Quantifying the Value of Reduced Lead Time and Increased Delivery Frequency

Executive Summary

Sean Walkenhorst

Introduction

A large consumer package goods company that we will call SupplierCo has improved its profitability by optimizing its part of the supply chain to minimize its costs. As the company considers other options to further improve its supply chain, it has identified options that might improve the overall supply chain but would add internal costs. These costs might actually be less than the benefit to its customers; however, to see whether or not the options do improve the total supply chain, SupplierCo needs to be able to estimate the potential benefits to its customers. A change which would benefit its customers more than it would add to SupplierCo's costs could then be pursued by negotiating with customers to adjust pricing or share costs so that all companies within the supply chain could realize some of the joint benefit.

For example, if SupplierCo built more distribution centers (DCs) around the country, then the lead time to ship products to retailers would be shorter. That shorter lead time could benefit its customers through lower inventory levels, lower handling or storage costs, or fewer out of stocks. But it would also translate into higher costs for SupplierCo. Similarly, if SupplierCo shipped more frequently to retailers, retailers could achieve lower inventory levels, lower handling or storage costs, or fewer out of stocks, but SupplierCo would incur increased freight costs. Thus, the purpose of this thesis is to evaluate the potential savings for the retailers from possible network changes that SupplierCo could implement. In particular, it addresses the question: What is the value to the customer of increased delivery frequency or reduced lead time?

Project scope

This question was studied for SupplierCo by looking at three national retailers in the United States: a mass merchandiser (MassCo), a grocery store chain (GroceryCo), and a drug

store chain (DrugCo). The three retailers provide an opportunity to examine various retail channels that attract different types of customers and which are fairly representative of SupplierCo's overall customer base. These retailers have different levels of shipment frequency and demand volumes allowing us to see the potential benefit to each type. For instance, MassCo has a high frequency of shipments from SupplierCo to its DCs while DrugCo has only one-third to one-sixth of MassCo's frequency going to its own DCs.

Three products were chosen to focus the research; Big&Fast that ships frequently to customer DCs and has short lead times from customer order to delivery; Big&Slow that ships frequently to customer DCs but has long lead times, and Small&Slow that ships infrequently to customer DCs and has long lead times. A summary table of the attributes for these products is shown below in Figure 1.

	Frequency	Lead time
Big&Fast	High	Short
Big&Slow	High	Long
Small&Slow	Low	Long

Figure 1 – Products Studied

Finally, for each retailer we selected three of its DCs, one in the East, one in the Midwest, and one in the West. This will allow us to examine whether there are differences due to geography, primarily when it comes to lead time. Since SupplierCo's distribution points are located mostly in the Midwest, shipments to the West Coast take several more days. The retailers, products, and DC locations were selected as a representative sample to reveal as much insight as possible in the time available for the project.

Methodology

Possible sources of benefit to SupplierCo's customers could come from lower inventory levels, lower handling or storage costs, or fewer out of stocks. In talking with several supply chain managers at these companies, all agreed that the main benefit would be lower inventory levels so the analysis focused on quantifying the amount of possible inventory reduction through various scenarios.

An analytical deterministic model was built in Excel that calculated a theoretically optimal inventory level for each product in each customer's DC. The inputs to this model were the averages and standard deviations of demand and travel time, the target service levels, frequency of shipments, current inventories, and product prices. The outputs of the model were cycle stock and safety stock for several scenarios. These inventory levels could then be compared among the various scenarios to determine which scenarios provided the greatest benefit.

The scenarios varied frequency, average lead time, or lead time variability to determine what offered the largest potential benefit for the different types of products. Some of those scenarios studied were:

1. Combining multiple product families together on the same truck to achieve a daily shipment frequency. If more products could ship together, all would ship more frequently, and the DCs would need less cycle stock of each.
2. Increasing the frequency of shipments for Big&Slow and Small&Slow by shipping these products together. Focusing frequency improvements on those products that have the most room for improvement might deliver the most value for the lowest cost.
3. Reducing lead time variability by 50% which would reduce the need for safety stock.

