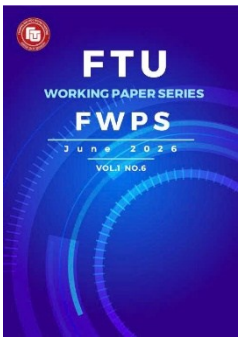

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PHÂN TÍCH MÔ HÌNH TRUNG TÂM HOÀN TẤT ĐƠN HÀNG CỦA WALMART VÀ HÀM Ý ĐỐI VỚI MẠNG LƯỚI PHÂN PHỐI BÁN LẺ TẠI VIỆT NAM

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Tóm tắt

Sự phát triển nhanh chóng của thương mại điện tử cùng kỳ vọng ngày càng cao của người tiêu dùng về việc giao hàng nhanh chóng và linh hoạt đã buộc các nhà bán lẻ phải thiết kế lại các mạng lưới phân phối truyền thống. Trung tâm hoàn tất đơn hàng (Market Fulfillment Centers - MFCs), một hình thức hoàn tất đơn hàng vi mô tích hợp tại cửa hàng, đã nổi lên như một giải pháp chiến lược kết hợp giữa tự động hóa và lợi thế gần sát người tiêu dùng cuối cùng. Sử dụng dữ liệu thứ cấp từ các báo cáo doanh nghiệp và nguồn tin ngành, nghiên cứu này khám phá quy hoạch hoàn tất đơn hàng kỹ thuật số, hệ thống điều phối đơn hàng, nền tảng vận hành robot và quy trình vận hành trong môi trường MFC của Walmart. Kết quả nghiên cứu chỉ ra rằng mô hình MFC của Walmart dành cho cả hàng hóa nhiệt độ thường và hàng hóa kiểm soát nhiệt độ, kết hợp với lộ trình đơn hàng linh hoạt và thực hiện đơn hàng tại cấp cửa hàng, cho phép Walmart cung cấp dịch vụ giao hàng trong ngày và ngày kế tiếp trên quy mô lớn, đồng thời giảm cường độ lao động. Dựa trên phân tích này, bài viết thảo luận về những hàm ý đối với mạng lưới phân phối bán lẻ tại Việt Nam, nơi quá trình đô thị hóa gia tăng và việc áp dụng thương mại điện tử đang mở ra nhiều cơ hội cho các mô hình hoàn tất đơn hàng tự động hóa tại địa phương.

Từ khoá: trung tâm hoàn tất đơn hàng, hoàn tất đơn hàng vi mô, tự động hoá kho hàng, phân phối bán lẻ, Việt Nam

ANALYSIS OF WALMART'S MARKET FULFILLMENT CENTERS AND IMPLICATIONS FOR RETAIL DISTRIBUTION NETWORKS IN VIETNAM

Abstract

The rapid growth of e-commerce and rising consumer expectations for fast, flexible delivery have compelled retailers to redesign traditional distribution networks. Market Fulfillment Centers (MFCs), a form of store-integrated micro-fulfillment, have emerged as a strategic solution that combines automation with proximity to end consumers. Using secondary data from corporate disclosures and industry sources, the study explores Walmart's digital fulfillment planning, order orchestration systems, robotic execution platforms, and operational workflows within MFC environments. The findings indicate that Walmart's MFC model of ambient and temperature-

controlled goods, combined with dynamic order routing and store-level fulfillment, enables Walmart to deliver same-day and next-day services at scale while reducing labor intensity. Based on this analysis, the paper discusses implications for the retail distribution network in Vietnam, where increasing urbanization and e-commerce adoption present opportunities for localized automated fulfillment.

Keywords: market fulfillment centers, micro-fulfillment, warehouse automation, retail distribution, Vietnam

1. Introduction

The rapid growth of e-commerce and rising consumer expectations for fast and flexible delivery are reshaping retail supply chains. Traditional centralized distribution models increasingly struggle to support same-day or next-day fulfillment, prompting retailers to explore new approaches that integrate physical stores with digital commerce systems. MFCs have emerged as a solution by embedding automated fulfillment capabilities within or adjacent to retail stores. Walmart has been a leading adopter of this approach, transforming its store network into a hybrid retail distribution system supported by digital orchestration and robotic micro-fulfillment technologies.

