Working Paper 2025.1.6.1

- Vol. 1, No. 6

TRÍ TUỆ NHÂN TẠO TRONG QUẢN LÝ CHUỖI CUNG ỨNG: TRƯỜNG HỢP ỨNG DỤNG AI CỦA FPT SOFTWARE CHO CÁC DOANH NGHIỆP KHÁCH HÀNG

Đinh Thanh Ngân[1], Trần Thị Ngọc Linh, Nguyễn Phạm Thục Nhi, Phan Lê Hà Nhi, Nguyễn Ngọc Phương

Sinh viên K61 CLC Kinh doanh quốc tế – Viện Kinh tế & Kinh doanh quốc tế

Trường Đại học Ngoại thương, Hà Nội, Việt Nam

Nguyễn Thị Yến

Giảng viên Viện Kinh tế & Kinh doanh quốc tế

Trường Đại học Ngoại thương, Hà Nội, Việt Nam

Tóm tắt

Bài nghiên cứu nhằm tìm hiểu vai trò của trí tuệ nhân tạo (AI) trong quản lý chuỗi cung ứng, đặc biệt là các ứng dụng AI của FPT Software đối với các doanh nghiệp khách hàng. AI đang ngày càng được áp dụng rộng rãi trong các hệ thống quản lý chuỗi cung ứng để tối ưu hóa hoạt động, giảm chi phí và cải thiện quá trình đưa ra quyết định. Nghiên cứu sử dụng dữ liệu thứ cấp để phân tích các ứng dụng AI mà FPT Software đã phát triển, bao gồm tối ưu hóa kho, quản lý yard, theo dõi tự động và kiểm tra chất lượng, nhằm nâng cao hiệu quả hoạt động và tăng cường sự hài lòng của khách hàng. Qua đó, bài nghiên cứu sẽ đưa ra những khuyến nghị về việc áp dụng AI trong chuỗi cung ứng cho các doanh nghiệp Việt Nam, nhằm tối ưu hóa quy trình và công việc vận hành.

Từ khoá: trí tuệ nhân tạo, quản lý chuỗi cung ứng, FPT Software, ứng dụng AI, tối ưu hóa

[1] Tác giả liên hệ, Email: k61. 2212550049@ftu.edu.vn

ARTIFICIAL INTELLIGENCE IN SUPPLY CHAIN MANAGEMENT: THE CASE OF FPT SOFTWARE'S AI APPLICATIONS FOR BUSINESS CLIENTS

Abstract

This paper aims to explore the role of Artificial Intelligence (AI) in supply chain management, with a particular focus on FPT Software's AI applications for business clients. AI technologies are increasingly integrated into supply chain systems to optimize operations, reduce costs, and enhance decision-making. The study utilizes secondary data to analyze AI applications developed by FPT Software, including warehouse optimization, yard management, auto-tracking, and visual inspection systems, to improve operational efficiency and increase customer satisfaction. Through this analysis, the paper will provide recommendations for Vietnamese businesses on adopting AI technologies to optimize their supply chain processes and achieve greater operational success.

Keywords: Artificial Intelligence, supply chain management, FPT Software, AI applications, optimization

1. Introduction

The advancement of Artificial Intelligence (AI) has significantly transformed various industries, with Supply Chain Management (SCM) being one of the most impacted areas. As businesses strive to optimize operations, reduce costs, and improve decision-making, AI technologies are increasingly integrated into SCM systems to enhance efficiency and performance. From predictive analytics to robotics and machine learning, AI helps address the complex challenges faced by modern supply chains.

In Vietnam, companies like FPT Software are leading the way in leveraging AI to provide innovative solutions for businesses looking to streamline supply chain processes. With a deep understanding of AI's potential, FPT Software has developed tailored AI applications to help businesses manage inventory, forecast demand, optimize routes, and enhance customer satisfaction.

This paper explores the role of AI in supply chain management, focusing on FPT Software's AI applications for business clients. The study will examine key AI technologies, their applications in SCM, and the effectiveness of these solutions in improving supply chain performance. Additionally, recommendations will be provided for Vietnamese businesses on adopting AI technologies to optimize their supply chain operations.

This study aims to offer a comprehensive understanding of how AI can revolutionize supply chain management and provide valuable insights for organizations looking to leverage AI for operational success.

2. Theoretical background

2.1. Supply chain and supply chain management

A supply chain is defined as "a set of three or more entities (organizations or individuals)" also known as parties, taking part in both the upstream and downstream processes related to products, services, money, and information, moving from the source to the customer (Mentzer et al., 2001). The supply chain involves all parties, whether directly or indirectly, that contribute to fulfilling a customer's needs. The supply chain includes not only the manufactures and suppliers, but also transporters, warehouses, retailers, and even customers themselves (Chopra & Meindl, 2010).

