JOURNAL OF INTERDISCIPLINARY PERSPECTIVES
PRINT ISSN: 2984-8288 | ONLINE ISSN: 2984-8385
https://doi.org/10.69569/jip

TWR Publishing

Research Article

Operations Management Assessment in the Pharmaceutical Supply Chain: A Case Study of International Pharmaceuticals, Inc. (IPI)

Joseph James V. Dinopol, Vicente S. Maravilla Jr.

Author Information:

School of Business and Economics - Graduate Programs Office, University of San Carlos, Cebu City, Philippines

Corresponding Author:

Joseph James V. Dinopol
Email: josephjamesdinopol18@gmail.com

Article History:

Date received: August 4, 2026
Date revised: October 16, 2026
Date accepted: November 3, 2026

Recommended citation:

Dinopol, J.J., & Maravilla, V., Jr. (2026). Operations management assessment in the pharmaceutical supply chain: A case study of International Pharmaceuticals, Inc. (IPI). *Journal of Interdisciplinary Perspectives, 4*(11), 312-319.
https://doi.org/10.69569/jip.2026.418

Abstract. The global pharmaceutical industry requires operational excellence amidst stringent regulations and cost pressures. This study evaluates the Operations Management (OM) practices of International Pharmaceuticals Inc. (IPI) to identify localized bottlenecks and propose data-driven operational targets. Employing a descriptive case study design, data were collected through professional interviews with two key supply chain executives and a comprehensive review of internal company documentation. Observed findings indicate that while IPI effectively applies Just-in-Time (JIT) inventory and route optimization, persistent inefficiencies exist regarding high holding costs and frequent stockouts. To address this, the study proposes targeted interventions, including the expansion of the JIT framework and a transition to a Hub-and-Spoke distribution model. These projected enhancements target a 7–10% reduction in total logistics costs and a 95% on-time delivery rate.

Keywords: *Hub-and-Spoke distribution; Just-in-Time (JIT); Logistics optimization; Operations management; Pharmaceutical supply chain.*

The global pharmaceutical industry is defined by a highly demanding landscape in which operational excellence constitutes not merely a competitive advantage but a fundamental prerequisite for organizational survival (Sharma et al., 2022). Firms in this sector must consistently deliver high-quality products while navigating stringent regulatory environments and maintaining cost competitiveness (Queiroz et al., 2022). Within this context, International Pharmaceuticals Inc. (IPI), a leading manufacturer and distributor of pharmaceutical and consumer products in the Philippines since 1959, operates at the intersection of regulatory compliance, market competition, and logistical complexity. With an extensive distribution network spanning the archipelago, IPI's capacity to fulfill its mission of providing affordable, innovative, and quality products is intrinsically tied to the efficiency of its supply chain and logistics operations.

Despite its established market presence, continuous evaluation and improvement of Operations Management (OM) practices remain critical to sustaining leadership and realizing its vision of becoming "every family's partner in health and wellness." In this regard, integrating resilience analytics into modern OM frameworks is increasingly

This work is licensed under a Creative Commons Attribution-Noncommercial 4.0 International License (CC BY-NC 4.0)

recognized as essential for achieving organizational adaptability and long-term sustainability (Golan et al., 2020).

Recent studies show that integrating Supply Chain Management (SCM) with Total Quality Management (TQM) is positively correlated with improved operational resilience, particularly when Just-in-Time (JIT) methodologies are systematically employed (Abdelraheem & Hussien, 2023). Contemporary supply chains, however, remain highly vulnerable to disruptions, necessitating advanced agile operational models to mitigate risks such as stockouts and the perishability of pharmaceutical inventory (Sharma et al., 2022; Belhadi et al., 2021).

Despite the theoretical promise of these frameworks, emerging markets often constrain implementation through manual redundancies, limited digital integration, and complex geographical routing (Kumar et al., 2021). While empirical evidence demonstrates that digital supply chain transformation and Lean Six Sigma approaches improve throughput (Tavana et al., 2024), and recent literature positions Supply Chain Quality Integration (SCQI) as a primary driver of operational excellence (Huma et al., 2024), a notable research gap persists in the localized application of these theories within large-scale domestic pharmaceutical firms.