This paper seeks to address the following research question: How does the integration of digital process automation and physical warehouse automation in Walmart's Market Fulfillment Centers enhance retail distribution efficiency, and what implications does this model have for the development of retail distribution networks in Vietnam? To answer this question, the study examines Walmart's MFC practices to analyze how digital process automation and physical warehouse automation are integrated to support omnichannel operations. The contribution of this paper is twofold. From a theoretical perspective, it provides a structured analysis of how micro-fulfillment models integrate digital and physical automation within omnichannel retail systems. From a practical perspective, it offers insights into how the MFC concept can be adapted to the Vietnamese context, emphasizing a hybrid, store-based fulfillment approach that aligns with local market conditions rather than direct replication of highly automated systems. Using secondary data from corporate and industry sources, the study also discusses implications for retail distribution network development

in Vietnam. The remainder of the paper reviews relevant literature, presents the Walmart case analysis and concludes with key findings and future research directions.

2. Theoretical framework

2.1. Store-based fulfillment

Store-based fulfillment is a strategic model that emerges from the integration of logistics operations within an omni-channel framework. According to Hübner et al. (2016), this approach is operationalized through 'leveraging of store inventory' to fulfill online orders from shared shopfloor stock, and 'integrated store picking' where items are processed directly from retail shelves. Rather than serving solely as points of sale, stores are leveraged to support online order fulfillment, inventory holding, and last-mile delivery activities. Theoretically, store-based fulfillment generates economies of scope by utilizing existing fixed assets to serve both physical and digital channels (Agatz et al., 2008). By leveraging these sunk costs, retailers can lower the marginal cost of network expansion compared to the high capital requirements of building dedicated fulfillment warehouses (Ishfaq et al., 2016; Melacini et al., 2018). From a supply chain network design perspective, using stores as fulfillment hubs enables retailers to position inventory closer to customers, thereby reducing delivery lead time and last-mile logistics costs (Chopra & Meindl, 2019).

2.2. Micro-fulfillment center concept

2.2.1. Definition

Micro-fulfillment centers are defined as small-scale, highly automated warehousing facilities strategically positioned near end customers (Yang et al., 2024). Unlike regional distribution centers, MFCs are designed for quick online order fulfillment, greatly cutting down on last-mile delivery expense and time in large urban areas and cities (Vijayendra Vittal Rao, 2025). According to Rao, these centers utilize automatic selecting and packaging procedures. They typically occupy small footprints alongside modular scalability, which allows them to be retrofitted into existing infrastructure as the back of retail stores. This distributed location strategy is classified as a decentralised fulfillment strategy for inventory management and last-mile delivery (Alessandro et

al., 2022). One key characteristic of MFCs is the simultaneous optimization of both operational efficiency and responsiveness. While automated warehouses offer high efficiency through processes such as order picking and inventory management, MFCs enhance responsiveness by positioning fulfillment operations closer to the customer.

2.2.2. Omnichannel retail and order fulfillment

In the context of omnichannel retail, the MFC serves as the operations backbone that integrates online demand with physical retail assets. Traditional in-store fulfillment, which involves picking items from store shelves, often leads to inefficiencies such as congestion, stockouts and channel conflicts between online and offline channels.

Firstly, this segregation is critical for inventory health. Lee et al. (2023) suggested that the operation of MFCs eliminate waste cost stemming from failures in demand forecasting, a benefit that is particularly pronounced for perishable goods in the retail sector. Secondly, the operational benefits of MFCs in distribution networks are centered in their impact on cost and precision. Jaghbeer et al (2020) observe that automated systems shrink both time and cost related to picking activities. Thirdly, MFCs optimize the economics of last-mile delivery and real estate, addressing the critical pressures in the grocery sectors. According to Ratchford et al. (2023), the increasing consumer habituation to speed has driven expectations for speedy delivery, posing a primary challenge to the modern retail sector.

2.2.3. Last-mile logistics and urban fulfillment

Firstly, the introduction of semi-automated solutions positively impacts logistics speed. According to Andreas Karaoulanis (2024), contemporary MFCs utilize pick-to-cart or pick-to-robot systems which incorporate automated sortation to rapidly consolidate orders. This capability for quick consolidation is a critical component of the urban logistics equations, ensuring that orders are processed and quickly dispatched with the speed necessary to meet tight delivery windows. Secondly, the decentralized network structure alleviates urban congestion and environmental impact. Large urban centers or metropolises are characterized by high traffic density and strict regulatory constraints, which hinders the efficiency of large-scale delivery transportation (Rai et al., 2022).

Finally, this decentralized structure enables the quick commerce model. In this model, delivery windows are measured in minutes rather than days. Yang et al. (2024) describes the ability to fulfill orders from a local urban node rather than a distant regional hub as "winning the race to the customer."