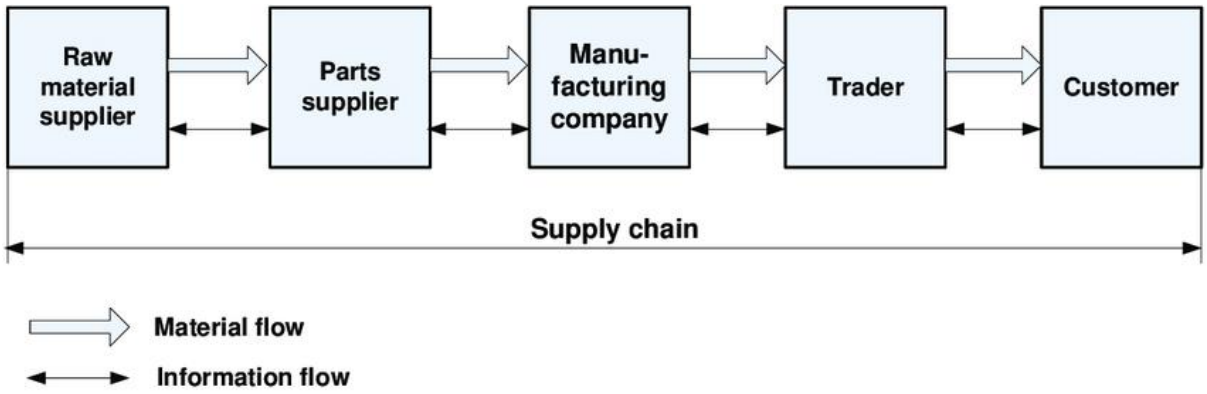

Figure 1. Material and information flow in the supply chain

Source: Logistic aspects of Industry 4.0

Efficient supply chain management (SCM) is crucial for gaining and maintaining a competitive advantage. SCM oversees the flow of materials, information, and funds across the entire chain, from upstream to downstream members, and handles material disposal according to environmental regulations. The goal is to achieve the lowest costs and highest efficiency (Dubey et al., 2012). According to Sebastian Kot (2013), "Supply chain management is the coordination of production, inventory, location, and transportation processes among the participants in a supply chain to achieve the best supply chain efficiency and customer satisfaction." SCM goes beyond logistics and internal planning; it includes strategic decisions such as inter-organizational matters and managing relationships between suppliers and customers (Chen and Paulraj, 2004).

2.2. Artificial Intelligence in supply chain management

Artificial intelligence (AI) refers to the intelligence demonstrated by artificial entities to solve complex problems, typically implemented through computers or machines (Geogre, 2009). AI enables machines to perform cognitive functions that replicate human behavioral patterns. It plays a crucial role in automating and digitizing supply chain operations, significantly transforming modern business practices (Shyla, 2024).

2.2.1. Types of AI technologies in supply chain management

Machine learning

Machine learning (ML) is a branch of AI that focuses on developing algorithms capable of learning from data and performing tasks without explicit programming (Arthur, 1959). ML

enables predictive capabilities that can identify complex manufacturing patterns and support tasks such as predictive maintenance, process optimization, and supply chain management. It helps analyze supply chain partners' information-sharing behaviors, enhancing partnerships (Rai, 2021), and can predict demand fluctuations, like the bullwhip effect (Carbonneau, 2008). Deep learning, a subset of ML, enhances SCM by improving demand forecasting, inventory management, and predictive maintenance (Schulz, 2012; Lima, 2024).

Predictive analytics

Predictive analytics uses business intelligence (BI) technologies to analyze large datasets and predict future behaviors and events. In SCM, it applies these methods to enhance supply chain design, competitiveness, and the integration of business processes (Matthew, 2013). It helps anticipate events such as machinery failures, customer churn, and marketing responses.

Blockchain

Blockchain is a decentralized ledger technology that ensures secure and immutable transaction records (Morris, 2016). In SCM, it enhances transparency, security, and efficiency by providing a tamper-proof digital ledger for tracking products, verifying transactions, and reducing fraud (Shyla, 2024). Blockchain improves traceability, supports ethical sourcing, and enables real-time monitoring, improving supply chain operations.

Internet of things

The Internet of Things (IoT) connects devices equipped with sensors and software to exchange data over communication networks (Gillis, 2021). In SCM, IoT enhances real-time tracking, inventory optimization, predictive maintenance, fleet management, and warehouse automation. It improves visibility and decision-making across the supply chain (Mahmud, 2018) and integrates communication and data processing for better transport system efficiency (Xie, 2017).

Computer vision

Computer vision focuses on acquiring, processing, and analyzing digital images to extract data for practical use (Reinhard Klette, 2014). In SCM, it applies to areas like object detection, activity recognition, and warehouse automation. Computer vision systems are used for real-time monitoring, quality control, and improving the efficiency of supply chain operations (Bernd et al, 2000).

2.2.2. Trends in applying AI to SCM in businesses

AI has rapidly grown over the past decade, with investments reaching $26-$39 billion in 2016 (McKinsey, 2016). In the supply chain sector, 64% of advanced companies have integrated AI to enhance decision-making (Gartner, 2018). By 2019, AI was one of the top trends for automating processes like demand forecasting, predictive maintenance, and production planning. In 2023, advanced analytics was the second most important emerging technology after digital transformation (Gartner, 2019).

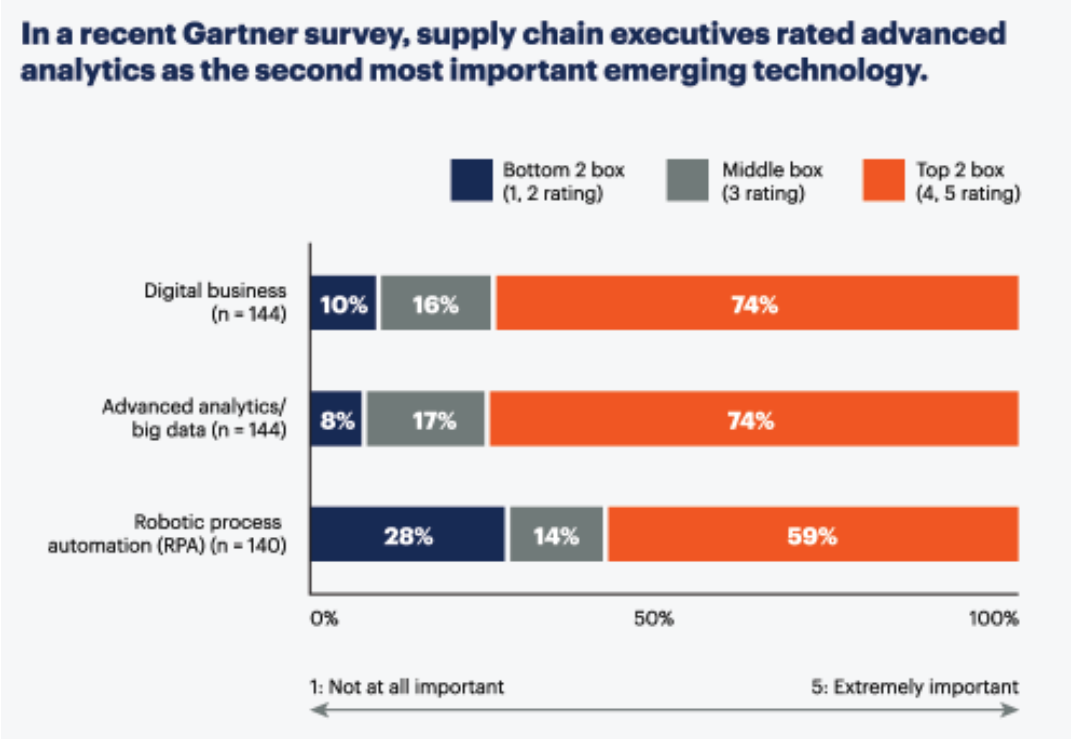

Figure 2. Importance of emerging technologies rated by supply chain executives

Source: *Gartner*

According to MMR, the AI application in the Supply Chain Market is projected to grow at a CAGR of 45.5% from 2024 to 2030. In 2023, Machine Learning was the most impactful AI tool in Supply Chain Management, followed by Computer Vision, Natural Language Processing, and Context-Aware Computing.