Many organizations struggle to translate academic OM concepts into practice, resulting in hidden inefficiencies such as higher inventory holding costs, frequent stockouts, and logistics bottlenecks (Spieske & Birkel, 2021). Existing studies affirm the importance of JIT, TQM, supply chain integration, and digital transformation in enhancing resilience and competitiveness. Moreover, resilience-focused strategies are increasingly critical as firms confront uncertainty and operational risks (Golan et al., 2020), while digital technologies strengthen visibility, responsiveness, and continuity across networks (Ivanov & Dolgui, 2021). Nevertheless, much of the literature privileges multinational corporations or industry-wide systems, with limited attention to the logistics functions of domestic firms in emerging-market contexts such as the Philippines. Few studies combine managerial perspectives with organizational records to identify context-specific operational challenges and improvement opportunities.

This study addresses this gap by evaluating the logistics operations of International Pharmaceuticals, Inc. (IPI) and examining how established OM concepts can be applied to enhance efficiency, service performance, and supply chain resilience. Specifically, the research aims to assess current practices within IPI's Logistics Group, identify areas where academic frameworks can be better utilized, and propose targeted enhancements. This study is significant because it can optimize logistics operations, reduce operational expenses, and improve customer satisfaction. Furthermore, the findings will strengthen IPI's resilience and competitiveness in the pharmaceutical market while facilitating the transfer of academic knowledge into professional practice.

Research Questions

This study was guided by the following questions:

1. What operations management practices are currently utilized by IPI's Logistics Group?
2. What operational challenges and inefficiencies are evident in the firm's supply chain and logistics processes?
3. How do the existing practices align with established operations management frameworks?
4. What operational improvements may be proposed to strengthen efficiency, service performance, and supply chain resilience?

Methodology

Research Design

The study utilized a descriptive case study research design. The unit of analysis is the Logistics Group of IPI, with case boundaries strictly focused on domestic warehousing and distribution functions evaluated during the final quarter of 2024.

Participants and Limitations

The study involved two key informants: the Logistics Group Head and the Vice President for Supply Chain. A purposive sampling technique was employed because both participants possess extensive knowledge of the organization's logistics operations, inventory management practices, and supply chain strategies. Their positions enable them to provide comprehensive insights into operational policies, performance monitoring, and organizational challenges. Participants were formally invited through organizational authorization and

voluntarily agreed to participate. Each interview lasted approximately 45 to 60 minutes and was conducted using a semi-structured interview guide. To preserve confidentiality, personal identifiers were excluded from the reporting of findings. Although the participants hold strategic leadership positions and possess broad organizational knowledge, the study recognizes that their perspectives may not fully represent operational-level experiences. This limitation is acknowledged and discussed in the limitations section.

Research Instrument

The study used a researcher-developed Operations Management Assessment Guide with two components: a structured assessment checklist and a semi-structured interview guide. The instrument covered four major domains: Process Strategy and Operations, Supply Chain Management, Quality Management, and Workforce and Logistics Operations. Sample interview questions included: How does the organization plan, monitor, and replenish inventory? What operational challenges frequently affect logistics performance? What key performance indicators are currently used to evaluate supply-chain effectiveness? What improvements are being considered to enhance operational efficiency? The instrument was developed based on established operations management principles, including JIT, TQM, supply-chain integration, and logistics management frameworks. The instrument's content validity was established by aligning it with relevant academic literature and consulting operations management practitioners. Documentary evidence was used to support and verify interview responses.

Data Gathering Procedure

Data collection was conducted in late 2024 following receipt of a formal letter of authorization from the Vice President of the Supply Chain Division. The primary procedure involved professional interviews conducted with the Logistics Group Head and the Vice President to gather high-level insights into current operational practices and challenges. This qualitative data was further enriched through a comprehensive review of internal company data, including delivery logs, financial statements, sales data, and warehouse audits. The data collection process included photographic documentation of site visits and interviews.

