Journal of Business and Management Studies
ISSN: 2709-0876
DOI: 10.32996/jbms
Journal Homepage: www.al-kindipublisher.com/index.php/jbms

JBMS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Ai Revolutionizes Inventory Management at Retail Giants: Examining Walmart's U.S. Operations

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| ABSTRACT

AI has gone from small pilot projects to widespread use in U.S. retail. Walmart is often mentioned as an early adopter of predictive analytics, computer vision, automation, and generative tools to help with inventory management. This article brings together peer-reviewed research on AI-enabled forecasting and inventory management with information from practitioners about Walmart's recent efforts, such as AI assistants for store associates and merchants, RFID-AR item location, digital twins, quality inspection automation, and route/pack optimization. We put Walmart's program in an evidence-based framework that connects data, models, and workflows to key performance indicators (KPIs) that can be measured. We talk about how stockouts and forecast errors have gone down, how excess inventory has gone down, how maintenance has been found sooner, and how task productivity has gone up. Next, we look at ethical and organizational issues like data quality, bias, explainability, human–AI teaming, and change management in a critical way. There are two main parts to the contribution: (i) a practice-oriented synthesis that links academic evidence to a large-scale retail deployment, and (ii) an analytic template for figuring out how valuable AI is in inventory operations. We finish with a research agenda that includes causal evaluation of AI interventions, multi-objective optimization that includes sustainability, and the creation of explainable tools for use by people on the front lines.

| KEYWORDS

Artificial intelligence; Inventory management; Demand forecasting; RFID; Computer vision; Generative AI; Walmart; Retail operations; Digital twin; Supply chain optimization

| ARTICLE INFORMATION

ACCEPTED: 15 November 2023 **PUBLISHED:** 25 December 2023 **DOI:** 10.32996/jbms.2023.5.6.15

1. Introduction

Managing retail inventory is very uncertain because demand changes, lead times are different, and product assortments are large. In the past, retailers used rule-based replenishment and human judgment. These methods worked well when things were stable, but they don't work as well when there are frequent promotions, regional differences, and supply problems. The growth of machine learning (ML) and the widespread availability of detailed data have made it possible to move toward predictive, adaptive control. Edge computing, robotics, and sensors also collect real-time data on shelves and assets to close the gap between planning and execution. Walmart's U.S. operations offer a significant perspective for examining this transition. Public disclosures show that Walmart is putting money into predictive forecasting for merchants, computer vision-assisted shelf visibility, autonomous quality inspection, augmented reality-assisted item location, and AI assistants that turn complex process knowledge into step-by-step tasks for employees (Walmart, 2025a; Benzinga, 2025; PYMNTS, 2025). Looking at Walmart's stack along with the rest of the research record helps us understand where AI adds real value, what risks are worth paying attention to, and how design choices affect results.

2. Literature Background

AI for managing inventory includes three areas that are all connected: demand forecasting, inventory control, and execution visibility. A substantial body of forecasting literature indicates that machine learning ensembles can surpass traditional time-

series methodologies when exogenous factors (such as weather, events, and prices) are present, and feature engineering effectively addresses nonlinearity (Makridakis et al., 2018). But improvements depend on how clean, detailed, and hierarchical the data is across SKUs, stores, and regions (Mau, 2021). Second, research on inventory control shows that more accurate forecasts only lower safety stock if the right estimates are made for uncertainty parameters and reorder policies are made based on service-level constraints (Silver et al., 1998; Babai & Syntetos, 2019). Third, visibility technologies like RFID, computer vision, and the Internet of Things (IoT) help solve the long-standing problem of discrepancies between on-hand records and shelf reality. Studies have shown that using RFID in clothing and general merchandise can improve inventory accuracy and on-shelf availability, especially for items that are fast-moving and come in different sizes (GS1 US, 2020; Hardgrave et al., 2013). The wider supply chain literature talks about how AI can help with risk sensing and resilience, but it also warns that models can break down during extreme events and that they need to be explainable in real-world situations (Baryannis et al., 2019; Ivanov & Dolgui, 2020). Lastly, research on organizations shows that training, incentives, and process redesign are what really make technology valuable; data and models alone are rarely enough (Waller & Fawcett, 2013).