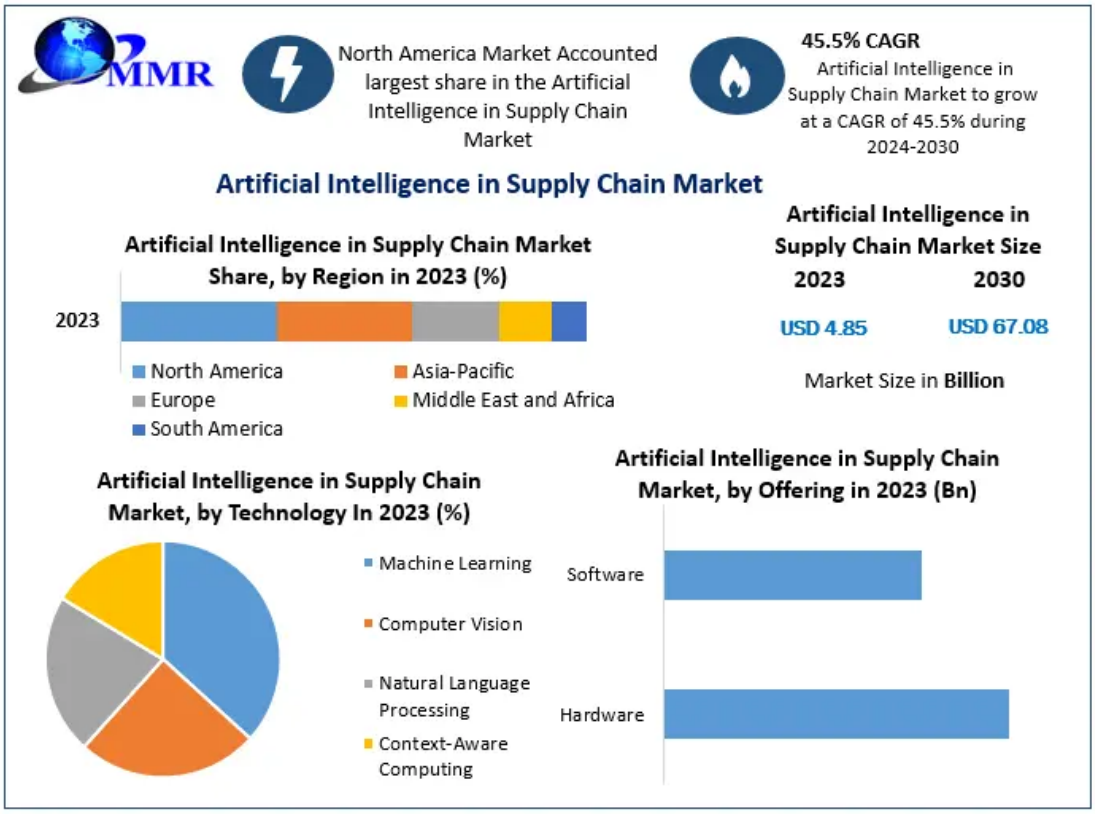

Figure 3. Artificial Intelligence in supply chain market overview

Source: *Maximize Market Research (MMR)*

3. FPT Software's AI applications for clients in supply chain management

3.1. Overview of FPT Software's AI solutions in supply chain management

FPT Software is a global IT services provider with over 33,000 employees across 86 offices worldwide (FPT Software Website). The company offers IT consultancy, digital platforms, product engineering, IT management, and other technology solutions across 30 countries in Asia Pacific, EMEA, and the Americas. It serves industries such as automotive, manufacturing, finance, healthcare, logistics, energy, and media.

FPT Software's AI-driven supply chain solutions integrate suppliers, internal teams, distributors, and customers. The company delivers digital solutions through cloud platforms and app stores for both B2B and B2C markets. AI technologies like machine learning, computer vision, and predictive analytics are embedded throughout the supply chain to automate tasks, enhance decision-making, and improve operations in logistics, inventory, and production planning.

Key AI solutions include Warehouse Optimization for improved loading and picking efficiency, a Yard Management System to reduce dispatch times and enhance communication, Auto-Tracking for Quay Cranes to streamline port operations, AI chatbots for customer service, and AI-based Visual Inspection for automated quality control in manufacturing. Through partnerships like Blue Yonder, FPT Software is helping transform supply chain management across Southeast Asia and beyond.

3.2. AI applications in FPT Software's supply chain management

FPT Software has implemented AI-driven solutions to enhance various aspects of supply chain management of its clients, both nationally and internationally. The following applications are notable examples of FPT's Software AI utilization.

3.2.1. Warehouse optimization

FPT Software's customer is a leading logistics provider specializing in electric precision parts, OA machinery, telecommunication equipment, electronics, and machine parts. Despite its leadership, the company faced inefficiencies in warehouse operations, especially during the goods picking phase, due to the lack of an automated system for space management and loading, affecting speed and cost-effectiveness.

The main challenge was slow and labor-intensive goods picking across multiple warehouses. Outdated rules for loading goods led to suboptimal placements and longer picking times. Staff also struggled to locate items, causing delays and higher costs. The absence of real-time space insights worsened loading decisions and storage inefficiencies.