4. Reducing the lead time by one day for all shipments. This could most likely be accomplished if SupplierCo were to improve its response time to orders. This could reduce the amount of safety stock needed in the DCs.
5. Limiting the lead time to no more than four days for all products and locations. This would require SupplierCo to have more inventory in more locations but could examine the potential inventory reduction at customer DCs due to all products having a short lead time.

Results and Potential Savings

Each of the five scenarios was compared to the theoretically calculated inventory level, and the percent improvement for each is shown below in Figure 2.

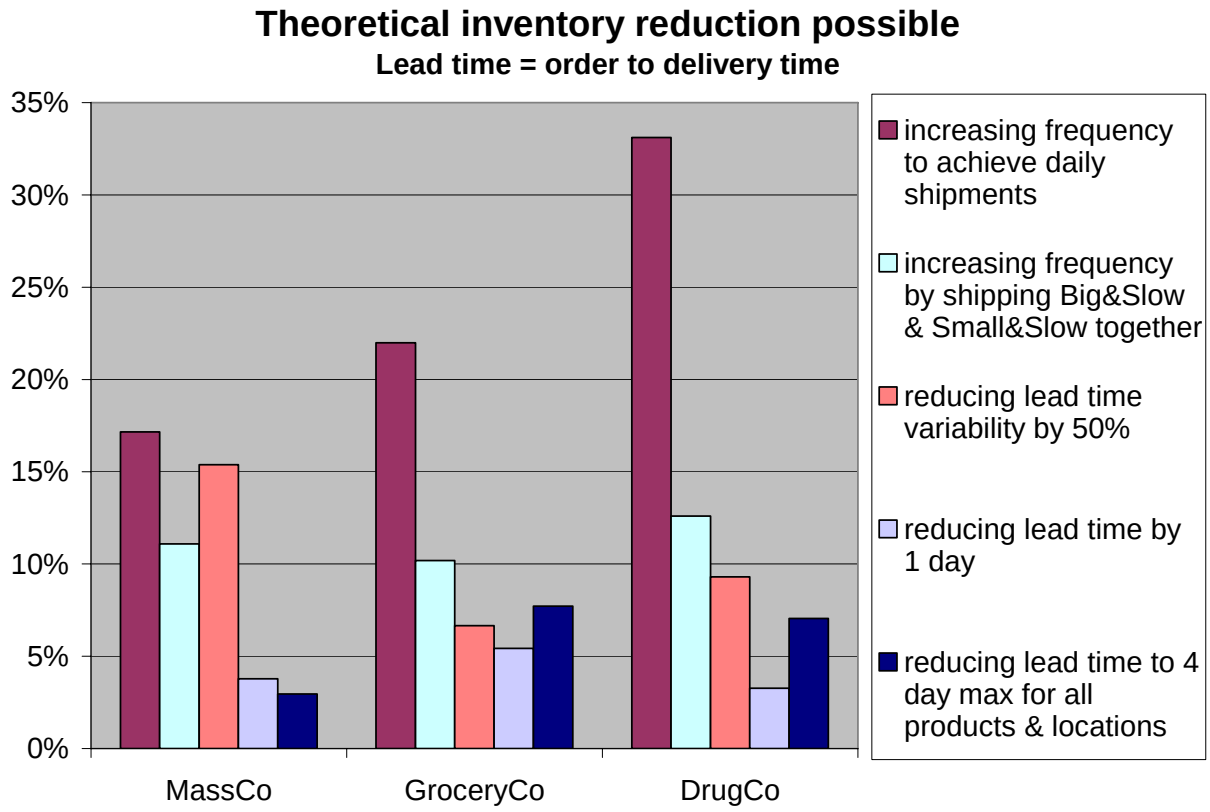

Figure 2 – Potential Inventory Reduction of Five Scenarios, Grouped by Customer

It can be observed that the largest potential improvement for all customers would be to increase frequency to daily shipments. Even just combining Big&Slow and Small&Slow creates more value than improving the average lead time. However, it is interesting to note that reducing lead time variability has a large potential benefit for MassCo. This is true for the Big&Fast and Big&Slow products which already have a relatively high frequency and stable demand. Since frequency is high, cycle stock is not a significant component of inventory. Since demand is stable, demand variability is not a significant component of safety stock. That leaves lead time variability as the largest driver of safety stock and of overall inventory.