2.3. Automation in Micro-fulfillment center

2.3.1. The goods-to-person process model

The goods-to-person (G2P) process model is an automated order-fulfillment approach in which products are transported directly to human operators or packing stations, rather than requiring workers to walk through storage racks to retrieve items (Boysen et al., 2019). In micro-fulfillment centers, compact, automated facilities often embedded within retail stores, therefore, the goods-to-person model is fundamental for achieving high throughput, accuracy and space efficiency (Wurman et al., 2008). In a typical MFC, the G2P process begins when a consumer places an online order via the retailer's digital platform. Automated storage and retrieval systems or autonomous mobile robots then locate and retrieve the required items, transporting them to centralized picking or packing stations. (Gu et al., 2010).

The G2P model offers several important advantages for MFC operations. First, by bringing goods to workers, it significantly reduces non-productive travel time, which is a major driver of inefficiency in manual picking systems (De Koster et al., 2006). Second, automation increases throughput and improves picking accuracy, reducing errors and enhancing customer satisfaction. Third, G2P systems enable vertical and dense storage, maximizing storage capacity in urban environments where space is limited (Boysen et al., 2019).

2.3.2. Automation categories

a. Semi-automated vs. Fully automated systems

In semi-automated MFCs, automation supports human workers by handling specific tasks such as retrieving inventory bins or conveying items while human operators still perform picking, packing and exception handling. Semi-automation is often preferred when order volumes are moderate or when facilities must maintain human flexibility for complex picks (Gu et al., 2007). In contrast, fully

automated MFCs feature end-to-end automation. These systems rely on advanced software, autonomous robots, and high-density automated storage and retrieval systems. Fully automated centers achieve very high throughput and consistency, making them suitable for high-order volumes in dense urban markets (Boysen et al., 2019).

b. Fixed vs. Flexible automation

Fixed automation refers to systems designed for specific, repetitive workflows with little change over time. Traditional conveyor belts, fixed AS/RS towers and dedicated sortation lines fall into this category. These systems deliver high efficiency when demand patterns and product flows are stable but can be difficult to reconfigure if business needs change (De Koster et al., 2006). At the same time, flexible automation includes technologies that can adapt more easily to changes in demand, product mix or facility layout. Flexible systems are especially attractive in MFCs, where space is limited and product assortments are continually evolving.

2.3.3. Automation technologies

a. Automated Storage and Retrieval Systems (AS/RS)

AS/RSs can be defined as computer-controlled systems that automatically and autonomously store and retrieve goods from storage locations by means of mechanical devices *(ResearchGate, 2012).* These systems can help leveraging vertical space, increasing storage density and reducing manual handling time.

b. Autonomous Mobile Robots (AMRs) and Automated Guided Vehicles (AGVs)

AGVs are driverless vehicles with their own drive unit that move on a specific, defined path. They are steered automatically and can therefore transport goods without an operator. However, AGVs can only drive on a predefined route. They use sensors to navigate as well as marks, inductive loops and nearby reflectors to guide them (KNAPP, 2025).

AMRs flexibly and dynamically react to changes in their surroundings in real time thanks to digital maps of the warehouse paired with highly sophisticated sensors and AI that allow them to independently detect obstacles and avoid them (KNAPP, 2025). Walmart has increasingly adopted

robotics solutions to support order picking and replenishment processes in its MFCs.

c. Robotic picking and sorting systems

Sorting is a new application of robotic autonomous vehicles, in which robotic vehicles sort parcels and transport them from any origin to any destination point (ResearchGate, 2021). These systems are often supported by machine vision and artificial intelligence, helping enhance item recognition and error detection.

d. Warehouse Management Systems (WMS)

WMS is a computer application system designed to manage and optimize workflows and the storage of goods within a warehouse. It often interfaces with the automated data capture and enterprise resource planning systems (ASCM, 2025). The systems integrated with real-time data analytics coordinate automated equipment, inventory tracking and order flow across the fulfillment center.

3. Analysis of Walmart's Market Fulfillment Center Practices

3.1. Overview of Walmart

3.1.1. About the company

Walmart Inc. is one of the world's largest multinational retail corporations, operating a vast network of hypermarkets, discount department stores and grocery stores across multiple countries. Founded in 1962 in the United States, Walmart has developed a highly integrated retail and logistics system that emphasizes cost leadership, large-scale distribution efficiency, and supply chain optimization. With the rapid expansion of online shopping and increasing consumer expectations for fast delivery, Walmart has transformed its traditional store-based retail model into an omnichannel retail ecosystem. Physical stores are no longer used solely as sales outlets but also function as inventory holding points and local fulfillment nodes. This strategic shift has required Walmart to redesign its distribution network and adopt new fulfillment models to compete effectively with e-commerce-focused retailers.

