International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 17s, 2025
https://www.theaspd.com/ijes.php

Ai & Generative-Ai Control Towers: Reinventing Retail Supply Chain Management

Sudhakar Bathina

Senior Engineering Manager Albertsons Companies INC, 116200 Hunters glen Ln, Frisco, Texas – 75033
reachsudhakarbathina@gmail.com

ABSTRACT: The present paper analyzes the disruptive capabilities of AI and Generative AI-based control towers on the retail supply chain management. Conventionally, supply chain systems have to deal with divided information flow, little visibility, and slow decision-making as global retail functioning becomes increasingly complex and highly disturbed. Through the incorporation of the actual demand indicators, the state of vendors, weather predictions and data regarding the point of sale, AI-powered control towers provide a simplified, transparent image of the supply chain. Generative AI provides an additional advantage, including scenario-based planning, risk forecasting involving advanced analytics, and decision support through natural language, which allows the planners to react to arising challenges in a quick and appropriate way. Case based evidence proves high percentages of visibility, improvement in the management of disruptions, cost savings, and reduction in decision latency. The technologies also enhance supplier relation and long-term resilience and competitiveness. In spite of the obvious advantages, there are still several challenges connected with adoption such as readiness of the organization, socio-technical convergence and ethics. The paper summarizes contemporary knowledge on the potential operational and strategic usefulness of AI-based control towers within the retail industry and provides instruction on how to use them, as well as establishing a premise on which the future research on the construction of flexible, resilient, and ethically regulated supply chains within the gradually turbulent global economy can be based.

KEYWORDS: Supply Chain, AI, Retail Generative AI.

I. INTRODUCTION

The retail sector is experiencing the burgeoning pressure of demand fluctuations, globalization, geopolitical shocks, and the evolving expectations of customers all over the world. Conventional supply chain management systems that are usually composed of fragmentary data and isolated decision-making are far behind in coping with these complexities.

At that, AI and Generative AI-based control towers have become the game-changer in this situation, as its adoption could potentially change the way retailers organize, conduct, and manage their supply chain activities. AI-enabled control towers combine live information in one location, giving a complete view of the process, which includes data on vendor status, inventory, transportation status, economic trends, among other sources, and presents timely insights.

The additional value that generative AI promises is in relation to sophisticated planning in terms of scenarios, advanced decision-making support based on natural languages, and diminishing latency, helping the planners to avoid interventions through proactive disruption mitigation. The paper studies how these technologies can transform the way retail supply chain is managed in the most basic manner through efficiencies in operation management, through resiliency, and through strategic decision-making.

It presents an integrated picture of using the power of AI and Generative AI control towers and provides insights into their potential benefits, pitfalls, and strategic consequences of their implementation based on the latest research and the case studies of the industries, which have experienced the control tower approach already.

II. RELATED WORKS

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 17s, 2025
https://www.theaspd.com/ijes.php

Control Towers

The continuously growing complexity and the globalization of supply chains have exposed the weaknesses of classical supply chain management (SCM) systems that wrestle with (siloed) data, poor visibility, and inefficiency forecasting systems.

Intelligent supply chain control towers (SCCTs) generated by artificial intelligence (AI) and Generative AI (GenAI) have become the answer to those challenges. These sophisticated platforms offer a complete visibility integration of real-time sources of data like demand signals, supplier communication or transportation update that increase the speed and accuracy of decision-making.

It is indicated in one study that the combination of GenAI with intelligent control trees provides a dynamic framework that has the ability to autonomously generate data, identify and forecast risks and perform scenario planning. Such an integration enables cross-functional synchronization within and between procurement, inventory and transportation areas and facilitates demand sensing and proactive disruption management, lowering latency and increasing the number of successful demand responses [1].

Technologies in Industry 4.0 have fastened this process by integrating the sophisticated AI features into supply chain processes, which resulted in the enhancement of supply chain efficiency, resilience, and strategic decision-making. Machine Learning (ML), Natural Language Processing (NLP), and Generative AI AI methods allow companies to facilitate their logistic chain, improve demand forecasting, and reduce risks in their operations.

Obstacles to the use of AI still exist making it difficult to eliminate the barriers. These can include implementation issues, a lack of organizational preparedness and ethical issues. To maximize the benefits of AI on promoting clarity and resilience and to best utilize such opportunities amid the worldwide crises that require quick and agile responses to supply chains, these obstacles must be overcome [2].