3. Methods and Analytical Approach

This research utilizes a structured case-synthesis methodology. We combine peer-reviewed research on AI capabilities with reports from practitioners and Walmart's public communications to get a complete picture of design choices and results. The method puts traceable claims first and doesn't try to guess at private metrics. When quantitative KPIs are shown as percentages or directions, we normalize them to an index (baseline = 100) so that they can be compared visually. The synthesis is centered on three layers: (i) the model layer, which includes forecasting, optimization, and assistants; (ii) the sensing/automation layer, which includes RFID, AR, computer vision, and robotics; and (iii) the workflow layer, which includes task orchestration and human–AI teaming. Ethical considerations encompass privacy, bias reduction, transparency of recommendations, and the avoidance of excessive surveillance resulting from automation. This method gives us a generalizable template for judging AI interventions in retail that is based on real-world experience.

4. Walmart's AI Stack for Inventory Management

Forecasting and helping merchants make decisions. Walmart has talked about using a merchant-facing generative assistant, which is often called "Wally," to combine sales, inventory, and outside signals to find underperformers and overperformers and suggest actions (PYMNTS, 2025). These kinds of tools add natural-language explanations and drill-downs to ML forecasts, which could speed up decision-making and improve cross-functional alignment. When governance makes sure that parameters like lead time and service targets are in line, forecast error reductions mean less safety stock in inventory planning (Silver et al., 1998).

Automation of the supply chain and distribution. AI-enabled quality inspection can automatically scan packages and flag defects at distribution centers. Pallet/load optimization takes into account weight, temperature, and routing constraints to cut down on touches and damage (Walmart, 2025a). Digital twin deployments copy store assets like refrigeration to find problems early, which is said to lower maintenance costs and emergency alerts through predictive detection (CNBC, 2025; Walmart, 2025b).

Tools for associates and visibility in stores. RFID-enabled workflows and AR overlays on the sales floor help associates find items and finish picks faster. This solves a common problem with order fulfillment and shelf recovery (GS1 US, 2020). Walmart has also talked about AI-assisted task orchestration that puts tasks in order and shortens planning time for overnight shifts, which frees up time for customer-facing tasks (Benzinga, 2025). Autonomous scrubbers with computer vision take pictures of shelves and send automated alerts when facings are empty or mispriced. This closes the loop between finding and restocking (Brain Corp, 2023).

Assistants who work with customers. Walmart has shown off multimodal shopping agents like "Sparky" that replace keyword searches with conversational guidance, dynamic bundles, and recipe-to-basket conversions. These are demand signals that can be used to improve short-term forecasts for omnichannel fulfillment (Times of India, 2025; Walmart, 2025a). These features make up a layered AI stack that includes data, models, and workflows.

5. Results: KPI Patterns and Operational Effects

Putting together the publicly reported results shows that there is a clear impact story. Adopters say that stockouts, too much inventory, and forecast error have all gone down. They also say that they can find anomalies earlier and that they are more productive when planning tasks and finding items. Walmart's communications have talked about, for example, how RFID-AR makes it easier to find items and how digital twins help find problems with equipment earlier and send fewer emergency alerts (CNBC, 2025; Walmart, 2025b). Figure 1 shows these effects on a 0–100 index that has been normalized. The pattern is illustrative and matches peer-reviewed research that predicts improvements and accuracy in records that together lead to service-level

gains with less inventory (Makridakis et al., 2018; GS1 US, 2020).