In converting these percent improvements into dollars, several assumptions were made after consulting with several SupplierCo employees. First, it was assumed that 50% of SupplierCo's sales went to companies like MassCo, 25% to companies like GroceryCo, and 25% to companies like DrugCo. Second, it was assumed that 20% of all sales came from products like Big&Fast, 50% from products like Big&Slow, and 30% from products like Small&Slow. This allowed us to look at total sales for SupplierCo and estimate total possible inventory savings for all customers. Multiplying these savings by a 15% inventory carrying cost gives us expected annual savings, which is shown below as Figure 3. This could then be compared with the potential costs of network changes SupplierCo could make to determine which would be most beneficial for the entire supply chain.

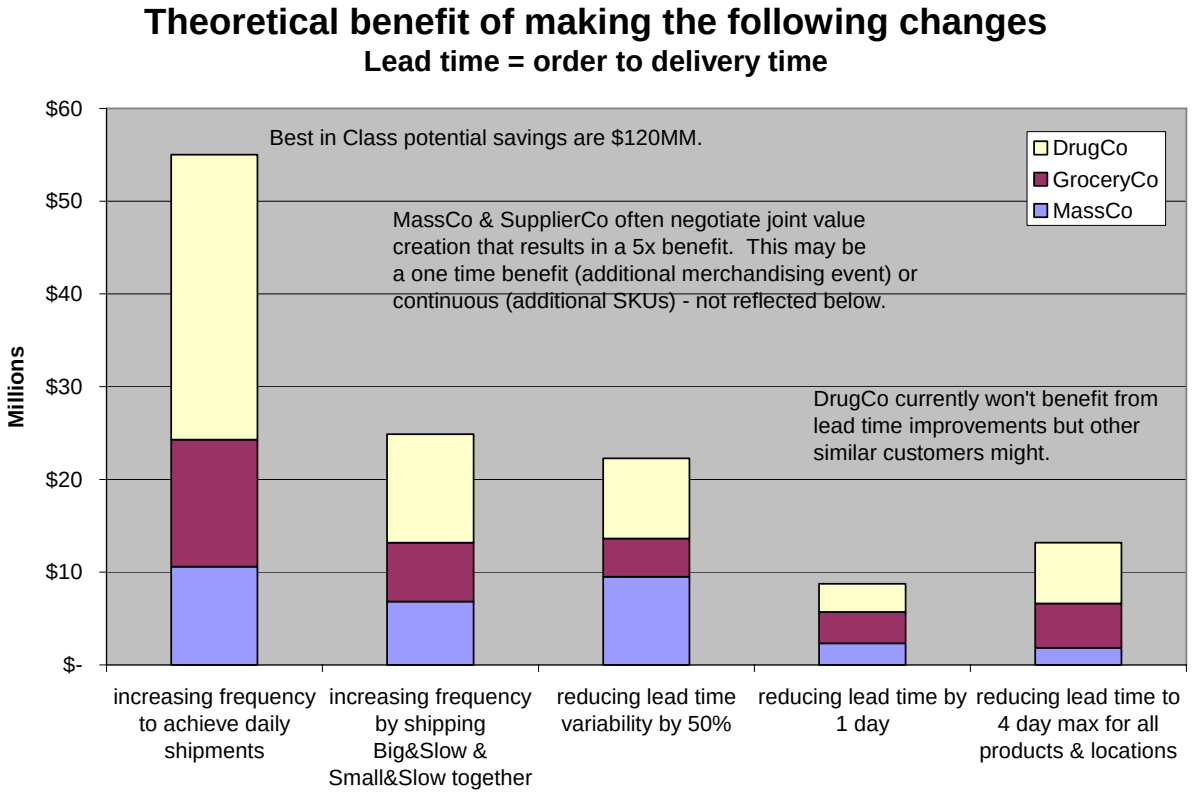

Figure 3 – Potential Carrying Cost Savings of Five Scenarios for all Customers

Effect of Heavy Promotions

The three customers focused on in this study had very different strategies for using promotions to generate sales, and this affects the ability of SupplierCo's network to create value for its customers. MassCo only had about 5% of its sales come from promotions and had fairly stable demand. GroceryCo had about 40% of its sales come from promotions and saw much more variable demand. DrugCo had about 75% of its sales come from promotions and had the highest demand variability. As a result of DrugCo's high use of promotions, its promotional planning process drove inventory levels, and orders were submitted to SupplierCo up to two months in advance. As a result, any changes SupplierCo could make to its network to improve its ability to respond quickly would not benefit DrugCo at all.

The heavy use of promotions also made the calculations in the model questionable since demand variability was so high. To better account for the promotional effect, demand variation could be determined from forecast errors. Since forecast data was not available, an assumption was made that demand variability would be similar to MassCo but somewhat higher because of the difficulty in accurately forecasting promotions. Since GroceryCo had 40% of its sales from promotions it was assumed its demand variability would be 50% higher than MassCo. Similarly, since DrugCo had 75% of its sales from promotions it was assumed that its demand variability would be 100% higher than MassCo. These assumptions allowed the model to better predict inventory levels and gave greater confidence to the calculated potential savings from the various scenarios.