To address these issues, FPT developed an Automated Data Analytics solution combining AI-driven recommendations with real-time space analysis. The solution focused on two components: (1) an AI model for optimized goods loading and (2) an automated system for real-time warehouse space calculation. By analyzing historical data, FPT identified loading inefficiencies as a key cause of extended picking times. The solution improves loading operations, reduces picking time, and optimizes warehouse workflows, fully integrating with the customer's existing Warehouse Management System (WMS) for seamless adoption.

FPT's Warehouse Optimization solution consists of two integrated modules:

- *Warehouse space calculation module* – Utilizing real-time inventory data and machine learning algorithms, this module continuously scans and calculates available space across warehouse zones, providing accurate, up-to-date information to operators.
- *AI-powered loading recommendation engine* – This AI-driven engine analyzes the current warehouse status, types of goods, and storage conditions to generate optimal loading strategies. It recommends specific shelf placements designed to minimize retrieval time and streamline picking operations.

The entire solution is connected to the customer's centralized WMS, enabling real-time updates, automated loading recommendations, and continuous feedback loops for system learning and refinement. Additionally, a dashboard provides warehouse managers with actionable insights, including heatmaps of underutilized zones and predictive analytics on future space availability.

FPT Software's Warehouse Optimization solution led to significant operational improvements. Picking time was reduced by 15%, and the AI recommendation engine achieved 91.5% accuracy in optimal goods placement, enhancing warehouse flow and productivity. Automation reduced reliance on manual processes, allowing staff to focus on higher-value tasks. Operational costs decreased with faster turnaround times and lower labor needs. Real-time analytics and continuous optimization positioned the customer for long-term success, improving customer satisfaction through faster and more reliable deliveries.

3.2.2. Yard Management System

FPT Software's customer is the Vietnamese branch of a global FMCG manufacturer with

a large distribution network. Despite its strong presence, the customer faced inefficiencies in yard operations due to manual dispatching and outdated communication methods, impacting loading times, labor costs, and safety. This highlighted the need for a semi-automated yard management system to improve workflows, safety, and reduce costs.

The dispatching process was manual and inefficient, taking 2–4 hours per truck. At the dispatch gate, parcels were manually verified, causing delays and reduced throughput. Additional costs arose from pallet rentals and forklift usage, which also increased the risk of accidents. Drivers could only identify their dispatch gate after entering the yard, leading to internal congestion and long wait times. Poor communication, relying on slow emails and phone calls, further contributed to operational inefficiencies.

FPT developed a semi-automated Yard Management System (YMS) using Computer Vision and AI technology to address operational challenges. The system automates parcel verification by scanning and validating SKU numbers, eliminating manual checks. To reduce forklift reliance, it recommends using conveyor belts for offloading parcels. The YMS also automates parcel counting, dispatch notifications, and task management with AI, improving speed and accuracy. Additionally, it enhances communication between hauliers, drivers, and accounting teams through an integrated notification system.

The Yard Management System integrates Computer Vision, AI-driven automation, and real-time task management. It automatically scans and matches each parcel's SKU with picking slips, ensuring fast and accurate validation. The system triggers automated dispatch notifications to hauliers and drivers, providing gate numbers and loading schedules before they enter the yard, reducing congestion. Conveyor belts replace forklifts in the loading process, reducing operational risks and cutting pallet rental costs. A centralized dashboard offers real-time data on dispatch statuses, parcel verification, and task assignments, while streamlining communication among stakeholders.

FPT's Yard Management System significantly improved operational efficiency. Dispatching time per truck was cut by 50%, and the forklift stage was mostly eliminated, saving on costs and enhancing safety. The system improved truck flow and allowed drivers to receive gate assignments in advance, reducing congestion and stress. Automated notifications streamlined communication, reducing errors and speeding up the dispatch workflow. Overall, the system optimized resources, lowered costs, and created a safer, more efficient yard environment.

3.2.3. Auto-tracking of quay crane for lighter

FPT's customer is a leading international multipurpose port in Singapore, handling millions of tons of cargo annually. Despite using advanced technology, the port faced issues with manual tracking of quay crane lifts, leading to billing discrepancies, inefficiencies, and operational delays. To address this, the customer needed an automated lift tracking system to improve accuracy and optimize processes.

The customer struggled with inefficiencies in tracking and billing due to manual recording, which led to inaccurate lift counts and billing mismatches. Resolving discrepancies took 30 to 60 minutes, further delaying operations. The reliance on manual documentation also increased the risk of human errors, and without an automated system, management lacked real-time visibility into crane operations, hindering optimization.

To address these challenges, FPT developed an Auto-Tracking of Quay Crane solution using advanced Computer Vision and IoT sensor technologies for automated lift counting and

monitoring. This AI-powered system ensures accuracy, eliminates manual errors, and enhances billing transparency. It captures all crane operations in real-time, categorizing lifts into chargeable and non-chargeable using AI analytics. Integrated with the port's data lake, it enables live monitoring, reporting, and optimization analysis. The system eliminates billing disputes by accurately determining chargeable lifts and reduces transaction tracing time from 30-60 minutes to just 5 minutes, while optimizing crane utilization and logistics flow.

FPT's Auto-Tracking of Quay Crane solution integrates AI, IoT sensors, and real-time data streaming to enhance operational efficiency. High-resolution cameras and IoT sensors on quay cranes capture each lift, while machine learning algorithms classify lifts into chargeable and admin categories for accurate tracking. The data is securely transmitted to the port's centralized data lake for real-time analysis and integration with automated billing systems, ensuring precise, dispute-free invoicing. Additionally, port operators benefit from a real-time visualization dashboard that provides lift counts, transaction logs, and crane performance metrics for improved monitoring and decision-making.

FPT's Auto-Tracking of Quay Crane solution greatly improved accuracy, efficiency, and transparency. It ensures 100% accuracy in lift counting, eliminating billing mismatches, and reduces transaction tracing time by 95%, from 30–60 minutes to just 5 minutes. Real-time crane visibility optimizes operations and enhances decision-making. Digital records increase transparency and accountability, building customer trust. The solution leverages AI and IoT technologies to streamline operations, reduce costs, and improve service efficiency.

