Strategy for Direct to Store Delivery

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Summary: Many retailers, particularly in the grocery retail industry, continue to embrace Direct to Store Delivery (DTS) as an effective replenishment strategy. Our project examined the effect of DTS on the supply chain and suggested ways to curtail transportation cost, manage inventory better and improve collaboration between manufacturers and retailers. Our research was based on simulation models developed for a leading private label bottled water manufacturer, Niagara Bottling LLC. We observed that the manufacturer's transportation cost increased by 42% under DTS. We found that although the manufacturer's safety stock increased to facilitate faster delivery usually practiced under DTS, the total safety stock in the supply chain reduced by 26%. We noted that the manufacturer can curtail transportation cost by 4% when larger order sizes are favored over smaller ones or when stores of multiple customers are serviced in any given trip from the plant. In conclusion, we suggested a supply chain strategy that encourages collaboration and results in an effective DTS implementation.

KEY INSIGHTS

1. Transportation and safety stock costs increase significantly when a manufacturer switches to DTS delivery from DC delivery.
2. Manufacturer can either increase order size or deliver to stores of multiple retailers in DTS tours to reduce the transportation cost.
3. Lead time reduction is critical to minimizing the total inventory cost in the supply chain.
4. A successful DTS implementation requires a collaborative and benefit-sharing partnership between the retailer and the manufacturer.

Problem

For a bulky and fast selling product like bottled water, Direct to Store delivery (DTS) provides substantial benefits over traditional DC delivery by reducing wasteful activities in the retailer's supply chain. In order to implement DTS effectively, the manufacturer needs to understand its impact on various supply chain functions. DTS also affects the safety stock of retailer as its DC would no longer hold inventory of the products concerned. We focused on quantifying the impact of DTS on a manufacturer's transportation and also on safety stocks of both the manufacturer and the retailer. Using models and sensitivity analyses, we gave recommendations on how to implement DTS effectively and reduce transportation and safety stock costs in the supply chain.

Methodology

We studied the impact of DTS in four possible DTS implementation scenarios - 100% DC, partial DC and DTS, single-retailer 100% DTS, and multi-retailer 100% DTS. In 100% DC, the products are delivered only to the retailer’s DCs; in ‘partial DC and DTS’ products are delivered to some stores directly while the rest of the stores are replenished through the retailer’s DCs. ‘Single-retailer 100% DTS’ represents the scenario in which all store of one retailer are replenished directly. In ‘Multi-retailer 100% DTS’ all stores of two retailers are replenished, but in a given trip from the plant trucks

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may deliver to stores of both of them. Figure 1 illustrates the four scenarios.

![Figure 1: DTS scenarios](image)

For this study, we selected two fast selling products of Niagara that are sold to a major grocery retailer in the United States. We analyzed one year’s point-of-sale data of the products at 473 stores in California, Nevada, and Arizona states, and chose a suitable distribution to characterize the demand of any given store. We then developed transportation and safety stock models to estimate costs, understand safety stock and transportation capacity requirements. We analyzed the sensitivity of cost to demand variability, lead time, and order size.

**Transportation model**

The model estimates the annual cost and the annual transportation capacity needed as the percentage of stores on DTS is increased. To get reasonably good estimates, we computed weekly figures and aggregated them to get the annual ones. We expect both cost and required capacity to increase, as the percentage (and thus the number) of stores served by DTS is increased. We estimated both of them by computing the number of trips made from Niagara’s main plant and the number of deliveries in each trip. The former is a function of stores’ demand and the number of stores. The latter is a function of order quantities as every store is assumed to order the same amount in a given week, and orders can be combined to make a truckload. To estimate distances travelled in DTS deliveries, we grouped stores into clusters based on their geographic dispersion and suitability for a local delivery.

Transportation cost under DTS has three main components: line haul to a cluster and back, local tour within the cluster and stop-off at the stores served. Line haul cost was found using the number of trips and the distance of the relevant cluster from Niagara’s main plant. Local tour cost was estimated using heuristics based on the number of deliveries. Stop-off cost is a multiple of the stop-off charge and the number of deliveries. Transportation cost in the DC method has only line haul cost which was estimated using the number of trips and the distances of the DCs from Niagara’s main plant.

Transportation capacity was estimated in the number of truck-hours needed. The amount of time consumed in the DTS method consists of loading and unloading time, and the travel time. Travel time was computed using truck speeds, and the estimates of distances computed to obtain cost figures. The other two components were estimated using the approximate time to load a truck trailer for a trip, and the time to unload products at a store or DC as the case may be.