3.1.2. Overview of Walmart's market fulfillment center

Walmart's MFC is a compact, automated micro-fulfillment facility located within or adjacent to existing Walmart stores. Instead of fulfilling online orders from distant regional distribution centers, MFCs leverage store-proximate inventory and automation technology to pick and prepare orders for same-day delivery, curbside pickup, or in-store pickup, thereby significantly reducing lead time and last-mile costs. The MFC concept is part of Walmart's broader omnichannel fulfillment strategy, which integrates physical store assets with digital order flows and automation systems to enhance service speed and flexibility for customers. Walmart began piloting its first MFC in Salem, New Hampshire, in late 2019 using robotic automation developed with Alert Innovation. The MFC holds thousands of popular grocery and consumable items in a dedicated space within the store, where autonomous bots retrieve products and bring them to a picking workstation for order assembly. Executives emphasize that MFCs not only improve order availability and speed but also help Walmart compete with pure-play e-commerce providers by exploiting its vast physical footprint with most U.S. consumers living within 10 miles of a store.

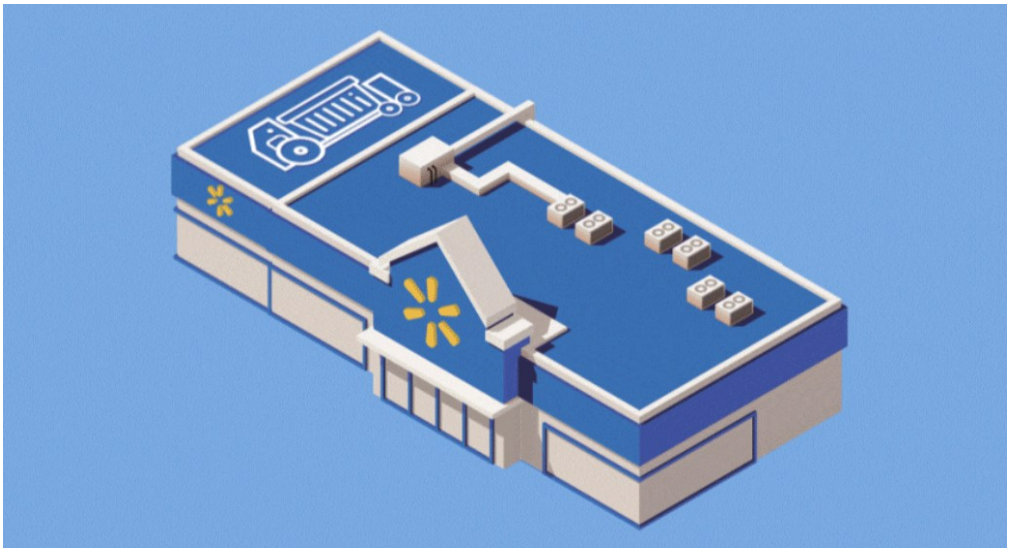

Figure 1: *Walmart's Market Fulfillment Center*

Source: Walmart's website, 2022

3.2. Current applications of market fulfillment center in Walmart

3.2.1. Walmart's digital process automation in MFCs

a. Digital fulfillment planning and order orchestration

Walmart's MFCs are supported by advanced digital fulfillment planning and order orchestration systems that determine what to fulfill, where to fulfill it from, and how to execute the most efficient fulfillment strategy across stores and fulfillment modules. Rather than fulfilling online orders from centralized distribution centers, Walmart's systems integrate real-time inventory data, customer demand signals, and fulfillment capacity at individual store locations, enabling rapid and localized fulfillment for pickup or delivery (Corporate Walmart, 2022).

At the core of Walmart's digital orchestration is the ability to synchronize e-commerce orders with inventory held in MFCs and store stock, ensuring that orders are routed to the most appropriate fulfillment point based on criteria like item availability, customer location and delivery timing. Walmart has articulated that MFCs are designed to boost online order capacity and speed by dedicated automation rather than relying solely on picking from store shelves, reducing manual exceptions and out-of-stock situations. Walmart also provides digital tools that enhance inventory visibility and supply chain coordination beyond the store walls. Order orchestration logic at Walmart coordinates these digital inputs to assign orders to the optimal fulfillment channel based on delivery goals and inventory locations. Official Walmart communications emphasize this seamless digital orchestration as a strategic advantage as MFCs expand the company's ability to fulfill orders rapidly through a combination of store assets and digital planning systems.

b. Digital control systems

A core component of Walmart's digital execution layer is the robotics control software that manages task sequencing, fleet coordination and real-time feedback within the MFC environment. Walmart's MFCs use software to allocate discrete tasks to autonomous bots based on priority, robot availability and workspace flow, thereby minimizing idle time and maximizing throughput.

