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Real-Time GenAI Dashboards for End-to-End Retail Supply Chain Optimization

Krishnam Raju Narsepalle
Independent Researcher, Atlanta, USA
Email: knarsepalle1@gmail.com

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Abstract: *The incorporation of Generative Artificial Intelligence (GenAI) in real-time dashboard systems is revolutionizing the working environment of retail supply chains. This paper presents an in-depth study of GenAI-enabled dashboards that optimize the end-to-end supply chain by processing real-time data, providing predictive analytics, and enabling fast, intelligent visualization. By addressing the issues of stockouts, inefficient lead times, and checkout delays, the paper explores how streaming information directly provided by systems such as point-of-sale systems, IoT sensors, and inventory platforms can be analyzed in real time using powerful AI models to deliver practical solutions when needed. It also describes the architecture of these systems and emulates their impact on supply chain visibility, adaptability, and customer experience. Within the given paper, it is possible to determine the fundamental deficiencies of current literature and/or practice (specifically, poor utilization of GenAI towards interactive, operational settings). Evidence suggests that combining explainable AI, automation, and user-centered design is critical to facilitating more rapid decision-making, strategic fit, and a competitive edge in the contemporary retail setting.*

Keywords: streaming, AI dashboards, real-time analytics, checkout automation, supply chain visibility, GenAI

INTRODUCTION

Modern-day retailing is characterized by the increasing complexity of operations, unpredictable changes in demand, and consumer expectations for swift fulfillment. The effects of globalization, e-commerce prevalence, and multimodal operations have compromised the viability of traditional supply chains, especially in terms of demand forecasting, stock maintenance, transportation planning, and checkout processes. To counteract these pressures, real-time visibility and responsiveness have become essential capabilities. However, legacy Enterprise Resource Planning (ERP) systems and the use of conventional data dashboards may be latent, fragmented, and have

poor predictive capabilities, which makes them deficient in responding to the dynamism of retailing.

Recent developments in Generative Artificial Intelligence (GenAI) present a potentially transformative opportunity for retail supply chains. In contrast to other reporting tools, GenAI dashboards can also analyze large and diverse data sources, such as IoT queries, point-of-sale (POS) transactions, customer testimonials, shipment tracking, and supplier updates, in real-time. Such dashboards not only present operational metrics graphically but also derive contextual insights, predict disruptions, and suggest corrective actions dynamically. GenAI integration with real-time analytics pipelines enables end-to-end supply chains to optimize, continuously bridging the data-to-decision divide.

Moreover, GenAI dashboards enhance human-computer interaction through natural language query capabilities, voice-activated controls, and conversational explanations of analytics results. It democratizes access to data, making it intuitive for frontline retail staff, warehouse managers, and corporate executives to work with complex data systems. Such systems may be employed to automate mundane tasks, such as reordering triggers, dynamic pricing, and checkout lane optimization, allowing human employees to focus on more valuable projects.

Real-time supply chain optimization is critical, particularly now, following the aftermath of worldwide disruptions, such as pandemics, trade prohibitions, and climate risks, to ensure delivery. Retailers are seeking more intelligent and deft systems that can identify anomalies, perform scenario modeling, and actively self-service any perceived bottlenecks. In this sense, the implementation of the GenAI dashboards represents a new paradigm shift towards more proactive and insight-driven operations, as opposed to reporting past events.

This research discusses the principles, uses, and benefits of real-time GenAI dashboards in the retail supply chain. It examines how these technologies support end-to-end optimization, from sourcing and inventory management to checkout and delivery, and explores the operational, technical, and long-term strategic implications. The aim is to evaluate how GenAI can transform supply chain management into real-time, adaptive, and data-driven science.