Data Analysis Procedure

The qualitative data from interviews were analyzed using thematic analysis. Interview transcripts and notes were reviewed repeatedly to identify recurring themes related to inventory management, logistics operations, supply-chain coordination, and operational challenges. Similar responses were grouped into thematic categories and compared with documentary evidence. Documentary records and operational reports were reviewed to identify performance trends associated with inventory turnover, stockout occurrences, transportation efficiency, order fulfillment performance, and delivery reliability. To enhance trustworthiness, data triangulation was employed. Information gathered from interviews was cross-checked against available organizational records and relevant industry benchmarks. The review examined and clarified any inconsistencies identified through follow-up verification of supporting documents. The combined use of thematic analysis and documentary review enabled a comprehensive assessment of current operations management practices and identified potential areas for improvement.

Ethical Considerations

Ethical principles were observed throughout the conduct of the study. Prior to data collection, permission to conduct the research was secured from the organization's authorized representatives. Participants received information about the study's purpose, expected participation requirements, confidentiality measures, and their right to withdraw at any time without penalty. Participation was voluntary, and informed consent was obtained before each interview. Permission was also requested for note-taking, recording, and documentation activities where applicable. All collected information was treated confidentially and used solely for academic purposes. The researcher securely stored organizational records and accessed them only. Data were anonymized during analysis and reporting to minimize the possibility of identifying individual participants. As the study involved professional insights regarding organizational operations without collecting sensitive personal information, it qualified for institutional exemption from formal ethics board review under standard academic research guidelines.

Results and Discussion

The following table presents the Operations Management (OM) practices currently used at International Pharmaceuticals Inc. (IPI), detailing the concepts applied, their contribution to organizational performance, and evidence of their success.

Table 1. *Effective OM Practices in International Pharmaceuticals Inc. (IPI)*

Area of OM	Concept, Theory, and Best Practices	Contribution to Competitiveness and Performance	Performance Indicators / Evidence
Product Strategy & Supply Chain Management	Just-in-Time (JIT) Inventory: Minimizing levels by receiving materials only as needed. Strong Supplier Relationships: Ensuring timely delivery of high-quality components.	Cost Reduction: Optimizing inventory and logistics. Improved Efficiency: Reduced lead times and increased production efficiency. Increased Responsiveness: Quick response to customer demand shifts.	Inventory Turnover Rate, Lead Times, Order Fulfillment Rates, and Supply Chain Costs.
Value Chain & Supply Chain Integration	Value Chain Analysis: Identifying areas for cost optimization across all activities. Supply Chain Integration: Coordinating procurement, logistics, and production.	Enhanced Quality: High-quality products and customer satisfaction. Competitive Advantage: Faster and cheaper delivery than competitors.	Customer Satisfaction feedback on quality and service.
Process Strategy & Process Design	Product Focus: High-volume, low-variety processes with long production runs, specifically suited for standardized pharmaceutical manufacturing.	Increased Efficiency: Streamlining production and resource utilization. Cost Reduction: Achieving economies of scale.	Increased production volume, reduced production costs, and improved on-time delivery.
Quality Management	Total Quality Management (TQM): Continuous, organization-wide commitment to excellence. TQM Tools: Use of check sheets, Pareto charts, and benchmarking.	Increased Sales: Improved reputation and response times. Increased Profitability: Combined effect of higher sales and lower rework/scrap costs.	Reduced defects, lower warranty costs, and increased productivity.
Inventory Management	JIT & Forecasting: Predicting demand and receiving materials when needed. Tracking & Audits: Real-time visibility and regular record verification.	Improved Cash Flow: Freeing up capital by reducing excess inventory. Efficiency: Timely availability of materials reducing downtime. Average of 4 stockouts per quarter.	Inventory record accuracy averaged approximately 82%, with an estimated inventory turnover ratio of 5.8 times per year, an average of 4 stockout incidents per quarter, and an average replenishment lead time of 14 days.
Transportation and Delivery	Route Optimization & Vehicle Utilization: Planning efficient routes and maximizing vehicle capacity. Real-Time Tracking: GPS monitoring of shipment status.	Reduced Costs: Lower fuel consumption and transportation expenses. Reliability: Providing customers visibility and meeting delivery expectations.	On-time delivery performance averaged 86%, average delivery lead time was 48 hours, and fleet vehicle utilization averaged 75%.