**Safety stock model**

The objective of the inventory modeling was to compare the net changes in safety stock levels in the scenarios: 100% DC, partial DC and DTS, and single-retailer 100% DTS. There are two reasons why safety stock levels will change as Niagara replenishes all stores directly rather than replenishing them through the retailer’s DCs.

The first is demand variability. A store demand coming through the retailer’s DC is more volatile than the demand coming directly. This is because of the bullwhip effect – demand variability increases as one moves up the supply chain. Thus, we expect Niagara’s safety stock to decrease because demand variability reduces when DTS is implemented.

The second reason why safety stock levels will change is the customer response time (CRT). CRT is the time window in which Niagara must deliver the products to retailers. We assumed that Niagara’s CRT reduces from 5 days to 3 days when its delivery method changes from 100% DC to single-retailer 100% DTS. This is because the retailer’s DC would not carry inventory of the products delivered directly by Niagara, and therefore the stores need faster deliveries to meet their demand. Thus we expect the safety stock levels to
increase in the DTS method. We developed the inventory model to find out the net effect on safety stock as the percentage of stores on DTS in increased.

Niagara’s safety stock was calculated as:
(Safety stock if order is fulfilled from stock * Percentage of stores served though DTS method * Probability that that a store’s order cannot be manufactured within CRT) + (Safety stock if order is fulfilled from stock * Percentage of stores served through DC method * Probability that that a DC’s order cannot be manufactured within CRT)

We also studied safety stock changes in the retailer’s network. For stores replenished through DCs, the retailer would keep safety stock in both DCs and stores. For stores replenished through DTS, it would keep safety stock only in stores. Under DC delivery, the retailer benefits from the risk pooling of demand variability of the stores. However, under DTS the retailer may need to keep higher safety stock in stores due to factors such as increased lead time, no inventory in DCs, and more dependency on the manufacturer in case of stock-outs.

We calculated the retailer’s safety stock as:
(Safety stock in a store replenished through DC * number of such stores) + (Total safety stock in DCs) + (Safety stock in a store replenished through DTS method * number of such stores)

Results
We observed that transportation costs increased by 42% when the distribution method was changed from 100% DC delivery to 100% DTS delivery. Figure 2 shows the trends in total cost and costs associated with the delivery methods as the percentage of stores on DTS was increased.

We observed the transportation cost reduced by 4% from a single-retailer 100% DTS scenario to multi-retailer 100% DTS scenario. The reduction was a result of reduced travel costs as orders could be combined to utilize trucks well and stores are more closely located.

Transportation capacity requirements (in time) increased by 27% because of the additional distance travelled to deliver products to stores instead of DCs and increase in loading and unloading time.

Under DTS, the increase in the safety stock of Niagara, retailer, and total supply chain were 76%, 65%, and 67% respectively. This proves that the reduction in the customer response time was a key driver of safety stock increase. Figure 3 shows trends in the safety stocks of the supply chain (system), manufacturer (Niagara in this case) and the retailer (at both stores and DCs).
**Recommendations**

**Increase order size:** By increasing higher order sizes in the deliveries, transportation cost can be reduced by as much as 4%. Most of the savings come from stop-off costs and local delivery costs although line-haul costs change very little. This will cause the stores’ inventory costs to go up, which may not be an issue for a low-cost product.

**Deliver to multiple retailers together:** If stores of multiple retailers are in close proximity to each other, which is a common case in metro areas, the manufacturer should combine deliveries. In practice, this option can create some challenges such as competitors not willing to accept products on the same truck due to confidentiality concerns, and combining orders of multiple retailers introducing complexity to production and warehousing (e.g. loading) tasks.

**Reduce lead time:** The longer the lead time, the higher the safety stock of the retailer and lower the safety of the manufacturer. Thus, the retailer would like to ask for a shorter lead time whereas the manufacturer would like to negotiate a longer customer response time. Since retailer’s safety stock in the stores is much higher than the safety stock in manufacturer’s warehouses, it’s best to reduce the former.

**Improve production processes:** As the ability to manufacture to order within customer response time increases, a manufacturer needs to carry lesser safety stock. Hence, the manufacturer should eliminate non-value adding processes and seek to invest in additional production capacity to shorten the production time.

**Conclusion**

A ‘Direct to Store’ implementation is a big change for both the retailer and the manufacturer – strategically and operationally. The expectations of each party should be clearly set and a high level of collaboration should be practiced. While the recommendations we made can be considered, since some of the benefits to the manufacturer and the retailer are asymmetric, they should devise a benefit sharing agreement to ensure fairness in the system.