3.2.4. AI-powered logistics chatbot

The customer is one of Vietnam's largest port operators, ranked among the top 25 ports globally, handling millions of tons of cargo annually. They offer import/export logistics, customs clearance, and cargo handling services. However, their customer service process was inefficient, relying on emails, chat, and direct calls, leading to inconsistent responses, high call volumes, and long wait times. To improve efficiency, the port sought an AI-driven chatbot solution to automate interactions, standardize responses, and provide 24/7 support.

The port faced issues with unstandardized communication, high call volumes, and slow response times. The lack of 24/7 support and a structured escalation system also delayed problem resolution. To address these challenges, the port needed an AI-powered chatbot to provide fast, accurate, and consistent support.

FPT developed an AI-powered chatbot to provide instant, standardized responses in both Vietnamese and English, ensuring a professional and efficient customer service experience. The chatbot automatically handles inquiries related to import/export procedures, customs documentation, and order tracking, significantly reducing response times. When the chatbot cannot answer a query, it immediately escalates the case to an administrator, ensuring smooth issue resolution. Additionally, by operating 24/7, the chatbot eliminates the reliance on human staff for routine questions, allowing employees to focus on complex customer concerns.

The chatbot leverages Natural Language Processing (NLP), AI-driven automation, and machine learning to continuously improve its ability to understand and respond to customer inquiries. It is integrated with the port's database, allowing real-time access to shipment status, customs regulations, and logistics tracking. The system also includes a centralized management dashboard, giving administrators full visibility into customer inquiries and chatbot performance. Over time, the chatbot learns from interactions, improving its accuracy and adaptability to customer needs.

The AI chatbot has revolutionized customer service by providing instant responses within one second, ensuring 100% standardized answers, and reducing inquiry handling time by 95%. Its 24/7 availability has eliminated long wait times, boosting customer satisfaction, while the automated escalation system efficiently manages complex issues. By automating repetitive inquiries, the chatbot has freed up human employees to focus on higher-value tasks, improving productivity. FPT's solution has helped the port modernize its customer service, enhance transparency, and establish itself as a leader in digital transformation in the maritime industry.

3.2.5. AI-powered visual inspection

The customer is one of Vietnam's largest manufacturing and logistics companies, specializing in warehousing, supply chain management, and production operations. Handling thousands of shipments daily, they ensure product quality before goods enter the warehouse or leave the production line. However, their manual quality inspection process became inefficient as the business grew, leading to higher costs, slower processing, and increased errors. To improve efficiency, the company sought an AI-driven solution to automate inspections and reduce human resource dependency.

The manual inspection process was labor-intensive, leading to high costs, slow processing times, and errors. This caused delays in warehouse intake and shipments, impacting supply chain efficiency. As production volumes increased, the manual approach became impractical, creating bottlenecks. The company needed an AI-powered solution to automate defect detection, speed up processing, and improve inspection accuracy.

FPT developed an AI-driven visual recognition system to automate product inspection and improve quality control across warehouses and production lines. The system uses advanced AI algorithms to detect defects like dents or crushed packaging in real time. Integrated with smart cameras, it monitors goods continuously, ensuring consistent quality and reducing human intervention. The solution is adaptable to various product types, allowing businesses to tailor it to their needs.

The system combines deep learning, computer vision, and IoT-enabled cameras to detect defects. It captures real-time product images, which AI algorithms analyze for abnormalities and categorize defects. The self-learning system improves accuracy over time, with all data stored and visualized on a centralized dashboard for process optimization.

By implementing FPT's AI-powered inspection system, the customer reduced inspection time by 30-40%, sped up warehouse intake and outbound shipments, and cut human resource needs by 70%. The system improved defect detection accuracy, minimized quality issues, and optimized the supply chain, positioning the customer as a leader in smart manufacturing.

3.3. Evaluation of the effectiveness of FPT Software's AI solutions for clients

FPT Software's AI-driven solutions have demonstrated significant effectiveness in enhancing the supply chain operations of its diverse clientele across multiple industries, including logistics, FMCG, and seaport operations. The following key factors highlight the impact and overall success of these AI implementations:

Business impact

FPT Software's AI customized solutions focus on enhancing efficiency and reducing costs through automation, improved accuracy, and minimized human intervention. All solutions significantly reduce processing time (by 15-50%) while optimizing workflows, leading to lower operational and labor costs, with up to 70% workforce reduction in inspection tasks. AI-

driven automation also enhances accuracy, achieving 91.5% to 100% precision, reducing errors in warehouse operations, parcel counting, and crane monitoring. These solutions are also scalable and adaptable, seamlessly integrating into various logistics and warehouse functions. Overall, they enable faster, cost-effective, and more accurate supply chain operations.

For process efficiency, automating manual tasks and enhancing decision-making through real-time data analytics were applied. The automation of processes such as parcel verification, goods loading recommendations, and lift tracking has significantly freed up human resources, allowing workers to focus on higher-value tasks. This shift not only boosts workforce productivity but also reduces labor-intensive bottlenecks and promotes a safer work environment, particularly in yard and warehouse operations. The integration of AI models with real-time data analytics provides clients with actionable insights through dashboards and visualization tools. These systems empower warehouse managers, yard operators, and port authorities to make data-driven decisions regarding space allocation, truck dispatching, and resource utilization, leading to optimized supply chain workflows and enhanced customer satisfaction.

Technical performance

The solutions prioritize high accuracy and real-time responsiveness to optimize supply chain operations. The Auto-Tracking of Quay Crane solution achieves 100% accuracy in lift counting, while Warehouse Optimization ensures 91.5% precision, minimizing errors and improving efficiency. In addition, the Chatbot in Logistics enhances speed and responsiveness, delivering instant replies within one second, significantly improving customer interactions. These solutions highlight a common trend of leveraging AI for both precision and speed, ensuring seamless, error-free, and efficient operations in logistics and supply chain management.

Integration & Compatibility

Scalability and adaptability were focused to meet diverse operational needs. The AI-Powered Visual Inspection system showcases high flexibility, allowing it to accurately inspect products of various shapes, sizes, and categories. The modular nature of the AI systems allows for future expansion and continuous learning through feedback loops. This adaptability ensures seamless integration into different manufacturing and logistics processes, making it a versatile and scalable solution for businesses looking to enhance efficiency while maintaining quality standards.