Existing Operations Management Practices

IPI's approach to Supply Chain Management is centered on the Just-in-Time (JIT) philosophy and Supply Chain Integration (SCI). By minimizing inventory levels and receiving materials only as needed, the firm effectively reduces holding costs and waste. This efficiency is bolstered by strong, collaborative supplier relationships, which ensure the timely delivery of high-quality materials. Integrating procurement, logistics, and production allows IPI to respond quickly to shifts in customer demand, providing a significant competitive advantage by delivering products faster and more affordably than its rivals.

For its manufacturing operations, IPI utilizes a Product Focus strategy, which is characterized by high-volume,

low-variety production runs. This approach is specifically tailored to the pharmaceutical industry, where large quantities of standardized drugs must be mass-produced to meet strict regulatory requirements and achieve economies of scale. By streamlining these production processes, the firm reduces costs and resource utilization while maintaining high on-time delivery performance.

At IPI, quality is not merely a regulatory compliance issue but a core pillar of its competitiveness. The firm employs Total Quality Management (TQM) principles, fostering an organization-wide commitment to excellence. IPI utilizes specific TQM tools, such as check sheets, Pareto charts, and scatter diagrams, to analyze data and continuously improve processes. This focus on quality increases profitability by reducing rework and scrap costs while enhancing the company's reputation and customer satisfaction.

The interview data corroborated the findings from organizational records regarding recurring inventory and logistics challenges. One participant emphasized that:

> "*Stock availability remains a challenge during demand fluctuations despite existing forecasting procedures.*" (Participant A)

Similarly, another participant noted that:

> "*Although route optimization tools are already in place, transportation efficiency is still affected by varying delivery schedules, geographic constraints, and intermittent supplier delays.*" (Participant B)

These statements indicate that while several operations management practices have been successfully implemented, operational gaps remain that require further refinement through enhanced forecasting, supplier coordination, and performance-monitoring systems.

IPI's logistics operations are characterized by high visibility and resource optimization. In terms of Inventory Management, the firm employs advanced forecasting and tracking systems, supplemented by regular inventory audits, to ensure record accuracy and reduce the risk of stockouts. This improves cash flow by preventing excess capital from being tied up in inventory. For Transportation and Delivery, logistics efficiency is maintained through route optimization software and vehicle utilization strategies that maximize load capacity. Real-time GPS tracking provides full visibility into the delivery process, ensuring products reach every corner of the country reliably.

The success of these practices is validated through a rigorous set of Key Performance Indicators (KPIs) monitored by the Logistics Group Head and the VP of Supply Chain. These include an on-time delivery rate target of >95%, improved inventory turnover ratios, and measurable declines in logistics costs as a percentage of sales. By benchmarking performance against industry leaders and using data-driven decision-making, IPI bridges the gap between theoretical OM concepts and operational excellence.

On the Optimization of Inventory and Process Workflows

Identifying elevated holding costs and recurring stockouts highlights inventory management inefficiencies that constrain liquidity and operational responsiveness. Expanding the Just-in-Time (JIT) framework, complemented by advanced forecasting techniques, is projected to align material inflows with production requirements, thereby mitigating risks of obsolescence, a particularly salient concern in the pharmaceutical sector where product perishability is critical (Abdelraheem & Hussien, 2023). Concurrently, proposals for Process Redesign and Automation directly address bottlenecks and manual redundancies that impede order fulfillment. Interpreted through Lean and Six Sigma paradigms, these interventions signify a systematic elimination of non-value-adding activities, with anticipated outcomes of reduced cycle times and enhanced production efficiency. While the company reports existing JIT and route-optimization practices, these applications have currently not prevented stockouts or high holding costs. This discrepancy exists because applying generalized JIT practices without considering pharmaceutical product criticality, expiry dates, and cold-chain requirements increases service-level risk. Expanding JIT could aggravate these shortages unless it is explicitly paired with strict product segmentation, safety-stock rules, and supplier-risk analysis.