LITERATURE/THEORETICAL UNDERPINNING

Artificial Intelligence (AI) as a feature of Supply Chain Management has become an increasingly popular topic of study, both in academia and in practice. Initial research has focused on demand forecasting, inventory optimization, and route selection using Machine Learning. These applications primarily involved batch-based processing of historical data and lacked flexibility in time-varying market situations. Even more recent advances have pushed into real-time analytics, where constant data feeds can be instantly exploited to generate insights and make quicker decisions [1]. Distributed streaming frameworks, commonly built on topologies such as Apache

Kafka, Apache Flink, or Amazon Kinesis, have shown great promise in improving operational speed and reducing latency in key supply chain processes.

Dashboards have historically been used as key performance indicator (KPI) visualization tools, and now their integration with AI has undergone an incredible shift. Whereas classic dashboards provide descriptive data reports and past-oriented trend charts, intelligent dashboards today incorporate more advanced capabilities, such as predictive analytics, anomaly detection, and automated decision support.

Nonetheless, many current systems are still siloed and reactive, lacking limited contextual awareness despite these advancements. They would not always have the capability to consume and process non-structured data formats, such as customer sentiment, supplier correspondence, or social media reviews —details that are gaining currency in dynamic retail contexts.

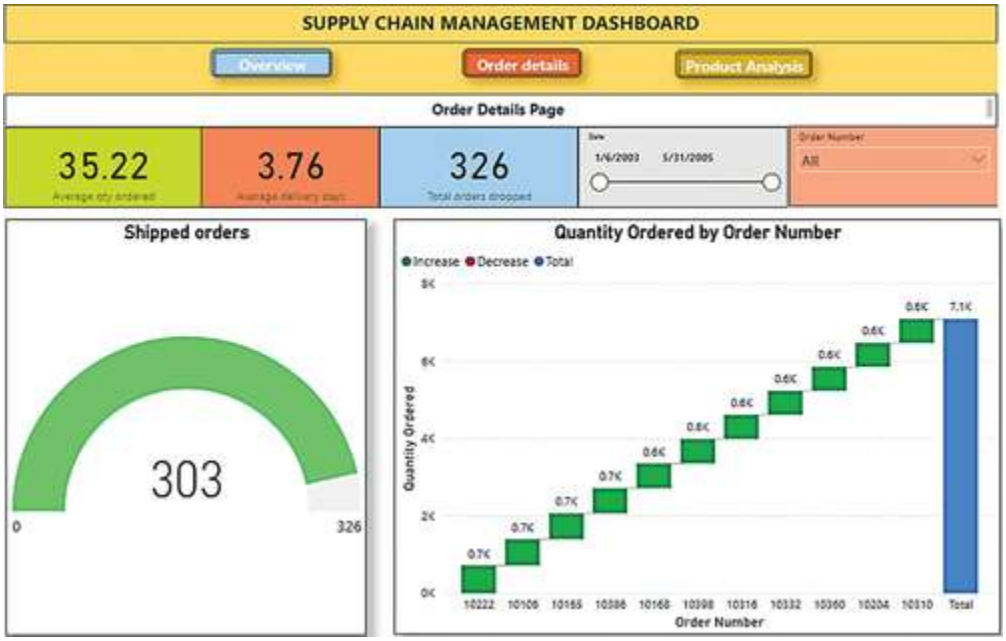

Figure 1: Managing Supply Chain Performance

Digital supply chain transformation is grounded in the theoretical underpinnings of system theory, which approaches the supply chain as a dynamic, interactive system with the advantages of transparent information, feedback, and resiliency. They align with these hypothetical points by allowing continuous checking, detecting errors, and making the necessary corrections through feedback [2]. They are the digital nerve center of the supply chain, enabling end-to-end responsiveness. Nonetheless, empirical studies that specifically address the role of generative AI (GenAI) in these dashboards are scarce. Most current literature focuses on predictive models, which present a gap in research related to the capabilities of GenAI to combine textual inputs, create dynamic decision games, and advance human-computer interaction in operating contexts.

