Fresh approaches to omni-channel in the grocery business

By Eva Ponce and Sergio Caballero

The innovative omni-channel supply chain models that have reshaped many parts of the retail industry continue to evolve in response to market changes. One of these changes is the increasing demand for grocery products ordered online, a trend reinforced by the COVID-19 pandemic that imposed restrictions on the use of physical stores for grocery shopping.

Eva Ponce, Ph.D., is director, omni-channel distribution strategies, MIT Center for Transportation & Logistics. Sergio Caballero, Ph.D., is a research scientist at the MIT Center for Transportation & Logistics. They can be reached at eponce@mit.edu and sergioac@mit.edu.

A challenge for traditional grocery retailers is how to develop omni-channel supply chains that support both online and offline buying channels and deliver seamless customer service profitably.

To explore this challenge, researchers at the MIT Center for Transportation & Logistics built a supply chain model as part of a project sponsored by one of the world's largest food retail groups. The model shows that omni-channel can deliver improved performance and reduced costs in the grocery business. The work also highlights further research opportunities.

Lack of integration

Many supermarket chains—including outlets operated by the sponsor company—have created "click and collect" purchase options, where customers place orders for groceries online and collect the products at a brick-and-mortar store on the same day. However, home delivery of online orders is still the most common option in e-commerce.

While these service configurations offer some of the benefits of e-commerce, most retailers manage their offline and online channels separately. To fully exploit the advantages of omni-channel retailing, the channels must be integrated.

The main goal of the research project was to evaluate the impact of supporting the home delivery of online orders for groceries using an integrated distribution network. The work focused on the two key research questions that follow.

1. How can grocery retailers integrate online and offline channels to better serve their customers while remaining cost-efficient?

2. Should the sponsor company use its existing brick-and-mortar facilities to fulfill online orders?

The existing network

The company's current operating model for e-commerce and conventional buying channels is based on a network of DCs, dark stores, warerooms and physical stores. Dark stores are warehouses used to fulfill online orders. Warerooms also

serve the online market, but are smaller spaces attached to stores.

The proposed model was developed and tested in Massachusetts where the retailer operates hundreds of stores, four DCs, five warerooms and one dark store. It also serves almost 400 customer demand locations aggregated by zip code.

In its traditional offline business, the company ships product directly from its DCs to brick-and-mortar stores. The fulfillment process for online orders is a little more complicated. The first leg involves shipping product from three DCs to the dark store and warerooms. In the second leg, orders are distributed from the dark store and warerooms to customers.

Total distribution cost is driven mainly by transportation (48%), followed by order handling and facility opening/operating costs (about 26% in each case). Interestingly, in the company's online operation the second leg accounts for about 94% of total costs. This reflects the high cost of the last mile in the retail business.

Research approach

To answer the two research questions listed above, it was necessary to analyze the company's existing brick-and-mortar and e-commerce capabilities. Three key parameters were assessed: customer preferences, the physical flow of goods (including distribution network flows, product flows and inventory) and the service delivery model for fulfilling customer orders.

The model was built to meet several criteria. It should leverage the company's current infrastructure, compare the current distribution network with the omni-channel model and perform scenario planning analyzes to test its robustness. Throughout, there was an emphasis on reducing physical flow costs, and an objective function was created that minimizes transportation, handling and facility opening costs.

Importantly, the option of closing existing DCs and physical stores was not available when developing the new omni-channel model. Also, certain constraints pertaining to supply capacity and the capacity to meet demand at each node were added to the model, which also had to ensure conservation of flow throughout the network.

Cost-cutting alternative

Using the methodology described, the company's online distribution network was optimized based on the assumption that e-commerce demand remains unchanged.

The new network design retains the three existing DCs but replaces the company's warerooms and dark store with six new warerooms in different locations. This reconfiguration was driven largely by transportation costs that are highly dependent on the distance and locations of the various facilities in relation to the retailer's DCs and customers.

The overall cost profile of the proposed network is similar to the existing one. Transportation costs account for the largest portion (approximately 39%), followed by order handling and facility opening/operating costs (about 35% and 26% respectively). However, adopting the proposed omni-channel distribution network would enable the company to capture around $15.7 million in cost savings—a 22% reduction. Most of the savings derive from transportation in the second leg.