Walmart's fulfillment execution layer is powered by proprietary control software originally developed by Alert Innovation. Rather than focusing on mechanical movement, this digital control

platform functions as a real-time orchestration engine that converts customer orders into structured fulfillment tasks, manages system-wide priorities and synchronizes automated equipment with human workstations (Corporate Walmart, 2022). A key advantage of Alert's control architecture lies in its ability to perform dynamic task sequencing and fleet optimization, continuously adjusting fulfillment workflows based on order urgency, system congestion and workstation availability. In addition, the platform supports exception management and human-machine collaboration. When anomalies such as inventory discrepancies or order substitutions arise, the system reroutes tasks and alerts associates through digital interfaces, ensuring continuity of fulfillment without manual system resets.

3.2.2. Walmart's physical process automation in MFCs

Walmart has extensively deployed physical process automation technologies in its Market MFCs to revolutionize order fulfillment speed, operational efficiency and labor optimization. These automated systems serve as the cornerstone of Walmart's transition from traditional distribution models toward a highly responsive, omnichannel fulfillment ecosystem. At the center of this strategy is the implementation of the Alphabot solution. Unlike traditional warehouse setups that rely on static conveyors or lifts, these bots navigate horizontally, laterally and vertically across dense storage zones to store, retrieve and dispense items with unprecedented precision (Corporate Walmart, 2022).

The operational impact of Alphabot is most evident in its ability to streamline the pick-and-pack process. When an online order is placed, the system's bots autonomously identify and retrieve products from high-density storage racks, delivering them directly to a centralized picking station. This G2P workflow fundamentally alters the role of store associates instead of manually navigating miles of store aisles to fulfill individual orders. By situating these automated MFCs within or adjacent to its existing 4,700 stores, Walmart effectively transforms its physical footprint into a high-velocity logistics network. Furthermore, the strategic placement of these facilities allows Walmart to leverage its geographical proximity to the consumer base, with approximately 90% of the U.S. population residing within 10 miles of a Walmart location.

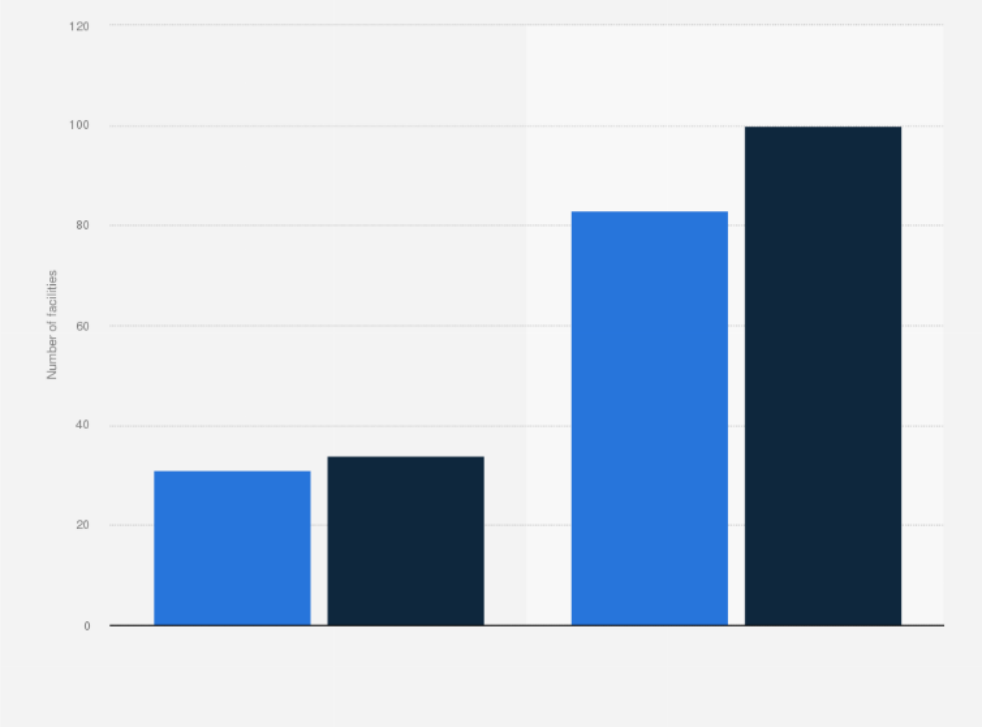

Figure 2: Number of e-commerce fulfillment centers managed by Walmart in FY 2022 and FY 2023