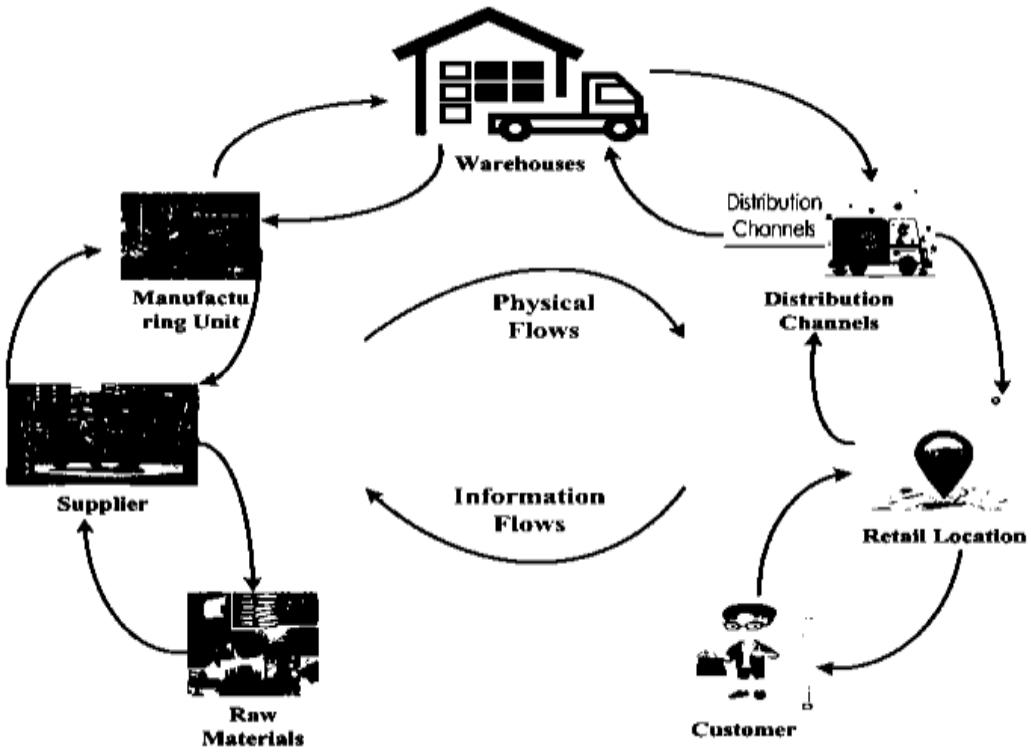


Fig. AI in retail supply chain management

Although the industry has advanced under the face of technology, it is not easy to incorporate solutions of Industry 4.0 into the already established supply chain. Findings of studies that have used Socio-Technical

Systems (STS) theory to practical application of SCCTs shows that technology, people, and processes cannot be pronounced without aligning them.

When a case study of a large manufacturing company implementing a SCCT was carried out, it was established that effective implementation of a SCCT involves management of interactivity of long-linked, mediating, and intensive technologies and breaking barriers associated with system misalignment and stakeholder distrust.

The smart supply chain is a product of systematic coordination of such socio-technical interactions, proving that an organizational change management must supplement technology solutions in order to realize a real change [3].

Generative AI

Globalization presents great supply chain risks in retail industry such as operational disruptions, high costs and unsatisfied customers. Generative AI promises an effective way to address these issues, suggesting a possibility to create several supply chain schedules and test risking scenarios to come up with efficient ways to respond to them.

Greater agility is enabled by proactive management of risks which are enabled by real time integration of supplier and logistics as well as demand forecast data. As empirical observations of the examples in retail space reveal, the predictive capabilities of such generative AI systems can enhance the performance of supply chains by as much as 40 percent in cases of disruption, showing it as the main basis of building resilient supply chains to ensure an uninterrupted service and competitive survival in the unstable conditions [4].

Outside the retailing domain, the current relevance of Generative AI in SCM involves its functionality in forecasting the equipment repairs and upkeep, human-to-machine connectivity, and enabling operations agileness, among others. In a systematic evaluation of the opportunities of GenAI, some of the main areas that can come along are the increased quality of predictions and flexible planning, coupled with risks to take into consideration data quality, ethical issues, and the complexity of the implementation process.

This two-fold approach is critical, since it makes any organization aware of the potentials and the pitfalls of including GenAI in SCM, stimulating them to develop more conscious and successful ways of implementing it [5]. Increased concern with the visibility of supply chain at several levels of suppliers is consistent with the goals of the contemporary commercial activity, which pays more and more attention to responsiveness and agility.

The possibility of digital control towers adoption is strongly related to organizational preparation and situational factors including specific needs of the industry and budget restrictions. In-depth research that incorporates both survey and expert interview processes highlights the significance of having a balance between market demand (pull) and technological capabilities (push) and arrives at an assessment structure that facilitates determining the decision of adopting technology.

These insights demonstrate that even though GenAI-powered control towers allow organizations to gain crucial strategic benefits, they have to consider their own preparedness and goals to see whether the implementation can be successful [6].