Conclusions

To summarize the key findings of this study, the following 2 by 2 matrix is shown below as Figure 4. It highlights what factor is likely to be the key lever in reducing inventory. Some results are fairly intuitive, but one is not.

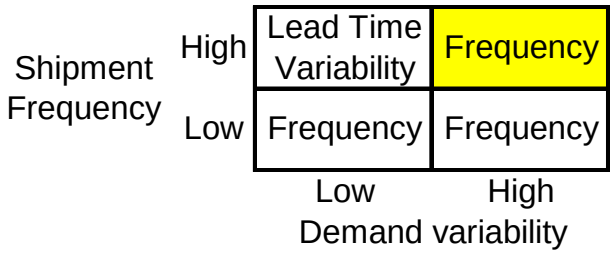

Figure 4 - Key Driver for Maximum Improvement

When shipment frequency is low, it makes sense that improving frequency is likely to have a big opportunity to reduce customer inventory. Also, after thinking through the key drivers of cycle stock and safety stock, it makes sense that when frequency is high and demand is stable that lead time variability would be the key driver. The part that is most surprising is that when frequency is high and demand variability is high that frequency still has a greater potential

for inventory improvement. Higher demand variability drives a higher safety stock level, so if frequency is already relatively high, how could increasing frequency further reduce cycle stock more than lead time improvements could reduce safety stock? The answer lies in the relative amounts of improvement possible in the overall frequency vs the overall lead time. Shipping more products together can increase frequency by 20-600% while lead time can likely only be improved by 10-50%.

Conversely, for retailers who had the ability to replenish their stores during promotions, reducing average lead time would be more valuable than increasing frequency. DrugCo does not replenish its stores to respond to high promotional demand but GroceryCo does. Both companies could benefit from improved frequency but only one would benefit from reduced lead time. Meanwhile, MassCo would benefit more from improved frequency than from reducing average lead time.

These insights can help guide SupplierCo in allocating limited resources most effectively to improve its supply chain. In most cases, increasing frequency will provide a greater benefit than reducing lead time. This may not be true for all businesses, but this same methodology could be used for other businesses in other locations to determine what the key driver for supply chain improvement is.