User adoption & Usability

FPT solutions prioritize user adoption and ease of use to boost operational efficiency. The Chatbot in Logistics enhances customer interactions with structured, consistent responses, improving customer experience and reducing the workload on human agents, making the system more efficient for both businesses and customers.

Clients reported faster, more reliable service delivery, strengthening customer trust. By addressing issues like delivery delays, billing disputes, and inefficiencies, FPT's AI-powered systems improved service levels, giving clients a competitive edge. Masahiro Hayashi, Former President of Hitachi Solutions, praised FPT's skilled team and long-term partnership, expressing interest in expanding beyond software outsourcing.

4. Recommendations for Vietnamese businesses

4.1. AI adoption strategies for supply chain optimization

For businesses aiming to modernize their supply chain, adopting Artificial Intelligence (AI) is crucial. FPT Software's success stories show how AI improves efficiency, reduces costs, and enhances decision-making across logistics, FMCG, and port operations. Key AI strategies to optimize supply chain management include:

Demand forecasting and inventory optimization: AI models forecast demand by analyzing historical sales and patterns. FPT's warehouse optimization achieved 91.5% accuracy in storage location recommendations, improving space utilization and reducing warehousing costs.

Intelligent warehouse automation: AI optimizes picking, loading/unloading, and layout planning. FPT's AI solution reduced picking times by 15%, enhancing throughput and worker safety.

AI-based yard and route optimization: AI improves yard operations and transportation routes. FPT's Yard Management System reduced dispatching times by 50% by recommending optimal parking and schedules, while AI route optimization reduces costs and carbon footprint.

AI-enhanced customer service and shipment tracking: AI chatbots provide real-time updates, improve transparency, and strengthen customer trust. FPT's AI-driven automation reduced billing disputes by ensuring data accuracy.

Data-driven decision-making and visualization: AI tools offer real-time insights and visualization, enabling businesses to respond quickly to disruptions, bottlenecks, and demand fluctuations, driving informed decision-making.

4.2. Challenges and policy recommendations for AI implementation

4.2.1. Challenges in AI implementation

AI implementation in supply chain management improves demand forecasting, reduces inventory costs, and enhances productivity. However, several challenges need addressing for successful adoption.

A major challenge is data quality and integration. Many organizations still use legacy ERP and warehouse management systems (WMS), which are not designed for AI, creating data inconsistencies. 55% of supply chain leaders cite integration with existing technology as a key hurdle (Gartner, 2023).

Another issue is the shortage of skilled personnel. 48% of companies report a lack of talent in data science, machine learning, and AI engineering (Gartner, 2023), slowing AI adoption and increasing reliance on third-party vendors.

High implementation costs also pose a barrier, with custom AI solutions costing up to $200 million (Taylor, 2025) for infrastructure, software, and training. Ongoing costs and rapid technology evolution add financial strain (Raj, 2024).

Employee resistance to AI adoption is also significant. 62% of managers report employee concerns about job security due to AI (Jordan, 2024), and 48.5% of organizations cite resistance as an obstacle (Dungay, 2024). Poor communication and insufficient training further contribute to this reluctance.

4.2.2. Policy recommendations

To promote AI adoption in supply chain management, the Vietnamese government and businesses must address challenges while fostering sustainable development. Key recommendations for Vietnam include:

First, the government should establish *national AI standards and regulations*, focusing on data governance, AI ethics, and cybersecurity. This would provide clear guidelines for supply chain management, similar to Singapore's AI Governance Framework, boosting business confidence in AI deployment.

Second, strengthening *public-private partnerships (PPP)* to build AI infrastructure is crucial. Collaborations with the private sector can help invest in cloud computing platforms and AI research centers, easing the financial burden on small and medium-sized enterprises (SMEs) and accelerating AI adoption in logistics and manufacturing.

Finally, the government should encourage *sustainable AI practices*. Policies can incentivize AI applications that reduce carbon emissions and optimize logistics, aligning with Vietnam’s commitment to net-zero emissions by 2050 and global ESG standards.

5. Conclusion

In conclusion, the integration of Artificial Intelligence (AI) in supply chain management offers businesses a transformative opportunity to improve efficiency, reduce costs, and enhance decision-making. FPT Software’s AI applications, such as warehouse optimization and logistics chatbots, have proven effective in addressing supply chain challenges and delivering improvements in accuracy, speed, and customer satisfaction. However, challenges like data quality, high implementation costs, and workforce resistance remain. To overcome these, Vietnamese businesses must adopt structured AI strategies, invest in workforce development, and collaborate with the government to establish supportive policies. By embracing AI, businesses can gain a competitive edge and ensure long-term success.

REFERENCES

Ahn, S.H., Lee, Y.H., Hwang, M.K. and Cho, D.W. (2012). A framework for measuring performance of service supply chain management. *The 40th International Conference on Computers & Industrial Engineering*, 62(3), pp.801–818. doi:https://doi.org/10.1109/iccie.2010.5668196.

Amar, J., Rahimi, S., Surak, Z. and Bismarck, N.V. (2022). 'AI-driven operations forecasting in data-light environments', *McKinsey & Company*. Available at: https://www.mckinsey.com/capabilities/operations/our-insights/ai-driven-operations-forecasting-in-data-light-environments (Accessed: 25 February 2025).

Awasthi, S. (2024). *Artificial Intelligence in Supply Chain Management*. Available at: https://www.researchgate.net/publication/382921023_Artificial_Intelligence_in_Supply_Chain_Management (Accessed: 19 March 2025).

Baig, A., Khan, S. and Gardezi, S.E. (2024). 'Singapore's Model AI Governance Framework', *Securiti*. Available at: https://securiti.ai/singapore-model-ai-governance-framework/ (Accessed: 27 February 2025).

Banerjee, A. (2024). 'South Korea Industry 4.0 Market Size, Share & Trends Analysis Report By Technology (Industrial Robots, Blockchain, Industrial Sensors, Industrial 3D Printing, Machine Vision, HMI, AI in Manufacturing, Digital Twin, AGVs, Machine Condition Monitoring), By End-User (Aerospace and Defense, Automotive, Energy and Utilities, Food and Beverages, Manufacturing, Oil and Gas) and Forecasts, 2024-2032', *Straits Research*. Available at: https://straitsresearch.com/report/industry-4.0-market/south-korea?utm_source=chatgpt.com (Accessed: 27 February 2025).

bctn2023.fpt.com. (n.d.). *FPT Annual Report 2023*. [online] Available at: https://bctn2023.fpt.com/en (Accessed: 25 February 2025).

