Omnichannel Supply Chain Transformation for Third Party Logistics Providers

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Summary:

This work presents the tangible benefits an omnichannel distribution network can provide over simpler multi-channel systems. In a second step, it elaborates a framework to enable a successful transition to an omnichannel network from an Information Technology perspective. The analysis considers an e-commerce distribution network in China, belonging to Maersk Logistics, a third-party logistics provider.

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Prior to MIT, Marion was an E-Commerce Product Manager for 3 years, which created her interest in supply chain management and brought her to MIT. She holds a Bachelor of Arts in IT Management from Steinbeis School of Management and Innovation, and an MBA from Hult International Business School.

KEY INSIGHTS

1. The omnichannel network has the potential to reduce the transportation cost by 73%.
2. The new model reduces lead-time from maximum 3.5 to 2.5 days, when orders can be prepared closer to the consumer.
3. Additional fulfilment locations increased the resilience of the system and one can take over if another one reaches capacity.

Introduction

Managing the supply chain and order fulfilment for retail companies is essential to the daily operations of our sponsor, a third-party logistics provider (3PL). In that context, e-commerce order management and fulfilment become more and more important. Consumers' expectations for fast, accurate deliveries have increased dramatically, and the costs for item-level direct-to-customer transportation costs are high.

The 3PL currently has a multichannel distribution strategy in China, fulfilling e-commerce consumer orders completely separately from store fulfillment operations. Consequently, a single distribution center in Shanghai, China, fulfills all online orders in China. An omnichannel design, however, would add stores to the network to also prepare and fulfill online orders.

Our capstone sponsor asked us to evaluate the benefits an omnichannel distribution network would provide over the current multichannel network. The focus of this capstone is to provide a network model to quantify the benefits and a framework for evaluating order management systems (OMS) to enable the multichannel to omnichannel transformation.

Some of the benefits identified include shorter lead-times, decreased transportation costs, and increased resilience. Additionally, an OMS could help to enhance the consumer experience by providing additional fulfillment options. Consumers could decide to buy online and pick up in store (BOPIS). They could also check the inventory online to make sure the desired item is in stock before going to a store. These consumer advantages would provide additional benefits for the retailers. If more online customers come to the stores, then additional items could be sold. At the same time, transportation costs would decrease and the ability for consumers to return merchandise to stores would help to further reduce costs