Source: Statista, 2023

3.2.3. Walmart's MFC operational workflow

a. Seamless integration of fresh and ambient goods

Walmart's MFC operational workflow is strategically engineered to solve the grocery paradox, the challenge of fulfilling high-velocity ambient goods alongside sensitive, temperature-dependent fresh products within a single, condensed environment. The core of this strategy is the multi-temperature automation zone. The Alphabot system is designed to operate seamlessly across ambient, chilled and frozen environments, allowing the same robotic fleet to handle everything from cereal boxes to refrigerated dairy. This integration allows Walmart to consolidate approximately 70% to 80% of a typical grocery order through automation. However, the true strategic sophistication lies in the concurrent manual-automation synchronization. For items that are high-touch or irregular in shape such as loose produce (bananas, avocados) or fragile goods (eggs), Walmart utilizes a "pick-to-tote" system where store associates pick these items manually from the sales floor or dedicated

fresh rooms. By leveraging the MFC as a high-speed buffer, Walmart can maintain lower on-hand inventory levels for fresh goods while increasing turnover rates. As noted in Corporate Walmart's 2023 reports, this operational precision has led to a noticeable reduction in "shrink" (food waste) and a higher "perfect order" rate, where customers receive exactly what they ordered at the peak of freshness. This synergy between temperature-zoned robotics and strategic manual intervention allows Walmart to scale its online grocery business which now accounts for a dominant 36% of the U.S. online grocery market (Supermarket News, 2023).

b. Last-mile handover efficiency

Unlike competitors who rely heavily on 3PL like UPS or FedEx, Walmart has built a proprietary crowdsourced delivery platform called Spark Driver. Once an order is assembled by the MFC's system, Walmart's routing engine uses real-time analytics to assign the package to the optimal channel. By 2023, the Spark platform had expanded to cover all 50 U.S. states, servicing over 10,000 pickup points. This integration allows the handover from the MFC assembly station to a driver's vehicle to occur in minutes, supporting Walmart's Express Delivery which can reach customers' doors in as little as 30 to 60 minutes (Corporate Walmart, 2023). Furthermore, the integration of Geofencing technology alerts the MFC staff the moment a delivery driver or a pickup customer enters the store's perimeter, ensuring the handover is nearly instantaneous.

3.3. Evaluation of Walmart's Market Fulfillment Centers

3.3.1. Achievements

A primary achievement of the MFC model is enhanced fulfillment speed and last-mile responsiveness. Store-proximate order processing shortens both picking distances and delivery routes, enabling faster order completion in targeted high-density markets (Walmart Inc., 2023). According to Walmart's Q3 FY26 earnings disclosures, approximately 35% of store-fulfilled online orders were delivered within three hours, indicating a substantial reduction in order cycle time relative to traditional distribution-center-based fulfillment (Walmart, 2025). Beyond responsiveness, MFCs also contribute to improved cost efficiency within Walmart's fulfillment network. Automation embedded within MFCs reduces reliance on manual picking labor and stabilizes

processing rates, improving operational consistency. Walmart reported that more than 50% of its U.S. e-commerce fulfillment volume is now processed through automated systems, reflecting a significant shift toward automation-enabled fulfillment (Retail Dive, 2025). These developments have been associated with a reported reduction of approximately 40% in net delivery cost per order in the U.S. market, driven by labor savings and improved route efficiency (Retail Dive, 2024).

Lastly, MFCs also enhance inventory efficiency by enabling shared utilization of store-level inventory across online and offline channels. Instead of maintaining separate safety stocks for different fulfillment channels, Walmart can dynamically allocate inventory based on real-time demand signals. This integrated inventory approach reduces stock imbalances and improves availability for high-velocity grocery and household items, where service reliability is critical (Verhoef et al., 2015).

3.3.2. Limitations

A key limitation of the MFC model is its dependence on sustained order volume density to justify high upfront investment costs. Automated micro-fulfillment systems require substantial capital expenditure for robotics, facility retrofitting, software integration and workforce training. Walmart's automation strategy therefore prioritizes high-throughput locations, indicating that MFC deployment is less economically viable in low-demand or geographically dispersed markets. This pattern aligns with supply chain network design theory, which highlights the risk of underutilized fixed assets in decentralized fulfillment configurations when demand volumes are insufficient to support capacity utilization.

Operational complexity further constrains the performance potential of store-based automation. This forces a zero-sum trade-off: maximizing fulfillment space often comes at the cost of reducing customer sales floor area, potentially interfering with the in-store shopping experience. Embedding automated fulfillment operations within active retail stores requires careful coordination between customer-facing activities and back-of-house logistics processes. Moreover, while automation enhances efficiency for standardized goods, it introduces inherent operational rigidity. Consequently, this creates a structural limitation where the system handles high-volume standard

goods efficiently but leaves complex exceptions to manual labor, diluting the overall return on investment. (Chopra & Meindl, 2019).