Market testing the model

Scenario analysis was used to test the feasibility and robustness of the model. The scenarios also provide insights into how the company's integrated omni-channel operation might perform under different market conditions.

Scenario 1. The first scenario involved a break-even analysis that indicates the amount customer demand would have to increase to make the new network's costs equivalent to those of the existing network. The analysis showed that the company can grow demand by 37% without incurring additional costs relative to its current operations—an indicator that the model is cost-effective.

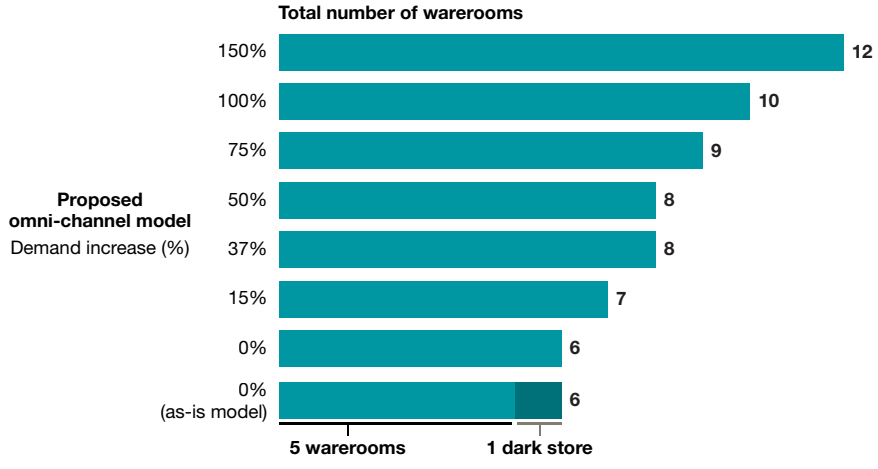
Scenarios 2 and 3. These scenarios explored the impact of expected 15% and unexpected 50% demand increases on the proposed omni-channel network. The former scenario aligns with possible market trends; the latter is indicative of a sudden surge in demand caused by an unforeseen event such as the COVID-19 pandemic. The analyzes show that in both scenarios the proposed network can adjust to the new demand levels, affirming the model's flexibility and robustness.

In addition, a scenario planning exercise was

carried out to assess the impact of rising demand for online orders on the number of warerooms attached to existing stores that would need to be opened. A notable result is that wareroom numbers do not increase proportionally with demand (see Figure 1). For example, when demand doubles the number of required facilities increases from six to 10, a 67% increase. This is another indicator that the proposed network is robust and capable of absorbing rising demand levels.

FIGURE 1

As demand increases, so does the total number of warerooms required for order fulfillment



Source: Authors

Another noteworthy observation is that when developing solutions in response to different demand scenarios, the model usually favored more warerooms as opposed to dark rooms—even though the latter generally offer lower handling costs. This insight suggests that supporting multiple smaller facilities such as warerooms closer to customers performs better than supporting a large warehouse such as a dark store.

Omni-channel-led changes

It appears that if the retailer adopts the proposed omni-channel network, it will achieve substantial cost savings, enabling it to increase profitability while fulfilling growing demand from its online customers. Importantly, the new configuration integrates the retailer's online and offline channels by leveraging existing facilities. And the model is capable of coping with rising demand for groceries from online customers—even when caused by large-scale, unanticipated disruptions.

However, the findings are not conclusive, and further research is recommended in the following areas:

- investigate different demand patterns and the time required to establish new warerooms;
- explore the environmental impact of the proposed omni-channel network;
- analyze the economic and environmental impacts of offering different channels and hybrid formats beyond home delivery, such as click & collect service options; and
- explore the scalability and replicability of the proposed model in other states and regions of the United States.

Retailers that redesign their omni-channel grocery distribution networks could reap substantial rewards. Many of the consumers who have turned to omni-channel delivery models during the COVID-19 pandemic are expected to continue using these services after the crisis is over. This behavioral shift could help transform the grocery business as it has done in other areas of retailing.

****

This article describes research carried out for a capstone research project in the MIT Supply Chain Management Master's Program (SCM). Sergio Caballero and Eva Ponce are project advisors. The research was carried out and authored by Wassim Aouad and Nikhil Ganapathi. They can be contacted at waaou@alum.mit.edu and nikhil_ganapathi@alum.mit.edu