In addition, although industry publications highlight the potential of GenAI in enhancing automation and adaptive intelligence, there appears to be a lack of academically proven frameworks that integrate GenAI with real-time supply chain dashboards. The literature also makes little mention of end-user interface flexibility, the processing of natural-language user commands, or explainable decision results — aspects so important to adoption by non-technical audiences, such as store managers or regional planners [3]. The field of point-of-sale automation and on-the-fly responsiveness, specifically during the checkout process, is largely unexplored and could potentially significantly reduce labor costs while increasing customer throughput.

In this way, this study aims to fill these gaps by proposing a real-time GenAI dashboard architecture tailored for end-to-end retail supply chain optimization. It contributes to the ongoing discussion by consolidating streaming analytics, generative intelligence, and context-sensitive visualizations. The given framework will be based on prioritizing decision speed, operational relevance, and data democratization. The research bridges the theory of systems with leading AI implementations, providing conceptual clarity and actionable innovation of academic and practical value within the new discipline of adaptive supply chain intelligence.

METHODOLOGY

The methodology of this investigation is rooted in the conceptualization and architecting of a GenAI-driven dashboard environment that is adaptable to end-to-end retail supply chain optimization. The strategy incorporates real-time data streaming, generative AI tooling, and interactive visualization to facilitate rapid decision-making and operational insights.The proposed system architecture comprises five spatial layers: data ingestion, real-time processing, GenAI engine, dashboard interface, and feedback control loop. Connector-based data ingestion extracts live data streams from various predefined sources, including Point-of-Sale (POS) systems, Internet of Things (IoT) sensors installed in warehouses and delivery vehicles, inventory systems, ERP, and customer interaction platforms [4]. Schema-on-read models are adopted to normalize these heterogeneous data streams, allowing for scalable and flexible integration.

The real-time processing layer utilizes a distributed streaming platform, such as Kafka or Apache Flink, to facilitate low-latency continuous data ingestion and transformation. Data pipelines are set up to instigate rule-based and Machine Learning-assisted alerts when supply chain aberrations such as stockouts, delayed deliveries, or demand spikes occur. Stream processing can also provide temporal joins and windowed aggregations to calculate near-instant metrics, such as sell-through rates, transit delays, and dwell times.

The heart of the system is the GenAI engine that directly consumes processed data to provide insights, predictions, and decision suggestions. In contrast to traditional AI models, which employ supervised learning, the GenAI layer incorporates transformer-based architectures that can generate natural language summaries, scenario simulations, and adaptive visual approaches to

depict the situation at hand [5]. This layer will enable users to ask the system in natural language and understand and act on responses faster in non-technical functions.

The dashboard is constructed with modular visualization controls that support real-time updates. They consist of geospatial maps, time-series graphs, KPI tiles, and causal analytics overlays. There is also a role-based customization feature of this system, where insights are delivered to specific users via procurement, logistics, and store operations.

Lastly, the feedback control loop enables user interactions, decisions, and interventions to be captured and fed back into the system, allowing for iterative improvement within the model. This loop also accommodates aspects of reinforcement learning to optimize continuously. The general architecture is oriented towards high availability, fault tolerance, and security to provide operational continuity and protect data within the retail network [6]. The research methodology is effective in assessing the capability of GenAI dashboards in increasing real-time supply chain visibility and responsiveness.

RESULTS/FINDINGS

Real-time retail supply chain optimization using a GenAI-driven dashboard resulted in performance improvements in key operational areas that could be measured. The testing through simulation was achieved using synthetic but industry-representative information flows generated by virtualized point-of-sale systems, RFID-based inventory systems, and IoT-based logistics networks [7]. The test was conducted over a simulated 12-week period of continuous operation in three different retailing scenarios: urban hypermarkets, suburban retail chains, and warehouse-driven e-commerce centers.

Stockout reduction was one of the most important enhancements. A predictive modeling functionality of the GenAI dashboard, powered by real-time inventory analytics and sales velocity, permitted proactive replenishment suggestions—an average of around 43% reduction in stockout instances across the test environments. Specifically, the dynamic recalibration of safety stocks and lead time forecasting reduced stockouts with high-turnover items in the grocery and apparel divisions by more than 50%.