Methodology

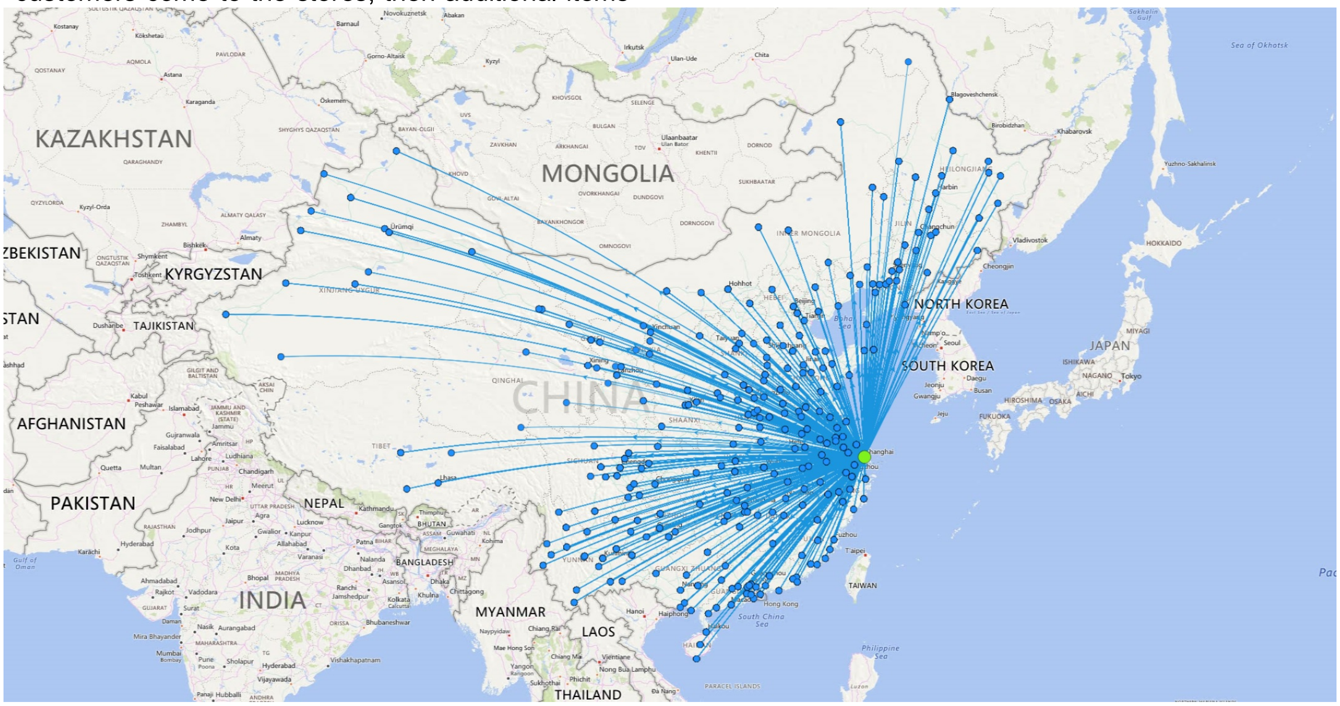

Figure 1: baseline scenario, resembling the current multichannel supply chain

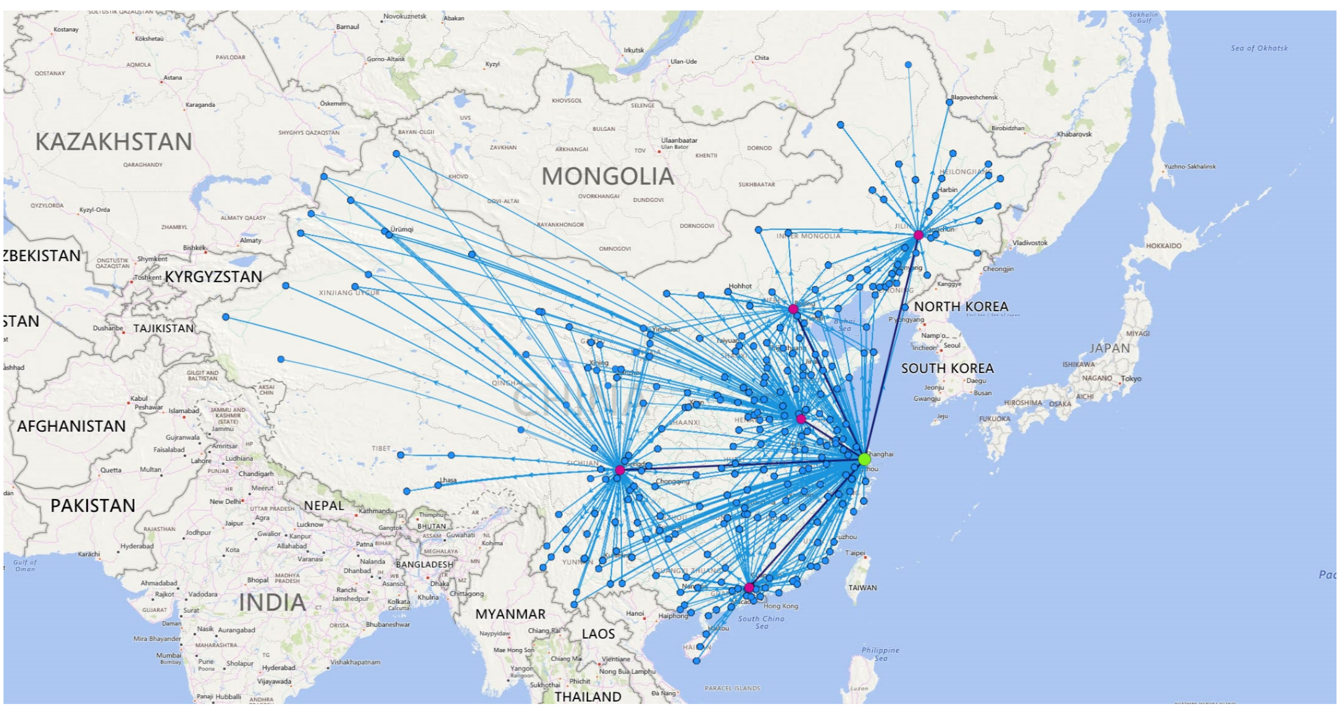

Figure 2: second omnichannel scenario with a capacity constraint on store locations

An omnichannel supply chain is intended to improve service levels by making inventory available across fulfillment channels. To demonstrate the improvements an omnichannel transformation would bring to the supply chain, a network optimization model of a third-party logistics provider's existing multichannel supply chain in China was elaborated using Llamasoft's Supply Chain Guru X software (SCG). The baseline model will then be compared to an omnichannel optimized supply chain.

The data used for the model originates from two customers:

- Source 1: a shoe retailer with only an e-commerce presence in China.
- Source 2: a fashion label with brick-and-mortar shops in China.

These clients distribute their merchandise in China through 3PL services, which begin at a distribution center in Shanghai. The data available for this project ranges from January 2018 to December 2018. The raw data was obtained from the warehouse management system (WMS), the external marketplaces where orders originate, and from the last-mile courier partners that deliver orders to consumers. Additional data for distance and cost elements was researched and added.

In this model, additional brick-and-mortar store locations were used as inventory locations in the new omnichannel supply chain. The important distinction is that in the multichannel baseline model, the brick-and-mortar store locations do not play a role, but in the omnichannel model, the brick-and-mortar store locations become points where inventory can be stored and made available to nearby ecommerce consumers.