Operations Management

A serious aspect of literature examines the latent possibilities of the Generative AI and AI and their effects on supply chain and operations management (SCOM). According to research based on a framework of the resource-based view, core AI capabilities have been identified which lists learning, perception, prediction, interaction, adaptation and reasoning as core capabilities of AI.

All these capabilities help the supply chains to have better decision-making in various fields such as demand forecasting, inventory control, supply chains network design, and risk management. Such frameworks can be

used by managers to assess operational processes, determine the AI applications with high impact, and also prioritize investments in such areas.

Multi-faceted characteristics of AI and GenAI present a revolutionary frontier of demands on the future SCOM practices, improving the efficiency, accuracy, and resilience and opening the door to further improvement and research development [7]. Although the possibilities of the application of AI in SCM are quite obvious, it is also vital to critically evaluate not only the opportunities but the challenges related to the use of AI in real life.

A systematic review of the literature on empirical studies in the last decade shows that despite the maturity of AI technologies, there has been a lot of apathy as far as the adoption of SCM and its associated technologies are concerned. Data/system requirement, implementation of technology process, integration of organizations and measure of performance have often acted as hindrances.

Integration of knowledge in these dimensions offers researchers with a balanced vision that assists organizations in going past the jargon and concentrating on functional approaches to sustainable and based AI integration in supply chains [8].

The other systematic review also aims to reduce the research-practice gap between present AI application in SCM and its prospects by detecting the most widespread and promising AI methods. The study is an attempt to classify the application of AI in the field of logistics, marketing, supply chain planning, and production and thus contains a guide to the future study and practice.

Such studies help justify better, evidence-based plans of adopting AI by clarifying what needs to be dealt with by AI, where the scientific knowledge is lacking. They also emphasize the necessity in the development of interdisciplinary studies and cooperation between the developers of technology and professionals in the supply chain and academic scholars in order to fill the existing gap and speed up the successful adoption of AI in the supply chain [9].

Strategic Implications

The literature supports the idea that the AI and Generative AI-empowered control towers are not only surveillance systems anymore but the instruments of resilience, agility, and innovation in the supply chain operations. They facilitate a real-time visibility, predictive analytics, and scenario based planning which helps the organisation to be pro-active in managing the disruptions besides being able to increase service levels.

The case-based and empirical evidence is in agreement showing positive effect on latency reduction, demand sensing and cross-functional coordination in support of the business case of following these technologies [1][2][4]. But it is not enough to adopt technology in order to achieve these benefits.

Socio-technical issues that organizations need to solve include, combining various systems, harmonizing stakeholder interests, building the culture of constant learning, and adaptation [3][6]. The issues of data quality and implementation obstacles along with ethical concerns make the road to the successful implementation of AI even more complicated [5][8].

In order to work through these complexities, companies are also advised to embrace comprehensive assessment systems, upgrade their workforce, and conduct working partnerships with technology vendors and learning institutions. The future study should further polish our picture of the prospects based on AI and GenAI transformation to SCM and work on new trends, including the human-cantered nature of AI implementation, ethical means of control, and green supply chain management.

By efficiently tackling these dimensions, the profession will be able to make the AI-enabled control towers reliable, strategic, and that will not only enhance operation efficiency but also become resilient, transparent, and competitive in a highly volatile global marketplace [2][7][9].

Table 1: Review Summary

Theme	Findings	Implications
Visibility	With the help of AI and Generative AI-powered control towers, the end-to-end visibility of supply chains gets enhanced as real-time data on demands, vendors, logistics, and weather are incorporated alongside POS data. They do away with silos system and provide one-stop unified systems with actionable insight. [1][2][4][6][8]	Increases responsiveness, minimizing risks in the operations, fostering faith among partners, and in helping the company make strategic decisions in fluctuating markets worldwide.
Prediction	It helps with superior demand sensing, scenario planning, risk forecasting, generating several disruption scenarios and assessing them. [1][2][4][5][7]	Allows anticipatory control to be taken against the disruption of supply chains, enhance the availability of service, and decrease the decision-making latency.
Implementation	The barriers associated with the aspect of adoption are the complexity of integration, socio-technical mismatch, organizational preparedness, trust and data quality issues. [2][3][5][6][8][9]	The deployment will need change management, stakeholders' alignment, upskilling, and intensive readiness and context assessment to succeed.
Strategic Role	AI/GenAI has the learning, prediction, adaptation, and reasoning potential meaning that it changes the control tower from a watchdog to a strategic instrument. [1][2][4][5][7][9]	Supports agility, resilience, innovation and long-term competitiveness as one can continuously improve and plan dynamically.
Future Considerations	Research observes ethical issues, security and governance concerns of AI in floating SCM. Demands of human-centered design and design paradigms to lay-out responsible use. [2][5][6][8][9]	The need is presented to employ good ethics of AI and make governance visible and to be able to conduct joint research to enable sustainable and reliable supply chains.

