E-Commerce Cold Chain Fulfilment

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Summary: This research focuses on four segments of cold chain fulfillments: package routing and delivery, consolidated returns, competitive research, and packaging technologies. The different categories were considered based on three key performance indicators (KPIs): speed, quality, and cost. Each fulfillment segment offers tradeoffs in the KPIs through use of new technology or efficient design. A holistic approach looking at all four segments will allow managers to focus on the KPI that is most important for the product.

KEY INSIGHTS

1. Perishable goods require cold chain delivery methods, but these solutions are only feasible at large volumes to preserve profitability
2. An optimized delivery network can be achieved leveraging drop shipping networks to fulfill E-Commerce demand of individual products.
3. An optimized scorecard approach can provide insight into delivery options and implications on cost, integrity and speed.

Introduction
The E-Commerce purchase channel has been growing for consumer facing goods with the growth of online marketplaces such as Amazon, Alibaba, and EBay (McCrea, 2014). This purchase channel requires home delivery which highlights a number of requirements for perishable good delivery through cold chain. These requirements include a more strict temperature window, increased packaging requirements, and oftentimes a shorter timeframe to expiration. Current solutions for these problems require a cost increase, limiting profitability.

Companies faced with the issue of delivering perishable items purchased through the E-Commerce channel are likely to experience an increase in volume (Jacobsen, 2014). The E-Commerce channel for consumer purchases has been growing steadily and encompass 11% of retail sales by 2018 (McCrea, 2014).
Consumer delivery presents a large additional cost driver for goods purchased through the E-Commerce channel. In order to evaluate consumer delivery, the practice was segmented into four categories: Package Routing and Delivery, Consolidated Returns, Competitive Research, and Packaging Technologies. Our research evaluates each segment and reveals the tradeoffs for each decision.

**Methodology**

Each of the segments in consumer delivery followed different methodologies to obtain information. Information was routinely supplemented by personal interviews conducted with a company within the industry.

Understanding methods for competitive research and packaging technologies involved thorough review of literature and news resources. Understanding searches are not exhaustive of all information, this research was reviewed and supplemented with interviews with companies within the industry as well as drop shipping partners. Drop shippers were able to provide information across countries and speak to industry trends.

Package routing was evaluated by leveraging the network of a company within the industry as well as their drop ship network. Using distribution center locations, drop shipper locations, and proposed drop ship expansion networks, networking options for delivery origins were created. Data obtained from a large freight shipping company allowed an evaluation of shipping days within the network (See Figure 1). Temperature data were also leveraged to understand the potential spoilage rate in different areas of the United States throughout the course a year.

Returns also benefited from a thorough evaluation of news and literature. In addition, interviews were conducted with both drop shippers as well as online retailers to understand existing relationships as well as potential areas for improvement.

**Data and Literary Review**

Starting with the literature review, findings were prevalent across all segments of delivery. Literature from academic resources was supplemented with news stories uncovering innovation in delivery of perishable items. To highlight key findings, instances of packaging innovation that can control temperature have been created, but at a much higher price point than traditional cardboard box packaging (Tyler, 2010).

Additionally, another key finding was uncovered regarding last mile delivery. Study of the agricultural products industry, it would found that rerouting perishable goods to be delivered later in the day significantly increased delivery quality. The routing took delivery trucks outside of the standard optimal route at a relatively low 8% level of inefficiency (Li Xiuli, Liu Zhaohui, & Xu Zhikun, 2014).

Data collected revealed that the case study company had a network that would allow for delivery to end consumers within four freight days across the continental United States. Should the company leverage certain locations of the drop shippers as additional nodes, the delivery time would be cut to a maximum of two days. Furthermore, with the planned expansions from the drop shippers, a larger proportion of the customer delivery areas would be able to be served within a single day – limiting the amount of exposure for deterioration within the transfer.

Temperature data collected showed that the majority of the United States would be within the needed temperature window for more than six months. Temperature data can be leveraged to adjust the packaging needs in combination with the shipping window. An interview with a drop shipper revealed that certain, proprietary, ERP systems possess the capability to calculate the shipping needs based on forecasting and freight delivery time estimation (See Figure 1 - Distance from Distribution Centers).
Figure 2). This technology is exclusive to the particular drop shipper and has not been implemented on a larger scale.

![Summer Temperatures](image)

**Figure 2 - Summer Temperatures**

Data collected for the competitive research and returns segments involved stakeholder interviews and an analysis of the customer comments for online sales. This uncovered pain points in customer satisfaction including misaligned product expectations and spoilage.

**Results**

Research and data led us to a number of different options that a company could take when shipping perishable goods through E-Commerce. Many of these different options provided tradeoffs in the key performance indicators of cost, quality and speed. Cost is defined as shipping cost and does not include startup capital or internal firm resources included. The quality of the good is defined as defects coupled with customer complaints. Finally, speed is determined as an increase in time from the final distribution center to the doorstep of the consumer.

In the shipping routing segment, optimal routing indicated a positive or neutral effect on all of the KPIs. Current shipping operations for the case study company showed that the online fulfillment was operating from one location, thus accounting for potential ground freight delivery times of up to five days. Leveraging current locations with drop ship partners to create an optimal network would increase the speed of delivery, lower the cost of shipping through fewer freight days and finally increase the quality of the goods with a smaller handling window. Additionally, returns can achieve a relative higher score in the KPIs through a partnership with retailers. The case study company does not have a widespread retail network and therefore returns are sent through the postal service. The products sent through the postal service are subject to conditions that can damage the product further limiting the information collected by the company. Additionally, processing of refunds and replacement may take weeks. Partnering with retail locations for returns alleviates many of the pain points in the cycle. Employees at a partner retail location would be able to refund the customer, dispose of the good, and potentially replace the product in a matter of minutes rather than weeks. This would increase speed and quality in the key performance metrics.

Other solutions involve common tradeoffs of quality and cost or speed and cost. These options are later aggregated to create a scorecard evaluating a segmented view of the final delivery of perishable products through E-Commerce.

**Combined Results**

Companies can choose from a variety of options across each of the four segments in the delivery of E-Commerce goods. As a result, a scorecard was created for each of the options in the four segments to provide insight on tradeoffs based on the delivery goals.

When creating the scorecard, different alignments became apparent that could be utilized based on the goal of the supply chain. For example, a speed option can be created by leveraging an optimized delivery, consolidating returns and providing standard packaging options. Similarly, a high product quality approach would leverage packaging innovation and cold chain delivery to the home of the consumer.

![Selected Segments](image)

**Figure 3 - Balanced Scorecard Example**
Other options can be created based on a cost saving approach of focusing on marginal increases in two of the three KPIs. Companies can use this framework to add additional options to view the effect of the four segments of E-Commerce delivery.

Conclusions
E-Commerce is a growing channel and companies can leverage options in the four segments of consumer delivery. While there is no single solution that will optimize the delivery of all perishable goods, companies can look to a holistic view utilizing a scorecard to design the supply chain that best fits the business needs. Network optimization and retail partnered returns offer opportunities to lower cost, increase speed, and boost quality; but these options are not achievable without investment.

Further areas of research would involve gathering data for capital expenditure involved in each of the options for the delivery segments. Workforce expansion and administration time can also be tracked. Finally, additional data collected regarding the volume implications on cold chain doorstep delivery could provide more specific cost implications.

References