The objective function for every tested scenario minimized the total network cost. That encompassed travel distance, facility, package, inbound and outbound costs. The model in Figures 1 and 2 consisted of one central node representing the Shanghai DC (green dot) as the point of origin for all shipments. Five shops (purple dots) in the five cities with the highest order density were then included in the model.

Finally, 47,856 consumers' city centers (blue dots) were set up as the destination nodes representing consumers residing in each city. Capacity constraints were initially not included in the base model but were eventually taken as 100,000 units for the Shanghai DC, and 2,000 units per physical store.

Four scenarios were developed to evaluate the multichannel against the omnichannel fulfillment model and quantify the benefits:

1. A baseline scenario, resembling the current multichannel supply chain (Figure 1).
2. An omnichannel scenario, which enables consumer-facing shops as additional inventory locations that can prepare and fulfill e-commerce orders with no capacity constraint.
3. A second omnichannel scenario with a capacity constraint on store locations (2,000-unit throughput) to describe a more realistic network and compare changes in order fulfillment allocations (Figure 2).
4. A third scenario based on the previous 100% demand increase to test the resilience of the model.

Potential omnichannel benefits can be offered to a 3PL's customers using a best-of-breed OMS. Omnichannel OMS are continuously developing. Selecting the correct one from a specific vendor is challenging when a multichannel supply chain is transformed into an omnichannel one for the first time. To select the best possible solution, business priorities and customers' requirements for omnichannel fulfillment must be understood. A Weighted Sum Model, Multiple-Criteria Decision Analysis (WSM-MCDA) methodology was used to assess the specific omnichannel needs and evaluate components.

Results

In the first scenario – the baseline model - a total of 70,849 shipments per year are fulfilled for an optimized cost of USD $1,130,267 (CNY ¥7,007,024). Figure 1 is a visualization of the distribution network currently used in China. This figure demonstrates that the DC fulfills all consumer orders from the same origin, regardless of the distance to the end consumer (blue dots). Fulfilment in this model takes up to 3.5 days

The second scenario introduces the omnichannel network by incorporating the brick-and-mortar shops (purple dots) into the network model and assigns them unlimited storage capacity to deliver online orders. The selected shop locations were set to consider in Llamasoft and the solver used all available stores for online fulfillment. The objective here was to see which service area clusters would be selected to minimize transportation cost and permit shops to fulfill e-commerce orders. The resulting network model demonstrates six clusters. The optimized transportation cost was reduced by 72% from Scenario 1 to USD $312,018 (CNY ¥1,933,575).

The third scenario builds off of Scenario 2 by incorporating a capacity constraint on the brick-and-mortar shops. The optimized total cost was increased by 170% over Scenario 2 to USD $530,515 (CNY ¥3,287,491). The purpose of this analysis was to identify which city clusters would minimize transportation costs and permit shops to fulfill e-commerce and other store orders. The resulting network model is shown in Figure 2, and demonstrates consumers being served from multiple locations. This observation, however, will only appear when shops are approaching their maximum capacity.

The fourth scenario builds off of Scenario 3 by doubling the consumer demand to view how the supply chain would handle a very large increase in order volume. What we primarily observe is that the DC assumes most of the excess demand as the shops reach their capacities. In this scenario the maximum capacity of most shops is reached earlier than in the previous scenarios.

SCENARIO	DCs	SHOPS	SHOP CAPACITY CONSTRAINED	TOTAL REVENUE (CNY)	TOTAL TRANSPORT COST (CNY)	MARGIN INCREASE
Baseline	1	0	No	93,227,811	7,004,024	Status quo
Included shops	1	5	No	93,227,811	1,933,575	6%
Shop capacity	1	5	Yes	93,227,811	3,287,491	4%
Higher demand	1	5	Yes	186,455,621	8,591,568	106%

Table 1: Scenario overview and results

Table 1 summarizes the four scenarios and the overall results.

Conclusions

This capstone project presented the implications an omnichannel supply chain could provide to a 3PL if the current multichannel supply chain were to be transformed into an omnichannel supply chain. The project then expanded on this by elaborating a framework that would help the company select the most suitable Order Management System for its needs.

Overall, our conclusion based on the data used for this report was that an omnichannel distribution network would save up to 53% in transportation cost and would enable more versatile order fulfilment options such as the “by online pick up in store” capability. This versatility in the supply chain is most apparent when shop throughput capacity is reached, and excess consumer orders are fulfilled by other shops or the DC. Supply chain redundancy is also increased, which enables the 3PL to fulfill orders effectively even if a particular area is unable to operate. The maximum lead-time could be reduced from 3.5 days to 2.5 days.

The model also demonstrates that the network could accommodate future demand growth and large short-term spikes. The design could be further expanded to include more shop and customer locations.

Finally, the OMS selection framework and scoring method will be able to determine that the 3PL needs to focus on OMS products that prioritize Distributed Order Management features over other, less critical features. The final recommendation for management is to enter the next phase of procurement negotiations with the OMS providers using the developed scoring model and implement the most appropriate system for the company and its customers.