that includes robust encryption, multi-factor authentication, and continuous monitoring can help protect against security threats. Additionally, regular training and awareness programs for employees can further enhance data security.

9.3 Organizational and Cultural Barriers

9.3.1 Change Management: Overcoming resistance to new technologies and processes within the organization is essential for successful implementation. This includes addressing concerns about job displacement and ensuring that employees understand the benefits of the new systems.

9.3.2 Solution: Implementing comprehensive training programs and clear communication of the benefits can help overcome resistance. Engaging employees early in the process and involving them in decision-making can also foster a sense of ownership and acceptance.

10. Future Trends and Developments

10.1 Emerging Technologies

10.1.1 Advances: Continued development of AI, ML, and IoT technologies promises to bring even greater improvements in supply chain efficiency and resilience. These advancements will likely include more sophisticated AI algorithms, enhanced IoT devices, and greater integration with other emerging technologies such as blockchain and 5G.

10.1.2 Impact: The potential impact of these technologies on supply chain management is significant, offering new opportunities for optimization, automation, and innovation. As these technologies continue to evolve, they will provide even more powerful tools for managing complex supply chains.

10.2 Industry Predictions

10.2.1 Future Directions: Increased adoption of autonomous vehicles and advanced analytics is expected to further transform the supply chain landscape. Autonomous trucks, for example, can operate continuously without the need for rest breaks, significantly improving delivery times and reducing costs.

10.2.2 Long-Term Benefits: Sustainable and efficient supply chain operations will become the norm as more companies adopt these technologies. The long-term benefits include reduced environmental impact, increased profitability, and enhanced competitive advantage.

11. Conclusion

11.1 Summary of Key Points

The integration of AI/ML-based C^3I systems with IoT-enabled trucks significantly enhances road-based supply chain efficiency by optimizing operations, improving decision-making, and increasing transparency. These technologies provide valuable insights and automation capabilities that enable supply chain managers to respond quickly and effectively to changing conditions.

Embracing these technologies is crucial for maintaining a competitive advantage and ensuring the resilience of supply chains in the face of future challenges. The benefits of integration extend beyond operational efficiency to include strategic advantages such as improved risk management, reduced costs and customer satisfaction.

Industry stakeholders should prioritize the adoption and continuous innovation of these technologies to fully realize their potential benefits. More than *70%* of all freight tonnage moved in US was by trucks and *97.4%* of all trucking in US is SMBs [13] and adoption of latest tech by these companies will revolutionize the efficiency of these operators. By investing in AI, ML, and IoT, these companies can create more efficient, resilient, and sustainable supply chains that are better equipped to meet the demands of the future while leaving a positive impact on one of the keystome industries in the US.

References

[1] Tan, A. (n.d.). Artificial Intelligence in Supply Chain Management.

[2] Korkmaz, T., & Yildiz, S. (n.d.). Logistics 4.0: Digital Transformation of Supply Chain Management.

[3] Dey, N., et al. (n.d.). Internet of Things and Big Data Analytics Toward Next-Generation Intelligence.

[4] Ahmed, Bilal & Shuja, Mirza & Mishra, Hari & Qtaishat, Ahmed & Sharma, Mukesh. (2023). IoT Based Smart Systems using Artificial Intelligence and Machine Learning: Accessible and Intelligent Solutions. 1-6. 10.1109/ISCON57294.2023.10112093.

[5] Zantalis F, Koulouras G, Karabetsos S, Kandris D. A Review of Machine Learning and IoT in Smart Transportation. *Future Internet*. 2019; 11(4):94. https://doi.org/10.3390/fi11040094

[6] Pathik N, Gupta RK, Sahu Y, Sharma A, Masud M, Baz M. AI Enabled Accident Detection and Alert System Using IoT and Deep Learning for Smart Cities. *Sustainability*. 2022; 14(13):7701. https://doi.org/10.3390/su14137701
[7] Biswas A, Wang HC. Autonomous Vehicles Enabled by the Integration of IoT, Edge Intelligence, 5G, and Blockchain. Sensors (Basel). 2023 Feb 9;23(4):1963. doi: 10.3390/s23041963. PMID: 36850560; PMCID: PMC9963447.
[8] Trends in AI, ML, and IoT in Logistics and Supply Chain Management. Gartner Reports (2023)
[9] Sal Arora, Wigbert Böhm, Kevin Dolan, Rebecca Gould, Scott McConnell. Resilience in Transport and Logistics (McKinsey Research). 2020 Feb 4
[10] Deloitte Insights. (2023). Articles and Reports on Digital Transformation in Supply Chains, Including the Use of AI and IoT.
[11] Krishnan, M. & Khastgir, A. (2024). Enhancing Supply Chain Efficiency to Build Next-Gen Artificial Intelligence (AI)/Machine Learning Network Through AI-Driven Forecasting. *International Journal of Supply Chain Management, 13*(3), 28-41, https://doi.org/10.59160/ijscm.v13i3.6244
[12] Singh, P. K., 2023. Digital Transformation in Supply Chain Management: Artificial Intelligence (AI) and Machine Learning (ML) as Catalysts for Value Creation. *International Journal of Supply Chain Management, 12*(6), 57-63, https://doi.org/10.59160/ijscm.v12i6.6216
[13] https://worldmetrics.org/us-trucking-industry-statistics/