E-commerce Fulfillment: Omnichannel Operations, Returns Management, and the Last-Mile Challenge

Chen Liyuan
Jiangxi University of Science and Technology, China

ABSTRACT

This paper is investigating how the fulfillment of e-commerce changes. Because customers' expectations have improved, the speed of distribution, the sense of peace of mind and the management of returning goods have become very important to the competition of retail industry. In paper, regional fulfillment centers, ship-from-store, drop shipping, micro-fulfillment centers, and third-party logistics also emphasize the increasing challenges of e-commerce returns. Because returning goods will become a burden both in money and in the environment. Moreover, we are also talking about the method of automatic investigation, the method of putting back the inventory immediately, and the measures of no return and refund. In addition, he also analyzed that the pressure of delivery on the same day and the next day is increasing, and the infrastructure of last-mile is expanding. The conclusion of this study is that the future performance of fulfillment will depend more and more on automation, another delivery technology and the control of the cost of the last mail and management regulations.

Keywords: E-commerce Fulfillment; Omnichannel; Returns Management; Last-Mile; Micro-fulfillment; Drop Shipping; Amazon; Delivery Speed

1. INTRODUCTION

E-commerce fulfillment-from accepting online orders, selecting goods, packing to delivering goods to customers-has changed from a simple warehouse job to the most complicated and competitive topic in retail industry. Customers want to "deliver early" from a few weeks (catalog fulfillment in the 1990s) to a few days (ordinary e-commerce), a few hours (Amazon prime now) and food delivery (quick commerce). By 2022, there are 175 full-document centers in the world, and there are air cargo hubs, distribution stations and last-mile delivery infrastructure, representing the most sophisticated consumer fulfillment operation ever built

2. FULFILLMENT CENTER OPERATIONS

2.1 Pick, Pack, and Ship

In the work of fulfillment center, there are receiving inventory, slotting optimization (putting the best-selling things in an easy-to-operate place to shorten the moving time), selecting goods for order, which requires a lot of manpower, packaging and labeling for delivery, loading trucks, etc., to better complete these core tasks. In the fulfillment center using Amazon robot, thousands of driving units transport the stored pod to the static picking place. In this way, it can not only be 2-3 times faster than picking things up by hand, but also reduce the area of facilities and keep more goods. The wave-based picking (batching orders for simultaneous picking to improve picker travel efficiency) versus discrete picking (picking one order at a time for simplicity) trade-off is a fundamental fulfillment center design choice.

2.2 Micro-fulfillment Centers

Micro-fulfillment centers (MFCs)—small, highly automated fulfillment facilities located close to population centers (in or near existing retail stores, urban warehouses) to enable same-day and sub-hour delivery for a curated range of SKUs—represent the frontier of urban fulfillment innovation. Grocery retailers (Kroger, Wakefern, Albertsons) have deployed Ocado-technology MFCs to enable online grocery fulfillment at costs approaching store picking; quick commerce operators (Gorillas, Getir, Jokr) operate ultra-small 'dark store' fulfillment nodes optimized for 15-minute delivery of a limited SKU range. The MFC model trades increased fixed infrastructure cost for lower last-mile delivery cost (shorter delivery routes from urban locations) and faster delivery capability.

Table 1. E-commerce fulfillment models, descriptions, and optimal contexts.

Fulfillment Model	Description	Optimal Context
Fulfillment center	Large regional DC with wide SKU range; efficient for volume	Standard 1-2 days delivery; broad SKU range; high volume
Ship from store	Pick and ship from retail inventory; enables same-day	Omnichannel retailers; excess store inventory; same-day
Drop shipping	Supplier ships directly to customer; zero inventory risk	Long-tail SKUs; heavy/bulky items; marketplace extensions
Micro-fulfillment center	Urban automated fulfillment; sub-2-hour delivery	Grocery; convenience; high-density urban markets
Third-party fulfillment (3PL)	Outsourced fulfillment; shared infrastructure	SMBs; international markets; overflow capacity

3. RETURNS MANAGEMENT

E-commerce returns—typically running at 20-30% of apparel orders and 10-15% of electronics orders compared to 8-10% for physical retail—represent one of e-commerce's most significant operational challenges, imposing processing costs of $10-20 per return on top of the original fulfillment cost. Optoro's analysis of U.S. consumer returns estimated that returned merchandise generates 5.8 billion pounds of landfill waste annually—demonstrating that returns management is both a financial and sustainability challenge. Returns management best practices include: returnless refunds (Amazon's policy of refunding without requiring return for low-value items where processing cost exceeds item value); automated condition assessment; rapid restocking of sellable returns; and partnerships with off-price retailers or donation programs for unsellable inventory.

4. CONSUMER DELIVERY EXPECTATIONS

Consumer delivery speed expectations have escalated continuously since Amazon Prime launched two-day free delivery in 2005: same-day delivery has transitioned from premium to expected for grocery and convenience categories; next-day delivery has become the de facto standard for most e-commerce categories. Delivering Happiness—meeting these escalating expectations economically—has driven enormous investment in last-mile infrastructure: Amazon Logistics (Amazon's own delivery network), Instacart, DoorDash, and Uber Eats have collectively built or contracted millions of delivery capacity. The economics of last-mile delivery at consumer-acceptable speed and cost remain challenging: most same-day delivery services are subsidized by platform economics that don't reflect full delivery costs.

5. CONCLUSION

E-commerce fulfillment has evolved from a back-office logistics function into a strategic competitive differentiator as delivery speed, reliability, and returns experience directly influence consumer choice among competing e-commerce options. The fulfillment arms race—driven by Amazon Prime's standard-setting and the consumer expectation escalation it has created—has forced massive infrastructure investment across the retail industry with implications for real estate (fulfillment center demand), labor markets (warehouse employment scale and conditions), and urban logistics (van delivery volume in residential areas). Future research should examine whether autonomous delivery technologies—self-driving vehicles, drones, delivery robots—can fundamentally change the last-mile economics that currently make fast home delivery expensive, and whether urban logistics regulations (emission zones, delivery time restrictions, autonomous vehicle licensing) will accelerate or impede the adoption of these technologies.

REFERENCES

[1] Acimovic, J., & Graves, S. C. (2015). Making better fulfillment decisions on the fly in an online retail environment. Manufacturing and Service Operations Management, 17(1), 34–51.

[2] Hübner, A., Holzapfel, A., & Kuhn, H. (2016). Distribution systems in omni-channel retailing. Business Research, 9(2), 255–296.
[3] Optoro. (2021). The impact of returns. Optoro Research.
[4] Wollenburg, J., Hübner, A., Kuhn, H., & Trautrims, A. (2018). From bricks-and-mortar to bricks-and-clicks. International Journal of Physical Distribution and Logistics Management, 48(4), 415–438.