Capgemini. (2022). *Intelligent Supply Chain*. Available at: https://prod.ucwe.capgemini.com/wp-content/uploads/2022/12/Report-Intelligent-Supply-Chain.pdf (Accessed: 25 February 2025).

Carbonneau, R., Laframboise, K. and Vahidov, R. (2008). 'Application of machine learning techniques for supply chain demand forecasting', *European Journal of Operational Research*, 184(3), pp. 1140–115. (Accessed: 19 March 2025).

Chen, I.J. and Paulraj, A. (2004). 'Understanding supply chain management: critical research

and a theoretical framework', *International Journal of Production Research*, 42(1), pp. 131-163. (Accessed: 18 March 2025).

Chopra, S. and Meindl, P. (2001). *Supply Chain Management: Strategy, Planning, and Operations*. Upper Saddle River, NJ: Prentice-Hall. (Accessed: 17 February 2025)

Dubey, R., Singh, T. and Tiwari, S. (2012). 'Supply chain innovation is a key to superior firm performance: An insight from Indian cement manufacturing', *International Journal of Innovation Science*, 4(4), pp. 217-230. (Accessed: 18 March 2025).

Dungay, D. (2025). 'Bridging the AI Adoption Gap: Employee Resistance and High Costs Remain a Challenge', *UC Today*. Available at: https://www.uctoday.com/unified-communications/bridging-the-ai-adoption-gap-employee-resistance-and-high-costs-remain-a-challenge/ (Accessed: 26 February 2025).

Elsabbagh, R. (2024). *AI in Supply Chain Optimisation: Unlocking Efficiency with Real-World Applications*. [online] ProfileTree. Available at: https://profiletree.com/ai-in-supply-chain-optimisation/ (Accessed: 27 February 2025).

Eni, L.N., Groenewald, E.S., Hamidi, I.A. and Garg, A. (2024). *Optimizing supply chain processes through deep learning algorithms: A managerial approach*. Available at: https://www.researchgate.net/publication/378518191_Optimizing_Supply_Chain_Processes_through_Deep_learning_Algorithms_A_Managerial_Approach (Accessed: 19 March 2025).

FIS EN. (2024). *FPT IS partners with GONSA to build a technological 'highway' for the pharmaceutical industry - FPT IS - EN*. [online] Available at: https://fpt-is.com/en/fpt-is-partners-with-gonsa-to-build-a-technological-highway-for-the-pharmaceutical-industry/ (Accessed: 27 February 2025).

FPT Software. (2024). *FPT Software Partners with Blue Yonder to Transform Supply Chain Management Across Southeast Asia*. [online] Available at: https://fptsoftware.com/newsroom/news-and-press-releases/press-release/fpt-software-partners-with-blue-yonder-to-transform-supply-chain-management (Accessed: 27 February 2025).

Futurism Technologies. (2023). *The Role of AI in Supply Chain Management: A Futurism Advisory*. [online] Available at: https://www.futurismtechnologies.com/blog/the-role-of-ai-in-supply-chain-management-a-futurism-advisory/ (Accessed: 27 February 2025).

Gartner, Inc. (2019). *Gartner identifies the top 8 supply chain technologies*. Available at:

https://www.gartner.com/en/newsroom/press-releases/2019-04-24-gartner-identifies-the-top-8-supply-chain-technology-0 (Accessed: 20 February 2025).

Gartner, Inc. (2023). *Generative AI for Supply Chain: Usage, Expectations & Roadblocks*. Available at: https://www.gartner.com/peer-community/oneminuteinsights/omi-generative-ai-supply-chain-transformation-zoo (Accessed: 25 February 2025).

International Link Distribution. (2018). *Chuỗi cung ứng dịch vụ*. [online] Available at: https://ild.com.vn/news/chuoi-cung-ung-dich-vu/ (Accessed: 27 February 2025).

Jähne, B. and Haußecker, H. (2000). *Computer Vision and Applications, A Guide for Students and Practitioners*. San Diego: Academic Press. (Accessed: 19 March 2025)

Klette, R. (2014). *Concise Computer Vision*. Berlin: Springer. (Accessed: 19 March 2025)

Kot, S. (2013). *Main issues of supply chain management*. Available at: https://www.researchgate.net/publication/266616760_MAIN_ISSUES_OF_SUPPLY_CHAIN_MANAGEMENT (Accessed: 18 March 2025).

Ludger, G. F. (2009). *Artificial Intelligence - Structures and strategies for complex problem solving*. 5th ed. Harlow: Pearson.

Mahmud, K., Town, G. E., Morsalin, S. and Hossain, M. J. (2018). 'Integration of electric vehicles and management in the internet of energy', *Renewable and Sustainable Energy Reviews*, 82, pp. 4179–4203. (Accessed: 19 March 2025)

MAXIMIZE MARKET RESEARCH. (2024). *Artificial Intelligence in Supply Chain Market - Global Industry Analysis and Forecast (2024-2030)*. [online] Available at: https://www.maximizemarketresearch.com/market-report/global-artificial-intelligence-in-supply-chain-market/63829/ (Accessed: 27 February 2025).

Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. (2001). 'Defining supply chain management', *Journal of Business Logistics*, 22(2), pp. 1-25. (Accessed: 18 March 2025)

Morris, D.Z. (2016). 'Leaderless blockchain VC fund seeks to take on Silicon Valley', *Fortune*. Available at: https://fortune.com/2016/05/15/leaderless-blockchain-vc-fund/ (Accessed: 19 March 2025).

Morris, T. (2004). *Computer Vision and Image Processing*. Basingstoke: Palgrave Macmillan. (Accessed: 20 February 2025)

National Institute of Standards and Technology (NIST). (2023). *AI Risk Management Framework*. Available at: https://www.nist.gov/itl/ai-risk-management-framework (Accessed: 27 February 2025).