Table 2. *Proposed OM Enhancements for Improved Efficiency and Cost Reduction*

Operational Area	Identified Inefficiencies and Cost Indicators	Proposed Academic Concepts & Best Practices	Expected Impact on Efficiency and Costs
Inventory Management	High holding costs, frequent stockouts, inaccurate records, and capital tied up in excess stock.	Just-in-Time (JIT) System expansion, advanced forecasting techniques, and optimized replenishment policies (reorder points/quantities).	Reduced storage and obsolescence costs; improved cash flow and production efficiency.
Process Strategy & Design	Bottlenecks in workflows, unnecessary manual tasks, and inefficiencies in order fulfillment.	Process Redesign & Automation, adoption of advanced planning systems/CAD software, and Lean or Six Sigma methodologies.	Streamlined resource arrangement; reduced process cycle times and eliminated waste.
Transportation & Delivery	High fuel consumption, inefficient routes, low vehicle utilization, and lack of real-time shipment visibility.	AI-powered Route Optimization, Transportation Management System (TMS), and maximizing vehicle load capacity.	Measurable decline in logistics costs as a percentage of sales; reduced fuel expenses and improved delivery lead times.
Supply Chain Integration	Delivery delays exceeding benchmarks and inconsistent supplier performance.	Advanced Supply Chain Analytics, Supplier Relationship Management (SRM) program, and SAP digital upgrades.	Enhanced end-to-end visibility; proactive risk identification and improved supplier reliability.
Distribution Strategy	Fragmented storage and rising handling costs despite stable demand.	Hub-and-Spoke Distribution Model to centralize inventory in strategic locations.	Streamlined distribution network; significant reduction in total logistics costs (7–10% target).
Sustainability & Environmental Impact	High environmental impact and energy consumption in logistics operations.	Green Logistics Initiatives, including energy-efficient vehicles and sustainable packaging solutions.	Long-term cost savings through reduced energy consumption and waste reduction.

On the Technological and Logistics Transformation

The logistics strategy foregrounds inefficiencies in fuel consumption and delivery routing, proposing AI-enabled Route Optimization and the deployment of a Transportation Management System (TMS). These measures are interpreted as centralizing operational control while maximizing vehicle utilization, thereby reducing logistics costs relative to sales revenue. The transition toward a Hub-and-Spoke Distribution Model represents a structural reconfiguration of the network, designed to consolidate inventory in strategically located hubs (Sindhwani et al., 2023) and optimize multimodal transport under uncertain demand (Zhang et al., 2024). This redesign is projected to reduce logistics expenditures by 7–10% while accelerating delivery lead times, strengthening both profitability and customer responsiveness.

On the Strategic Integration and Sustainability

Addressing supplier inconsistency and delivery delays, the study advances the adoption of Advanced Supply Chain Analytics and a Supplier Relationship Management (SRM) program. Supported by SAP-driven digital upgrades, these initiatives enable real-time data exchange across the supply chain, facilitating proactive risk identification rather than reactive mitigation (Ivanov & Dolgui, 2021). According to Ferreira et al. (2026), green logistics initiatives contribute to long-term operational efficiency by reducing resource consumption and waste throughout supply chain activities, moving the firm closer to the 'Green Logistics 5.0' paradigm of sustainability-oriented innovation (Nicoletti & Appolloni, 2024). This sustainability commitment not only enhances regulatory compliance but also resonates with evolving consumer preferences for eco-conscious pharmaceutical firms.

On the Interpretation of Enhancement Goals

The findings indicate that IPI has established several effective operational practices, including Just-in-Time inventory management, route optimization, supply chain integration, and Total Quality Management initiatives. However, documentary evidence and participant interviews reveal persistent operational challenges, particularly in inventory accuracy, stock availability, transportation efficiency, and logistics costs.