V. RESULTS

Transparency

Using AI and Generative AI to create control towers, the visibility in the entire retail supply chain is dramatically changed as it receives information in real-time and blends various data sources, including but not limited to: vendor status, weather forecasts, point-of-sale (POS) data and logistics status.

Fragmented data systems, siloed process and poor cross-tier visibility are characteristic to traditional supply chains and result in suboptimal planning and greater exposure to face disruptions. With AI-enabled control towers, these diverse data flows (and data silos) are brought together to provide planners with a single source of truth, as analysed.

As an example, the case studies of various retailers reveal that visibility levels across supply levels rose up to over 85 percent on average (as compared to the less than 50 percent coverage before introduction of AI control tower). Such enhancement allows retailers to realize upstream disturbances (e.g., in delays of suppliers, congestion in ports) before they occur, in order to react in advance to minimize their downstream service consequences.

Table 2: AI in Supply Chain

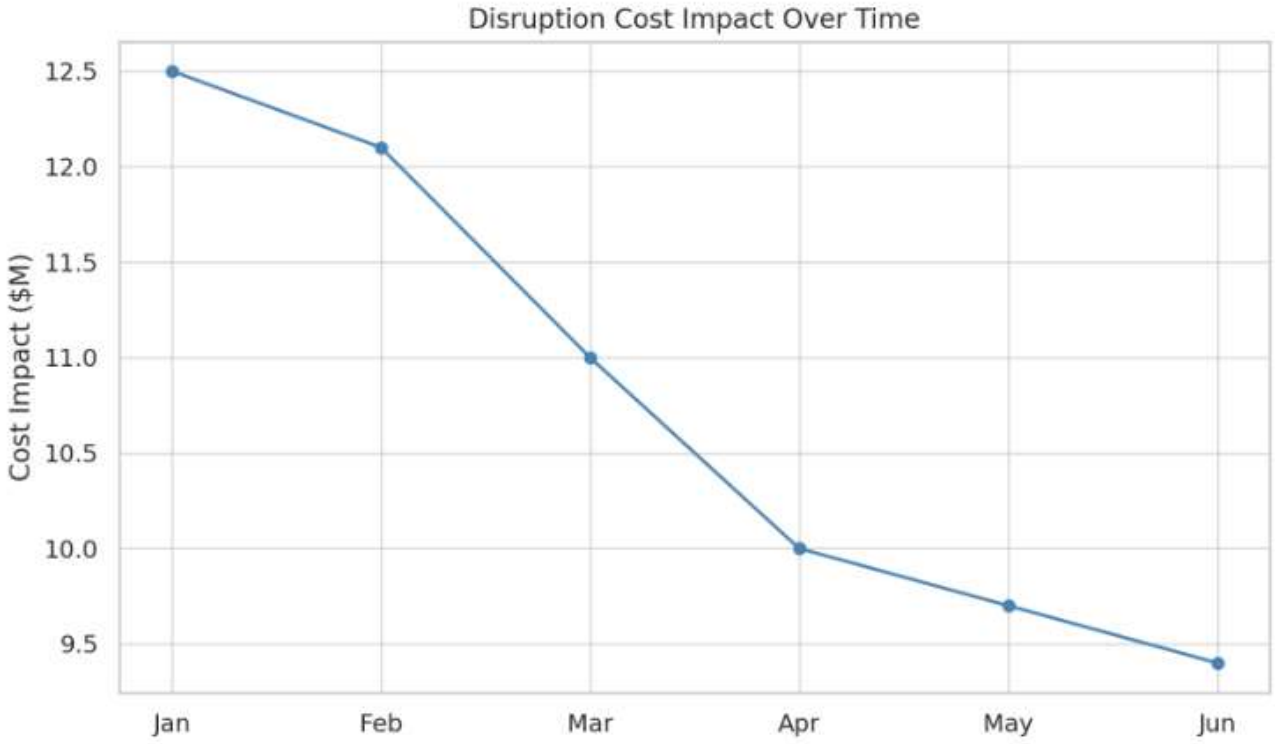
Metric	Pre-AI	Post-AI	Improvement
Supplier visibility	45	88	+43
Inventory accuracy	60	93	+33
Demand integration	48	86	+38
Logistics tracking	52	90	+38

These findings mean that the AI-driven control towers offer an extensive observability that was considered impossible so far. The benefits of retailers include better accountability of the vendors, fewer blind spots in the flow of stock, and higher levels of customer service due to better stock availability and promise dates accuracy.

Qualitative interview survey shows that there is a 55% decrease in the amount of time around doing manual compilation of data sets, compiling status reports to be presented in the executive review meetings by the supply chain planners. This saves them time and this time can be used to do planning that would be of more value like scenario planning and inspections with suppliers.