Nguyen, T.A. (2024). *Trí tuệ nhân tạo (AI) biến đổi hoạt động quản lý, vận hành kho trong thế kỷ 21 - FPT Digital*. [online] FPT Digital. Available at: https://digital.fpt.com/chuyen-doi-so/tri-tue-nhan-tao-ai-bien-doi-hoat-dong-quan-ly-van-hanh-kho-trong-the-ky-21.html (Accessed: 27 February 2025).

Nguyen, T.H. (2024). *Trends in the application of Artificial Intelligence in businesses*. [online] FIS EN. Available at: https://fpt-is.com/en/insights/trends-in-the-application-of-artificial-intelligence-in-businesses/ (Accessed: 27 February 2025).

Nguyen, T.N.P. (2019). *The Supply Chain Sector: How AI has Penetrated into This Emerging Market?* [online] FPT Software. Available at: https://fptsoftware.com/resource-center/blogs/the-supply-chain-sector-how-ai-has-penetrated-into-this-emerging-market#section8 (Accessed: 27 February 2025).

Patidar, S. (2024). *AI-Driven Supply Chain Optimization: Strategies and Benefits*. Available at: https://primathon.in/blog/ai-driven-supply-chain-optimization-strategies-and-benefits/ (Accessed: 25 February 2025)

PT Transport Logistics Co.,LTD. (2019). *Đặc trưng quản lý chuỗi cung ứng dịch vụ*. [online] Available at: https://pt-logistics.com/bai-viet/dac-trung-quan-ly-chuoi-cung-ung-dich-vu.html (Accessed: 25 February 2025).

Rai, R., Tiwari, M. K., Ivanov, D. and Dolgui, A. (2021). 'Machine learning in manufacturing and industry 4.0 applications', *International Journal of Production Research*, 59(16), pp. 4773–4778. Available at: https://doi.org/10.1080/00207543.2021.1956675 (Accessed: 19 March 2025)

Raj, A. (2024). 'Beyond the Hype: 12 Real Challenges of AI in Supply Chain', *Throughput*. Available at: https://throughput.world/blog/challenges-of-ai-in-supply-chain/ (Accessed: 25 February 2025).

Ratanjee, V. and Royal, K. (2024). 'Your AI Strategy Will Fail Without a Culture That Supports It', *Gallup*. Available at: https://www.gallup.com/workplace/652727/strategy-fail-without-culture-supports.aspx (Accessed: 27 February 2025).

Sakhuja, S. and Jain, V. (2012). *SERVICE SUPPLY CHAIN: AN INTEGRATED CONCEPTUAL FRAMEWORK 216-2*. [online] Cape Town, South Africa: CIE42 Proceedings. Available at: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=c8b0a8e1601f705706772ed9db64b392bb2ff140 (Accessed: 25 February 2025).

Schulz, H. and Behnke, S. (2012). 'Deep Learning', *KI - Künstliche Intelligenz*, 26(4), pp. 395–396. (Accessed: 19 March 2025)

Shapiro, L. G. and Stockman, G. C. (2001). *Computer Vision*. Upper Saddle River, NJ: Prentice Hall. (Accessed: 20 February 2025)

Skapinyecz, R., Illés, B. and Bányai, Á. (2018). *Logistic aspects of Industry 4.0*. Available at: https://www.researchgate.net/publication/329331526_Logistic_aspects_of_Industry_40 (Accessed: 18 March 2025).

Taylor, M. (2024). 'AI Operational Efficiency: Navigating GenAI's True Cost', *Virtasant*. Available at: https://www.virtasant.com/ai-today/ai-for-less-strategic-planning-to-lower-implementation-costs (Accessed: 25 February 2025).

Tran, T.M. (2023). *4 Key Considerations to Select the Best SAP S/4HANA Cloud Partner*. [online] FPT Software. Available at: https://fptsoftware.com/resource-center/blogs/4-key-factors-to-select-the-best-sap-s4hana-cloud-partner#section4 (Accessed: 27 February 2025).

Turner, J. (2024). 'AI's Impact on the Workplace: A Survey of American Managers', *theHRD*. Available at: https://www.thehrdirector.com/features/artificial-intelligence/ais-impact-workplace-survey-american-managers/ (Accessed: 26 February 2025).

Unival-Logistics. (2022). *What Is the Service Supply Chain? - and Why It Matters*. [online] Available at: https://unival-logistics.com/service-supply-chain (Accessed: 25 February 2025).

Van der Meulen, R. (2018). 'Improve the supply chain with advanced analytics and AI', *Gartner*. Available at: https://www.gartner.com/smarterwithgartner/improve-the-supply-chain-with-advanced-analytics-and-ai (Accessed: 20 February 2025).

Veluru, C.S. (2023). 'A comprehensive study on optimizing delivery routes through generative AI using real-time traffic and environmental data', *Journal of Scientific and Engineering Research*, 10(10), pp. 168-175. (Accessed: 27 February 2025)

Viet Chung (2024). *Hơn một thập kỷ FPT 'xây thành lũy AI'*. [online] Chungta. Available at: https://chungta.vn/multimedia/hon-mot-thap-ky-fpt-xay-thanh-luy-ai-1138466.html (Accessed: 25 February 2025).

Voitsekhivska, I. (2024). *AI in Logistics: Benefits, Applications & Leading Examples*. [online] ELIFTECH. Available at: https://www.eliftech.com/insights/ai-in-logistics-explained/ (Accessed: 27 February 2025).

Waller, M.A. and Fawcett, S.E. (2013). 'Data science, predictive analytics, and big data: A revolution that will transform supply chain design and management', *Journal of Business Logistics*, 34(2), pp. 77-84. Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/jbl.12010 (Accessed: 19 March 2025).

Xie, X.-F. and Wang, Z.-J. (2017). 'Integrated in-vehicle decision support system for driving at signalized intersections: A prototype of smart IoT in transportation', *Transportation Research Board (TRB) Annual Meeting*, Washington, DC, USA. (Accessed: 19 March 2025)

Yasar, K. and Gillis, A.S. (2024). 'What is the Internet of Things (IoT)?', *TechTarget*. Available at: https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT (Accessed: 19 March 2025).