Based on these observed conditions, the proposed interventions should be interpreted as strategic improvement initiatives rather than demonstrated outcomes. They aim to address identified weaknesses and support future organizational performance improvements. Explicit targets such as achieving a 95% on-time delivery rate and reducing holding costs by 5–10% serve as quantifiable indicators of transformation success. Implemented through a phased rollout, these proposals are expected to build a resilient, adaptive supply chain architecture. Ultimately, this strategic trajectory positions IPI to sustain its competitive advantage in the pharmaceutical market while ensuring nationwide access to wellness products.

Numerical Targets and Feasibility

The proposed strategic enhancements are guided by specific, measurable targets: a 95% on-time delivery rate and a 7–10% reduction in total logistics costs. Because these interventions have not yet been implemented, these figures are presented as proposed performance targets derived from industry benchmarking rather than definitive study findings.

7–10% Logistics Cost Reduction: This target is calculated based on the anticipated elimination of redundant storage facilities via the Hub-and-Spoke model, combined with a projected 15% decrease in fuel consumption driven by AI-powered route optimization.

95% On-Time Delivery: This target establishes a baseline improvement from the current estimated ~86% rate, achievable by implementing a Transportation Management System (TMS) to mitigate route delays and improve vehicle utilization.

Implementation Risks: The primary risks include high initial software integration costs (e.g., SAP upgrades) and resistance to change among operational personnel. To mitigate this, implementation should follow a phased, 12-to-18-month timeline overseen by the VP of Supply Chain, utilizing monthly KPI audits for evaluation.

The projected 95% on-time delivery rate and the anticipated 7-10% reduction in logistics costs are proposed performance targets, not research findings. These targets serve as managerial benchmarks to guide implementation and future evaluation and should not be interpreted as outcomes achieved during this study.

Conclusion

International Pharmaceuticals Inc. (IPI) sustains its competitive positioning through foundational OM principles. However, the analysis reveals that persistent inefficiencies in inventory holding costs and process bottlenecks constrain its operational capacity. The proposed interventions, including AI-enabled route optimization and a Hub-and-Spoke distribution model, constitute a theoretical roadmap for enhancement. If implemented and closely monitored through targeted KPIs, IPI could realize substantial cost efficiencies and strengthen supply chain resilience, ultimately supporting its mission to provide accessible wellness products nationwide.

This study has several limitations. First, the research focused on a single pharmaceutical company, which may limit the generalizability of the findings to other organizations or industries. Second, data were obtained from two senior executives whose perspectives primarily reflect strategic and managerial viewpoints. Operational personnel were not included; therefore, some front-line operational issues may not have been captured. Third, certain organizational records were confidential and could not be disclosed in full detail, limiting the presentation of specific performance metrics. Finally, the study should be interpreted as an organizational assessment rather than an evaluation of implemented interventions. The recommended operational enhancements were not executed or experimentally tested during the study period. Consequently, their anticipated benefits are based on operations management theory, industry benchmarking, and the interpretation of organizational evidence rather than direct empirical validation within IPI. Future research may evaluate the effectiveness of these interventions through longitudinal implementation studies, pilot testing, or comparative analyses across multiple pharmaceutical organizations.

Contributions of Authors

Joseph James Dinopol conceptualized the study, conducted data collection, analyzed the data, interpreted the findings, and prepared the manuscript.

Funding

No external funding was received for this study.

Conflict of Interests

The author declares no conflicts of interest.

Acknowledgment

The author thanks International Pharmaceuticals, Inc. and the participating executives for their cooperation and support during this research.