From a network resilience perspective, decentralizing automated assets across multiple store locations introduces maintenance fragmentation. While a centralized warehouse typically has on-site engineers to resolve technical issues immediately, a decentralized network of thousands of stores often relies on roving technicians. Therefore, capacity constraints or equipment disruptions at individual MFC sites can temporarily impair fulfillment performance in affected areas, necessitating sophisticated coordination and contingency planning to maintain service continuity. To mitigate this risk, Walmart's MFCs should not be applied uniformly, but rather selectively deployed in high-volume markets.Implications for Vietnamese Retail Enterprises

4. Implications for Vietnamese Retail Enterprises

4.1. Vietnamese enterprises situation in applying micro-fulfillment

4.1.1. Current situation

Vietnam's disproportionately high logistics cost, currently estimated at 18-20% of GDP, creates a significant structural cost burden for retailers (Vietnam +, 2025). Over 70% of domestic freight relies on expensive road transport, which incurs a massive base cost that often outpaces any financial gains from increased responsiveness (B&C, 2025). Regarding the last-mile delivery, Vietnam's context is dictated by a dominant 75 million motorbikes economy and severe urban congestion, where average travel speeds drop to 20km/h during peak hours (Kieu et al., 2025). Given the economic and logistical constraints of Vietnam's logistics environment, retailers adopt a distinct operational model, the manual store-as-hub. However, the functional necessity for rapid, decentralized fulfillment remains critical, while according to FMI (2025), high $3-$5 millions up-front capital expenditures decentralized retail automation conversely create a fixed cost burden that is unsustainable in such fragmented logistic capability.

The practical viability of the manual adaptation model is evidenced by the diverging logistics strategies of Vietnam's dominant retail players, WinCommerce and Bach Hoa Xanh. WinCommerce leverages the country's most extensive retail footprint, comprising nearly 4,000 points of sale, to

establish a ubiquity-based fulfillment grid. To address the margin erosion typical of fragmented 3PL relationships, the company internalized its supply chain by establishing Supra, a dedicated logistics subsidiary (VnExpress, 2024). Supra functions as a centralized command node, managing 10 regional distribution centers that process approximately 60% of the total network volume. By retaining centralized control over procurement while decentralizing fulfillment through manual store hubs, Supra achieved a 11% reduction in unit logistics costs in 2024. In contrast to Western high-tech models, Bach Hoa Xanh has developed a store-based fulfillment specifically adapted for the Vietnamese fresh food market, where perishables constitute 40-60% of the SKU mix and demand high-velocity turnover (Brands Vietnam, 2024). Bach Hoa Xanh executed a strategic network rationalization, closing underperforming nodes to consolidate volume and boost average revenue per store to 2.1 billion VND per month. Rather than deploying capital-intensive automation, Bach Hoa Xanh prioritized a process-first micro-fulfillment strategy. This involves leveraging AI-driven inventory management to reduce shrinkage to 3.2% and optimizing truck fill rates from regional centers to local hubs (PocketOption, 2024).

4.1.2. Evaluation

This evaluation highlights that the Vietnamese retail sector, particularly SMEs benefits from an abundance of low-cost manual labor, making high upfront investments in advanced robotic systems less economically attractive in the short term. While large players such as WinCommerce and Bach Hoa Xanh have demonstrated the ability to internalize logistics functions and optimize costs at scale, these capabilities are not easily transferable to SMEs due to differences in capital resources, operational scale, and technological readiness.

At the same time, the sector faces significant technological fragmentation, which creates long-term scalability challenges for SMEs. According to Market Research Report (2025), a clear divide exists between e-logistics providers, which have adopted Level 2-3 automation for standardized parcels, and grocery retailers, which remain reliant on Level 1 manual processes due to complex SKU variability and fresh inventory management. While manual operations remain cost-efficient in the current labor context, this dependence limits scalability and increases operational vulnerability as demand grows. Furthermore, SMEs lack access to shared automated infrastructure, restricting

their ability to compete with larger, vertically integrated retailers (B&C, 2025).

In addition, last-mile delivery remains a critical constraint. Vietnam's logistics environment is characterized by a motorbike-dominated delivery system and severe urban congestion, where average speeds can drop to 20 km/h. This makes large-scale delivery models used in developed markets less applicable and forces SMEs to prioritize cost efficiency over speed optimization. As a result, last-mile delivery continues to account for a disproportionately high share of total logistics costs, further constraining SME competitiveness.