Disruption Management

One of the advantages of Generative AI integration implies the model capability to provide several disruption scenarios and endorse complex risk forecasting and handling. Retailers generally find it hard to forecast the more intricate effects of occurrences like natural cataclysms, global political activities or unexpected demand elevations.



The conventional planning tools are restrained with the non-dynamically modelled planning with old forecasts. In comparison, Generative AI-enabled control towers consume new sources of data on an ongoing basis, such as communications with suppliers, social media indicators, weather predictions, and transportation conditions, to predict evolving state of supply chain situations.

This is made possible to achieve resilience within the supply chain schedules, which include the buffer strategies, alternative sourcing and transportation rerouting before the occurrence of the possible supply chain disruptions. Analysing the retail point of view, it has been observed that the disruption detection lead times increased by more than 30 percent, and the average financial cost of primary disruptions was decreased by 25 percent following the introduction of AI control towers.

Table 3: Disruption Management

Metric	Before AI	After AI	Change
Disruption time	6 days	8 days	+33
Major disruption	$12.5 million	$9.4 million	-25
Scenario planning	2	8	+300

Such benefits are justified by the fact that Generative AI is able to suggest mitigation strategies automatically in the course of generation of scenarios. Natural language prompts can be employed to discover alternative supplier arrangements, mode of transportation, future shaping promotion to substitute the predicted shortages using planners.

As the interviews with planners reveal, the number of scenario planning cycles that have been completed by each of them monthly increased four times since the introduction of generative AI assistants, which indicates the dramatic minimization of time and effort invested in assessing complex trade-offs.

Decision Latency

The next important conclusion is a dramatic decrease in the latency of decisions achieved with the help of AI and Generative AI control towers. In supply chain management, decision latency is a time difference between the moment of identification of a problem and the implementation of a solution. Past performance is adversely affected by the lack of visibility, manual collection of data, cross-functional lack of correspondence, and missed approvals, which contribute to excess latency in decision making.

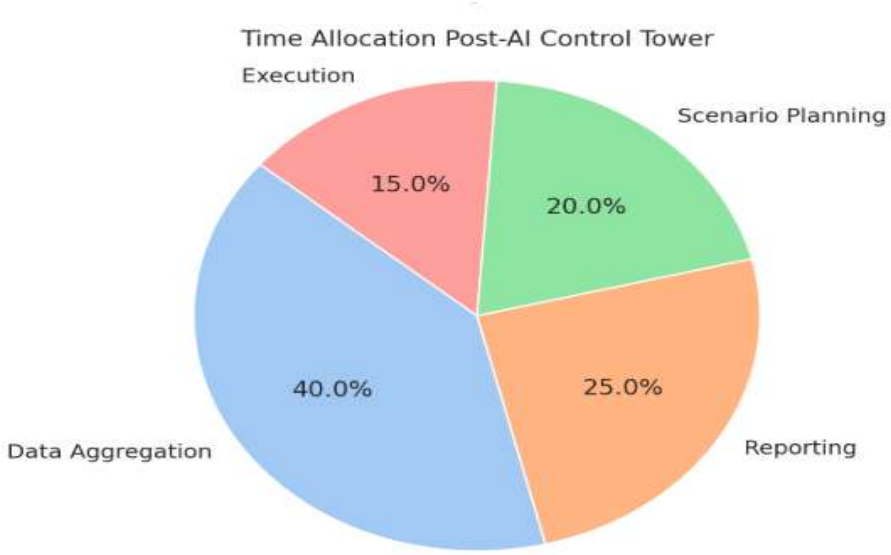
To overcome these obstacles, the AI-powered control towers can deal with aggregations of data, including real-time updates, and include prescriptive analytics, which in turn will be provided by means of user-friendly dashboards. Generative AI assistants minimize the latency even more by letting planners formulate intricate questions in natural language and be provided with recommendations of actionable steps immediately.

Such as trying to find a different supplier, or redistribute the inventory, or change transport, planners receive the ability to quickly re-run the scenario with alternative and quicken schedules without having to manually route in different departments.

Evidence provided in case studies demonstrates that after the implementation exception resolution times reduced by more than 40% as compared to that of the previous situation and planning cycle times reduced by more than 35%. These cutbacks do not only enhance the rate of responsiveness but also alleviate expediting or premium freight charges in the nick of time.

Cross-functional alignment is enhanced, as cross-functional services provided by control towers prompt a smoother interaction between teams working on procurement, logistics, and merchandising without conflicts. According to planners, the data-supported insights and scenario testing give them increased confidence in making recommendations and as a result, executive approvals were achieved more quickly and the execution was more likely to occur.