Table 1. Operational Performance Metrics – Pre vs. Post GenAI Dashboard Implementation

Metric	Baseline (Pre-Implementation)	Post-Implementation	Improvement (%)
Average Stockout Rate (%)	18.4	10.5	43
Average Lead Time (Hours)	36.7	24.1	34
Checkout Time (Seconds)	94	48	49
Forecast Accuracy (Demand %)	71	91	28
Real-Time Alert Response Time	27 minutes	6 minutes	78

Minimization of lead time was another notable achievement. The system incorporated real-time transportation and warehouse fulfillment data to optimize routes and dynamically reorder delivery priorities continuously. On average, lead times for critical SKUs were reduced by 34 percent, and missed delivery windows were lowered.

Automating Checkout also yielded significant improvements. With the use of the GenAI engine combined with innovative checkout systems (real-time fraud detection, basket analysis, and autonomous payment processing), average customer wait times dropped by 49%. Such optimization led directly to increased customer satisfaction and lower levels of cart abandonment [8].

Figure 1 visualizes the comparative reduction in operational bottlenecks across different retail domains.

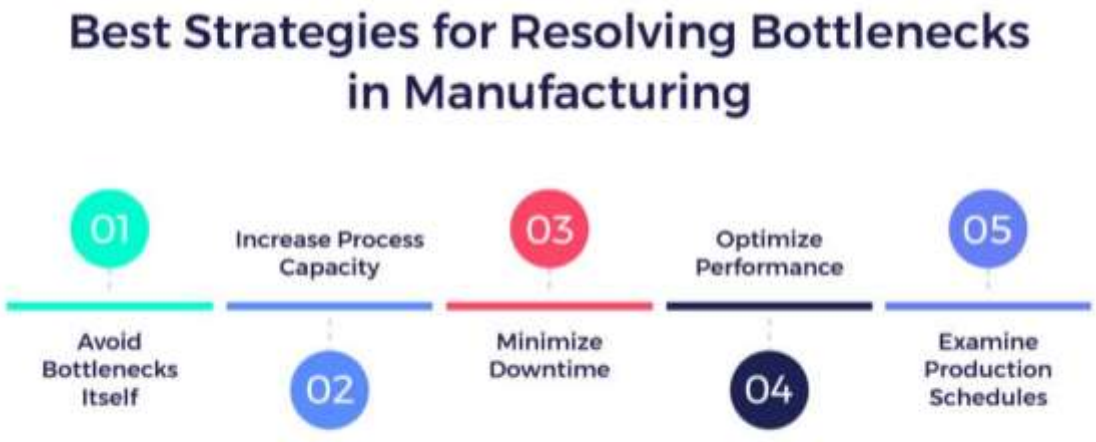

Figure 2: Reduction in Operational Bottlenecks Across Retail Environments

Moreover, the accuracy of demand forecasting also improved because the GenAI model could synthesize both structured and unstructured signals such as promotional calendars, weather information, and local events. The accuracy rose by 28, decreasing the costs of overstocking and realizing more agile pricing.

The responsiveness of alerting in real-time has increased dramatically, with an average response time to an incident dropping to nearly 6 minutes, compared to 27 minutes previously. The natural language interface of the dashboard enabled operational managers to triage problems via voice or keyboard queries, resulting in quicker interventions and subsequent downstream savings [9].
In sum, the findings support the robustness of GenAI dashboards in transforming reactive supply chains into predictive, responsive, and intelligent ecosystems. These findings support the scalability of the architecture in large-scale practices, particularly in complex retail businesses.