References

Abdelraheem, A.A.E., & Hussien, A.M. (2023). The effect of supply chain management on total quality management: An application of just-in-time (JIT) practices. Journal of Asian Finance, Economics and Business, 10(1), 9–17. https://doi.org/10.13106/jafeb.2023.vol10.no1.0009

Antony, J., Snee, R., & Hoerl, R. (2017). Lean Six Sigma: Yesterday, today and tomorrow. International Journal of Quality & Reliability Management, 34(7), 1073–1093. https://doi.org/10.1108/IJQRM-03-2016-0035

Belhadi, A., Kamble, S.S., Jabbour, C.J.C., Gunasekaran, A., Ndubisi, N.O., & Venkatesh, M. (2021). Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. International Journal of Production Economics, 233, 107972. https://doi.org/10.1016/j.ijpe.2020.107972

Ferreira, J.J., Fernandes, A.J.C., Nguyen, T.H.D., Rammal, H.G., & Pereira, V. (2026). Green logistics and supply chain knowledge management: An extended framework-based systematic literature review. Journal of Knowledge Management, 30(11), 168–188. https://doi.org/10.1108/jkm-04-2025-0483

Flynn, B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. Journal of Operations Management, 28(1), 58–71. https://doi.org/10.1016/j.jom.2009.06.001

Goetsch, D.L., & Davis, S.B. (2021). Quality management for organizational excellence: Introduction to total quality (9th ed.). Pearson.

Golan, M., Jernegan, L., & Linkov, I. (2020). Trends and applications of resilience analytics in supply chain management: A systematic literature review. Environment Systems and Decisions, 40(2), 222–243. https://doi.org/10.1007/s10669-020-09777-w

Heizer, J., Render, B., Munson, C., & Griffin, P. (2023). Operations management: Sustainability and supply chain management (14th ed.). Pearson.

Huma, S., Ahmed, W., Ikram, M., & Khawaja, M.I. (2022). The effect of supply chain resilience on organizational performance and competitive advantage: A review. Business Process Management Journal, 28(4), 971–995.

Huma, S., Ahmed, W., & Najmi, A. (2024). The role of absorptive capacity in driving supply chain quality integration: Insights from evolving and mature pharmaceutical supply chains. International Journal of Productivity and Performance Management. 73(9), 2841–2865.

Ivanov, D., & Dolgui, A. (2021). A digital supply chain twin for managing the ripple effect, resilience and disruption risks in supply chains. International Journal of Production Research, 59(3), 904–916.

Kumar, A., Luthra, S., Garza-Reyes, J.A., & Upadhyay, A. (2021). A framework for assessing the barriers to Industry 4.0 adoption from the perspective of supply chain management in emerging economies. International Journal of Production Research, 59(17), 5293–5311.

Nicoletti, B., & Appolloni, A. (2024). Green Logistics 5.0: A review of sustainability-oriented innovation with foundation models in logistics. European Journal of Innovation Management, 27(9), 542–561. https://doi.org/10.1108/EJIM-07-2024-0787

Queiroz, M., Ivanov, D., Dolgui, A., & Wamba, S.F. (2022). Impacts of epidemic outbreaks on supply chains: Mapping a research agenda amid the COVID-19 pandemic through a structured literature review. Annals of Operations Research, 319(1), 1159–1196. https://doi.org/10.1007/s10479-020-03685-7

Sharma, M., Kumar, A., & Singh, R. (2022). Mitigating operational risks and stockout challenges in healthcare and pharmaceutical supply chains. Operations Management Research, 15(3), 890–908.

Spieske, A., & Birkel, H. (2021). Improving supply chain resilience through Industry 4.0: A systematic literature review under the impression of the COVID-19 pandemic. Computers & Industrial Engineering, 158, 107452. https://doi.org/10.1016/j.cie.2021.107452

Tavana, M., Di Caprio, D., & Rostamkhani, R. (2024). A total quality management action plan assessment model in supply chain management using the lean and agile scores. Journal of Innovation & Knowledge, 10(1), 100633. https://doi.org/10.1016/j.jik.2024.100633

Zhang, J., Li, H., Han, W., & Li, Y. (2024). Research on optimization of multimodal hub-and-spoke transport network under uncertain demand. Archives of Transport, 70(2), 137–157. https://doi.org/10.61089/aot2024.1g17bx18