4.2. Recommendations for Vietnamese SMEs

4.2.1. Strategic digitalization and process standardization

Vietnamese small and medium-sized retailers should first implement low-cost technologies such as radio frequency systems and inventory management apps like KiotViet to improve order accuracy and reduce order cycle time. These technologies offer a cost-effective solution for businesses that are not yet ready to invest in fully automated systems. Once retailers have successfully implemented these systems and established a strong operational foundation, they can then explore more advanced solutions such as WMS and real-time data analytics to further enhance inventory coordination and order visibility across decentralized fulfillment hubs.

Additionally, retailers should adopt a centralized command model similar to WinCommerce's Supra, which mirrors Walmart's centralized order aggregation logic. This will ensure superior integration across decentralized manual hubs, enabling better inventory visibility and enhancing operational efficiency.

4.2.2. Incremental automation and scalability

For SMEs, Automation should be introduced through a modular, flexible framework that aligns with demand scale and rising labor costs, rather than a rigid upfront overhaul (VP Prabu, 2022). Initial investments should focus on semi-automated solutions, such as pick-to-cart or automated sortation systems, which support human workers and improve throughput while maintaining the operational flexibility required for diverse SKUs. For example, retailers can begin by deploying Autonomous Mobile Robots (AMRs) to handle smaller tasks such as inventory retrieval or order

sorting in limited spaces, gradually increasing automation as demand grows. This parallels the flexible automation category, utilizing AMRs that can function without fixed infrastructure, allowing for adjustments in facility layout as the omnichannel market matures, through which, allows SMEs to access advanced capabilities without owning expensive infrastructure. As demand increases and operations become more standardized, SMEs can gradually scale automation in selected high-demand locations, particularly in major urban areas.

5. Conclusion

This study examined Walmart's Market Fulfillment Centers as a contemporary model of store-integrated micro-fulfillment, highlighting how digital process automation and physical warehouse automation are combined to support omnichannel retail operations. Through analysis of Walmart's digital fulfillment planning, execution control systems, robotic retrieval infrastructure, and operational workflows, the case demonstrates how localized automation can enhance fulfillment speed, inventory utilization and last-mile efficiency. The findings indicate that Walmart's MFC model transforms physical stores into hybrid retail distribution nodes, enabling same-day and next-day services while reducing manual labor and improving order accuracy.

Further discussion should critically evaluate the feasibility of implementing the MFC model within Vietnam's urban environment, particularly in relation to land availability, real estate costs and last-mile delivery characteristics. Unlike developed markets where large retail stores can accommodate embedded automation systems, major cities such as Hanoi and Ho Chi Minh City are characterized by high population density, fragmented retail formats and limited availability of large contiguous spaces. This makes the deployment of fully automated, store-integrated MFCs more challenging, especially for SMEs

In addition, rising urban real estate costs further constrain the economic viability of dedicating in-store space to micro-fulfillment operations. Allocating valuable retail space to automated storage systems may reduce selling area and revenue potential, creating a trade-off that must be carefully evaluated. As a result, smaller scale micro-fulfillment solutions, such as dark stores or shared urban

warehouses, may be more practical alternatives in dense city environments. Moreover, Vietnam's last-mile delivery system is uniquely shaped by a motorbike delivery logistics network, which differs significantly from van delivery models in Western markets. While motorbikes offer flexibility and accessibility in congested urban areas, they also limit delivery capacity per trip and complicate batch delivery optimization. This reduces some of the efficiency gains typically associated with high throughput automated fulfillment systems. Consequently, the effectiveness of MFCs in Vietnam depends not only on warehouse automation but also on how well the model is adapted to local delivery conditions.

Overall, these factors suggest that while the MFC model offers clear advantages in theory, its direct replication in Vietnam is constrained by urban spatial limitations, cost considerations, and last-mile delivery characteristics. A more feasible approach would involve hybrid and flexible implementations, combining smaller-scale fulfillment nodes, digital coordination systems, and locally adapted delivery strategies.

The Walmart case offers valuable insights for retail distribution network development in emerging omnichannel markets. However, successful implementation in Vietnam would require careful consideration of capital investment, store layout constraints, digital maturity, and workforce readiness. Retailers may benefit from phased automation strategies that prioritize high-demand urban areas and leverage partnerships with technology providers. This study is limited by its reliance on secondary data and publicly available corporate sources. Future research could incorporate empirical performance metrics, comparative analysis across multiple retailers, or simulation-based evaluation of micro-fulfillment deployment in Vietnamese cities. Nevertheless, the findings suggest that Market Fulfillment Centers represent a promising pathway for modernizing retail logistics and strengthening last-mile capabilities in the rapidly evolving consumer market.

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