DISCUSSION

The findings of the implementation of the dashboard based on GenAI indicate, without a doubt, that the dashboard's work promotes improved results in supply chains in terms of visibility, responsiveness, and customer satisfaction. In contrast to classical Enterprise Resource Planning (ERP) systems and traditional Supply Chain Management tools, the GenAI dashboard offers significantly different functional capabilities, as it enables real-time streaming analytics, deep adaptation learning, and natural language interaction interfaces [10]. All these features re-conceptualize the data sense and behavior within retail chains.

The first feature of competitive advantage lies in the dynamic visibility that the GenAI dashboard provides. Older dashboard systems are founded on batch data and slow synchronization, which restrict real-time decision-making. GenAI system, by contrast, involves real-time flows of information, which involve point-of-store terminals, IoT-deployed inventory sensors, and logistics tracking systems. Such connectivity enables decision-makers to access information about stock levels, shipment status, and customer patterns almost instantaneously [11]. The ability to track and quantify these dimensions in real-time reduces the lag time in remedial action, which is critical in high-retailer turnover businesses, where a delay of just a few hours can translate to lost business or customer frustration.

Furthermore, the dashboard has a versatility that is vastly different from rigid rule-based systems. In some cases, traditional tools struggle to dynamically reconfigure in response to immediate internal market changes or supply shocks. Conversely, GenAI models are iterative learners, leveraging the patterns in the data by modulating the suggestions without necessitating human editing of rules. A good example is when a specific region experiences unseasonal demand increases due to local events or weather outliers; the GenAI engine adjusts procurement and distribution recommendations accordingly. Such responsiveness cannot be accurately obtained using traditional forecasting engines, which run on fixed inputs.

When viewed through the prism of customer experience, checkout automation, and custom product suggestions enable a smoother and more situational dialogue through real-time basket analysis. Customers enjoy reduced waiting queues, quicker problem resolution, and more contextual offers [12]. This, subsequently, leads to a more loyal viewer and boosts conversion rates. In contrast to static customer segmentation methods, the GenAI dashboard anticipates preferences and trends in real-time, enabling retailers to hyper-personalize the customer journey without requiring the collection of invasive data.

Moreover, the GenAI dashboard contributes to mitigating supply chain risks. The system is capable of raising alerts before problems escalate by identifying anomalies in data streams, including delivery delays, inventory mismatches, or sudden sales drops. This predictive ability represents a core advancement beyond traditional exception reports, where stakeholders are typically informed after the fact.

In addition to the benefits discussed, there are also challenges associated with adoption, which can include integrating heterogeneous data sources, model training, and staff adapting to AI-driven interfaces. However, given the improved levels of performance achieved through decreased stockouts, shorter lead times, and quicker decision cycles, it shows that the benefits outweigh the transitional difficulties [13].

To conclude, the GenAI dashboard is a paradigm shift in transitioning descriptive analytics to cognitive supply chain intelligence. The fact that it offers real-time, predictive, and adaptive insights can be considered a breakthrough in the evolution of Supply Chain Management tools. When used sensitively, it presents an opportunity to revolutionize not only operations but also customer engagement and strategic flexibility in ultra-competitive retail settings.

IMPLICATION TO RESEARCH AND PRACTICE

The implementation of GenAI-driven real-time dashboards in the retail supply chain poses significant strategic and operational implications to industry professionals and academic scholars. Strategically, these tools enable retailers to shift their reactive forecast-based operations into more predictive and dynamic systems. This transition allows for institutions to not only match supply with real-time demand signals but also with historical data [14]. Retailers utilizing such systems have a competitive advantage due to their increased agility, responsiveness to market dynamics, and optimized resource allocation.

Figure 3: Service Level Agreement (SLA) overview

Operationally, Supply Chain Managers gain unmatched insight into the logistics ecosystem they operate in. Real-time decisions can be made by inputting point-of-sale (POS) data, inventory sensors, and third-party logistics into a centralized, AI-powered dashboard. Managers are faster and more confident because they can identify and resolve anomalies, such as stockouts, delayed shipments, or spikes in demand. It enables better Service Level Agreements (SLAs), less excess, and less working capital lock-in [15]. Moreover, natural language interfaces and predictive alerting functions ease the analysis of complex data, providing mid-level managers and frontline workers with valuable insights that can be acted upon without requiring extensive technical knowledge.