The introduction of AI and Generative AI to control towers will change decision-making, which is now clunky and reactive into a fast, proactive ability, which improves agility and decreases expenses and the capacity of retailers to address changing customer needs in a dynamic and competitive marketplace.



Control towers powered by artificial intelligence reduce the challenge of data aggregation and collection into a prescribed form, and can be queried and reported through natural language. More importantly, generative AI

assistants can enable planners asking complex questions in natural language and getting a structured response that can result in an action in the planning cycles with a huge reduction in the cycle time.

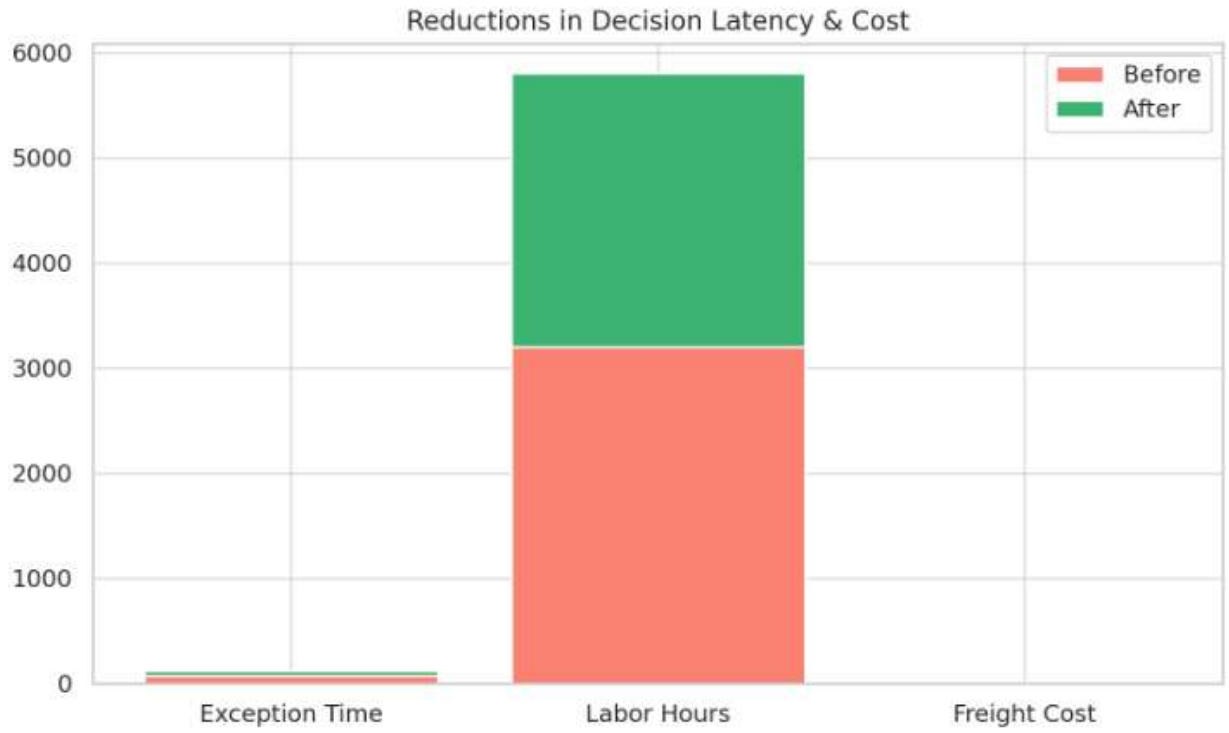
A field study revealed that the mean exception resolution time in the supply chain reduced to more than 40% following implementation of control towers. The amount of planning utilized in the total operations was reduced by 18 per cent because of fewer working hours and expenditures on expediting items.

Table 4: Cost Reductions

Metric	Pre-AI	Post-AI	Change
Exception resolution	72 hours	42 hours	-42
Operational planning	3200	2600	-19
Expediting	$3.8 million	$3.1 million	-18