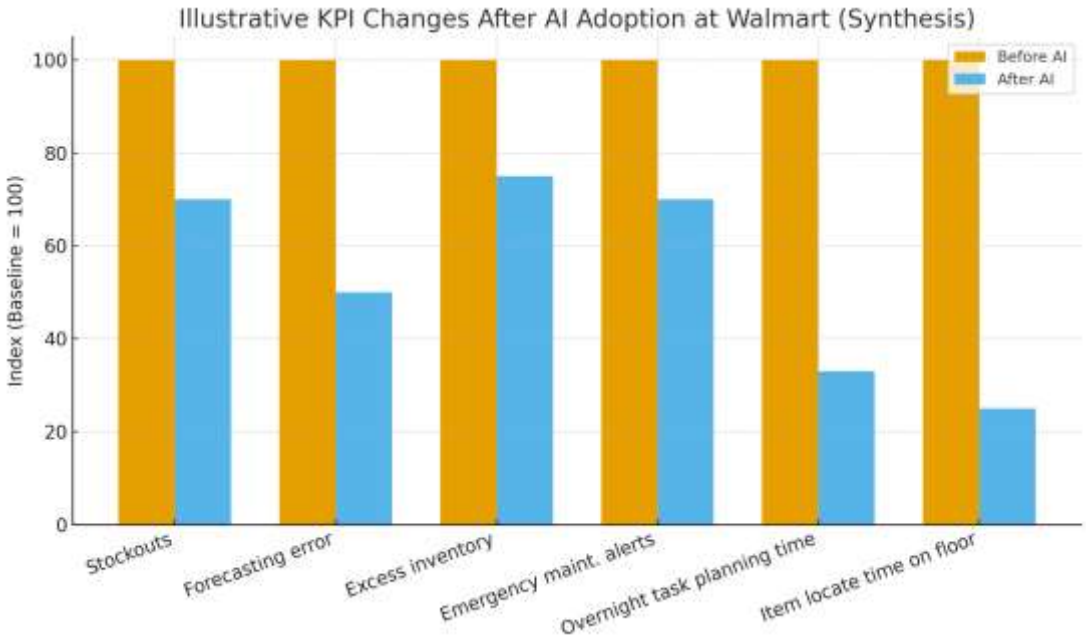

Figure 1. Illustrative KPI changes after AI adoption at Walmart (normalized baseline = 100). *Values synthesized from publicly reported percentage improvements (see References).*

6. Discussion

Three design choices stand out. First, combining forecasting with shelf-level visibility helps solve the common problem of inaccurate on-hand records: even if you have better predictions, if you don't have accurate execution data, you still misallocate stock. Second, putting explainable recommendations into assistants could make organizations more trustworthy and make it easier for people on the front lines to use them. However, governance is needed to stop people from relying too much on them and to get feedback from people to improve the models. Third, digital twins turn data from different pieces of equipment into a system state awareness, which lets you do maintenance before it is needed, which keeps the cold chain intact and stops write-offs. Retailers have to be ethical by reducing bias (for example, making sure that regional demand models don't unfairly serve some communities), protecting workers' privacy when assigning tasks, and giving people a way to appeal AI-driven task assignments (Baryannis et al., 2019; Ivanov & Dolgui, 2020). Explainable AI and audit trails help external stakeholders follow the rules and build trust with customers, especially when prices and availability are affected by algorithms.

7. Limitations and Future Work

This synthesis is constrained by its dependence on public sources; proprietary information regarding model architectures, feature stores, and A/B test designs is inaccessible. The reported magnitudes of outcomes may be specific to the context, and establishing causal attribution is challenging outside of controlled experiments. Consequently, the normalized indices in Figure 1 should be regarded as indicative rather than conclusive. Subsequent research ought to integrate randomized field experiments with quasi-experimental designs (e.g., difference-in-differences across staggered rollouts) to delineate effects. Methodologically, there is potential to incorporate multi-objective optimization—reconciling service levels, working capital, labor, and sustainability—and to create clear uncertainty estimates that influence reorder policies. Lastly, we need to do more research on how humans and AI can work together. Interfaces that let associates fix or explain exceptions can make data better and make people more likely to accept it.

8. Conclusion

Walmart's AI program shows how modern retail can link sensing, predicting, and acting on a large scale. The literature indicates that enhancements in forecasting, when integrated with precise execution data and coherent policies, simultaneously diminish stockouts and inventory levels. Walmart's reported efforts, such as merchant assistants, RFID-AR visibility, computer vision, digital twins, and task orchestration, are very similar to the evidence base. For practitioners, the message is clear: value comes not from individual tools, but from a design that connects models and operations in a way that makes sense. Walmart's use of AI

in inventory management raises important questions for researchers about causal inference, explainability, and socio-technical design. If these questions are answered, AI-enabled inventory management can be both more effective and more fair.

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