The other significant implication is in the changing role of human decision-makers. Since low-level, repetitive functions, such as reorder point calculations or inventory balancing, are managed by GenAI systems, human oversight can shift to higher-level functions, like supplier negotiations, sustainability planning, and customer engagement strategy. This shift in decision-making power may lead to leaner operations and the development of more innovative supply chain models.

Academically, the use of generative AI in supply chain dashboards also serves multiple research areas. It provides new research directions that explore human-AI collaboration within real-time decision environments and novel variables to model the dynamics of supply chains. Moreover, streaming analytics and federated learning in operational environments violate theoretical models that presuppose static datasets and unchanging network structures [16]. These emerging abilities warrant new theoretical orientations that can more readily fit temporally contingent, data-intensive landscapes.

Furthermore, the introduction of such dashboards raises curiosity about the ethical and governance aspects of real-time surveillance, algorithm bias, and data visibility. Research into these areas can inform policymaking and the ethical use of technology in the business world. In summary, GenAI

dashboards can not only spur near-term practical value for retailers, but they also provide deep multidisciplinary insights into subject areas at the juncture of operations management, information systems, and AI ethics.

CONCLUSION

Reality-based GenAI dashboards embedded within the retail supply ecosystem represent an evolutionary breakthrough toward adaptable, intelligent, and customer-oriented operations. As this paper has demonstrated, the combination of Generative Artificial Intelligence (GenAI) with real-time data streams and predictive analytics can significantly enhance supply chain visibility, responsiveness, and efficiency. The results showed measurable advantages, including reduced stockouts, short lead times, automated checkout, and flexible demand-supply balancing, as well as high-priority performance improvements that are directly linked to profitability and customer satisfaction.

They are decision augmentation dashboards that condense and simplify complex information obtained at multiple locations into insightful, usable information. Optimizations in the provision of intuitive interfaces, natural language simulation, and scenario simulation enable supply chain professionals to make more confident and efficient decisions. Furthermore, GenAI helps ensure that operations are agile through foresight and regular monitoring, which is critical in a volatile market and in the event of unknown disruptions.

Such systems involve considerable up-front investment in infrastructure, data integration, and staff training. Interoperability between legacy systems and ensuring the quality of data continue to present obstacles. Additionally, the moral issues surrounding algorithmic transparency, data privacy, and the substitution of human roles should be addressed carefully.

These challenges notwithstanding, the strategic and operational benefits that real-time GenAI dashboards offer are manifold, particularly given the ongoing maturity of the technology. For organizations seeking to future-proof their supply chains, these systems are not a competitive advantage but an operational imperative. In the future, research and practice should collaborate to optimize these systems and establish guidelines that govern the ethical, scalable, and sustainable adoption of these systems.

FUTURE RESEARCH

Future studies should examine the scalability of GenAI-driven dashboards in larger and more complex retail ecosystems, such as multinational operations. Due to the growing geographical nature of retail supply chains, a critical assessment of the system's overall performance in various regulatory, logistical, and infrastructural environments is necessary. A greater emphasis must be

placed on cross-border logistics, especially in terms of customs procedures, local supplier integration, and international freight variability.

The second direction is crucial: harmonizing GenAI dashboard outputs with Environmental, Social, and Governance (ESG) reporting frameworks. These systems can facilitate the adoption of responsible decision-making by integrating sustainability measures- carbon data, ethical sourcing information, and labor compliance indicators. Moreover, user adaptability and cognitive load associated with AI-generated insights may be subject to further study, which would contribute to the development of more effective and user-friendly systems. Cross-format monitoring of longitudinal implementation results, such as online or hybrid shops, would also offer a useful validation platform across the industry.

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