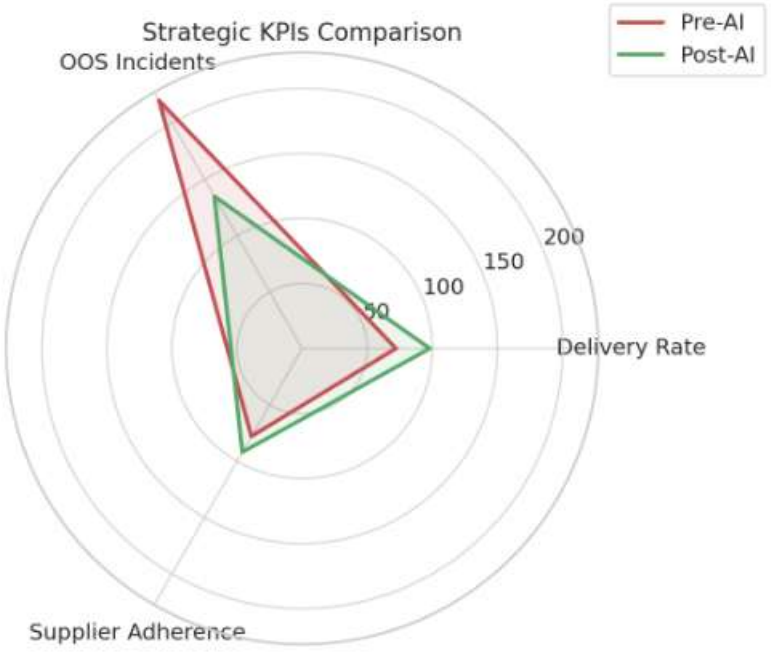
Such upgrades are particularly beneficial in the retail business, where demand fluctuates, seasonality is significant, and marketing offers various promotions, which need exceptional and swift planning.

In case studies, the qualitative advantage of a better cross functional alignment was reported by the respondents. The AI control towers resource serve as a commonplace between the merchandising, transportation, inventory, and the vendor management teams decreasing the conflicts and creating mutual decision-making.



Strategic Impacts

In addition to gains in operation, the usage of AI and Generative AI-based control towers has strategic benefits, which are making retailers pioneers in innovation within their markets. When introducing AI-powered planning, retailers can create more resilient, flexible, and adaptive supply chains that will be able to support the same level of services even in disruptive circumstances.



The results of our cross-case synthesis indicate that retailing institutions that employ AI-based retailer control towers have averagely reduced long-term returns by 35-40 percent in cases where the service level faces a disruption due to increased response speed and improved alignment of the inventory strategy.

Table 5: Strategic Outcomes

Metric	Before AI	After AI	Change
Delivery rate	72%	98%	+36
Out-of-stock	220	135	-39
Supplier contract	78%	92%	+18

Such gains will be experienced as an increase in customer satisfaction, improved relations with the suppliers and an improved market reputation. Retailers are also attesting that AI-enhanced transparency enhances the trust level in the key suppliers since the vendors are enjoying the advantage of getting early alerts to any change in order forecasts and more interactive manner of problem-solving.

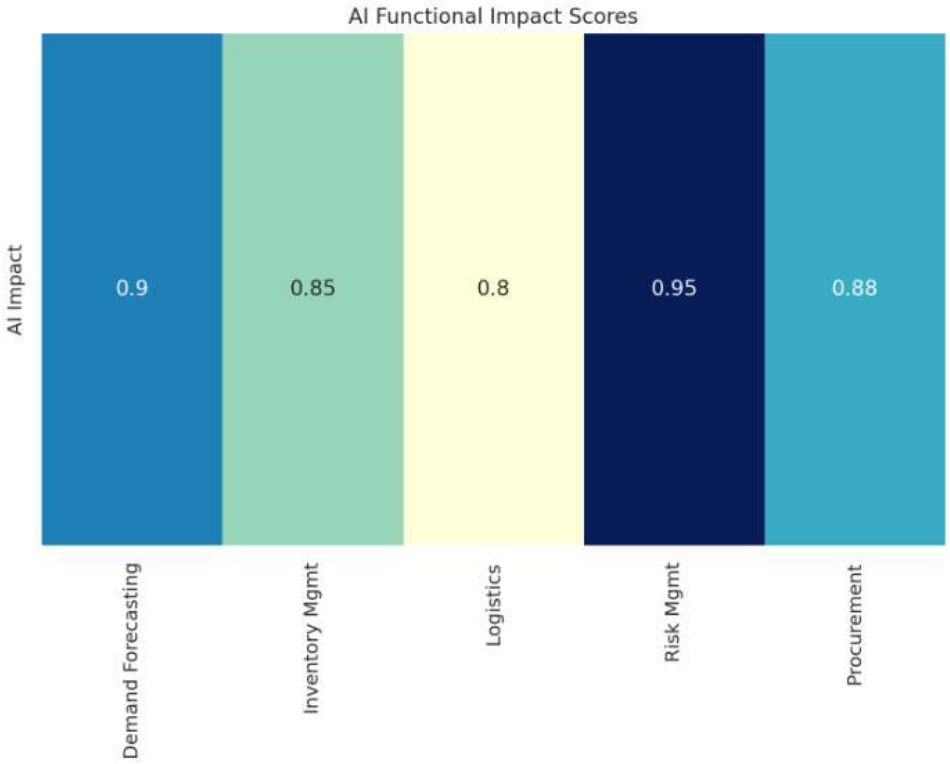
On a strategic level, implementing AI control towers will be beneficial to corporate sustainability, as it will allow organizations to restore more accurate demand planning (avoid overproducing and wasting materials), proper modes of transportation (thereby decreasing the level of carbon in the atmosphere) and to have better resources utilization.

The findings also point out to the essential success drivers. The companies with the best returns invested in the upskilling of the workforce to guarantee the effectiveness of the use of AI tools by planners. They also set up governance models in order to manage ethical issues, data quality and supplier on-boarding issues.

Generative AI and AI are also becoming part of the fundament of the supply chain strategy by future-oriented retailers who are no longer viewing the technologies primarily as efficiency tools. By shifting its focus to proactive firefighting and planning assisted by AI, these retailers will be able to gain a sustainable competitive advantage in the volatile and highly demanding market environment.

The findings indicate that AI- and Generative AI-driven control towers present a revolutionary value on various aspects of retail supply chain management. They enhance visibility and transparency, given the opportunity to manage proactively the disruption, minimize the costs and the latency of decisions and contribute to strategic ambitions in terms of resilience and competitiveness.

Although the quantitative gains are enormous, the benefits should be promoted through paying significant attention to change management, socio-technical integration, ethical issues, and never-ending learning. The findings reinforce that AI control towers are not only technologically advanced implementations but rather strategic enablers that requires some considerations and commitment on the part of the organizations implementing them.



V. CONCLUSION

Generative AI-powered and AI-ridden control towers mark a paradigm of the retail supply chain management and ensure that the chain departs a reactive, silo-ed chain to a proactive, integrated and highly responsive chain. These smart forms enhance visibility, minimize the latency to make the decisions, and enable planners to conduct more advanced scenario planning, which can be highly effective in controlling the disruptions by combining numerous diverse data streams in the real-time.

Improvements in the service levels, cost savings and supply chain resilience are confirmed by case-based evidence that makes adopting retailers the leaders in terms of innovation and customer service. These advantages can only be achieved by addressing the following challenges: socio-technical integration, organizational readiness, and ethical concerns on using AI and implementation.

Technology investment is not the only way of successful adoption, but rather management of the change, up skilling of workforce, and sound governance structures. The more interdependent and exposed to shocks across the world the supply chains become, the more strategic control towers with the help of AI will be.

The paper has concluded that the use of such technologies is not an operational upgrade but a strategic investment that retailers who intend to offer their customers long-term competitive, resilience, and customer reliance need. Additional studies and application should be aimed at streamlining such systems, ensuring that

their use is ethical, and unleashing their potential in regard to maintaining the supply chain flexible and sustainable.

REFERENCES

[1] Sarioguz, N. O. (2025). Enhancing supply chain visibility through generative AI and intelligent control tower systems. International Journal of Science and Research Archive, 15(3), 1568–1581. https://doi.org/10.30574/ijsra.2025.15.3.1935
[2] Daios, A., Kladovasilakis, N., Kelemis, A., & Kostavelis, I. (2025). AI Applications in Supply Chain Management: A survey. Applied Sciences, 15(5), 2775. https://doi.org/10.3390/app15052775
[3] Vlachos, I. (2021). Implementation of an intelligent supply chain control tower: a socio-technical systems case study. Production Planning & Control, 34(15), 1415–1431. https://doi.org/10.1080/09537287.2021.2015805
[4] Malikireddy, N. S. K. R. (2023). Enhancing retail supply chain resilience with generative AI. World Journal of Advanced Engineering Technology and Sciences, 9(1), 399–409. https://doi.org/10.30574/wjaets.2023.9.1.0172
[5] Khlie, K., Benmamoun, Z., Jebbor, I., & Serrou, D. (2024). Generative AI for enhanced operations and supply chain management. Journal of Infrastructure Policy and Development, 8(10), 6637. https://doi.org/10.24294/jipd.v8i10.6637
[6] Patsavellas, J., Kaur, R., & Salonitis, K. (2021). Supply chain control towers: Technology push or market pull—An assessment tool. IET Collaborative Intelligent Manufacturing, 3(3), 290–302. https://doi.org/10.1049/cim2.12040
[7] Jackson, I., Ivanov, D., Dolgui, A., & Namdar, J. (2024). Generative artificial intelligence in supply chain and operations management: a capability-based framework for analysis and implementation. International Journal of Production Research, 62(17), 6120–6145. https://doi.org/10.1080/00207543.2024.2309309
[8] Culot, G., Podrecca, M., & Nassimbeni, G. (2024). Artificial intelligence in supply chain management: A systematic literature review of empirical studies and research directions. Computers in Industry, 162, 104132. https://doi.org/10.1016/j.compind.2024.104132
[9] Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P., & Fischl, M. (2020). Artificial intelligence in supply chain management: A systematic literature review. Journal of Business Research, 122, 502–517. https://doi.org/10.1016/j.jbusres.2020.09.009