Multiple warehouse to customer site optimization study in support of a company strategic customer service initiative

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ABSTRACT

In the food ingredient supply chain, distributors play a vital role in moving and storing product from the supplier stage to the customer stage of the supply chain. In this process, high quality service can often be the differentiating factor among distribution companies.

A large distribution company used the concept of superior customer service to successfully grow the company to the level of a nationwide food ingredient distributor. A strategic requirement of their service concept identified top tier customers who would receive "over the top service." One example of that service would be guaranteed one-day delivery of ingredient orders. At the same time, the Operations Department was reviewing and closing warehouse locations across the country. In its growth, the company opened many warehouses, and some were identified as unnecessary. The question arose whether the new strategy might be hampered by the closure of too many warehouses or closing warehouses in the wrong locations.

The objective of this thesis was to determine if that service guarantee was possible given the number and location of the company's current warehouse assets relative to those priority customers. Utilizing data from the company's transportation management system, top tier customer ship-to locations were listed and those currently exceeding the 1-day delivery were found. A model was selected that would identify those customers' ship-to addresses that were within a 500-mile constraint of a target company warehouse. The figure of 500 miles was selected as this is the transportation industry recognized 1-day

transit distance. This would be done for all target warehouse locations and the datasets merged and sorted.

The results of the modeling demonstrated that all top tier customer ship-to locations were within one day's delivery transit of a company warehouse. Those designated high value customers could have their ingredient orders delivered within one day of departure. By optimizing the company warehouses, identifying those within the one-day transit target, delivered freight costs were reduced significantly. Additionally, the results provided insight into redundancies that may allow for warehouse closures or realignments and cost savings to the company. These same redundancies also demonstrated potential competitive advantages in the sales and service of high value customers by providing superior distribution coverage potential minimizing risk to the customer's ingredient supply chain. The results also suggested avenues for additional research to improve inventory efficiencies.

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CHAPTER I: INTRODUCTION

1.1 Company Background

Company ABC, Inc. is a family owned, full-service foods ingredient distribution company based in Rosemont, IL. It has nationwide sales coverage with the use of multiple warehouse locations to serve a substantial customer base. The company was founded in the Chicago area in 1979 as under a different name. It provided primarily sweeteners – sugar, corn syrup solids, fructose – to local and regional customers. In those early years there were less than 20 employees handling sales, purchasing, customer service and office administration, including accounts receivable and payable. There was one warehouse location to service the customer base.

In the food ingredient distribution industry, high levels of service and responsiveness to customer needs is critical to success. Having the right product available and delivering it faster than the competition dictated success in a highly competitive Chicago region. The company excelled in these tasks. Regardless of their size, all customers received the same high level of service and responsiveness. If an emergency bag of sugar was needed by a customer big or small, warehouse operations were put on hold, while the order was placed, it was picked at the warehouse and prepared for pick up. If necessary, a sales representative would deliver the bag by car. The warehouse was opened and staffed on Saturday or Sunday, if needed, regardless of customer size. All customers were high priority. This quickly set the company apart from competitors in the Chicago region and their customer base grew. Since the company was small, the cost of this level of service was marginal compared to the sales growth experienced.

Shortly after opening, the company added liquid sweeteners to the mix of dry sweetener products for which they were known. Corn syrups primarily, but also high fructose corn syrup, liquid fructose and liquid sucrose. A new facility was opened that packaged, warehoused and distributed liquid sweeteners. Within a few years, the expanding customer base began requesting they supply other products in addition to the sweeteners for which they had always been known. The Purchasing Department began sourcing and adding basic ingredients such as flour, baking powders, vegetable oils, dairy commodities, powdered eggs, oats and honey to its product line to support customers' needs. Over time, as its customers and other food manufactures have sought to innovate and expand what food can do in areas such as health, mouthfeel, functionality and quality, Chicago Sweeteners expanded its lines further. Dairy proteins, soy proteins, acidulants, chocolate and cocoa powders among other product lines were added to increase the depth and breadth of the ingredient offering. Product line complexity continued to increase, but the philosophy of service at all cost to the customer did not change.

1.2 Company Growth

From its inception in 1979 through 2018, the subject firm grew its pool of sales representatives beyond the Chicago and Northern Illinois area to other states and regions of the country. Some of this was accomplished by placing sales representatives in key areas, but much of it was through acquisition of competitors. From 1995 through 2011, numerous acquisitions were made which increased the number of employees and the company's geographic reach. At the beginning of 2011, the former company along with the newly added companies were rebranded under the Company ABC name.

This substantial growth resulted in sales coverage in all of the Continental US as well as Hawaii. Today the company has approximately 70 account managers and regional sales managers in the continental United States with sugar bagging and ingredient blending operations in Mexico. The growth in product diversity has, now reached over 20 item classes and well over 5,000 SKU's. A vision for the company was developing that focused on the wide-ranging sales coverage, a diverse and extensive product line and highly responsive service to all customers. The company was building its reputation to be a distributor who could deliver any ingredient to any customer big or small, when needed, where needed.

To achieve this vision, if customers were not near one of the primary warehouses, the company would enter into a contract with a local third-party logistics warehouse (3PL). These facilities were necessary if their extremely high level of service provided to all customers was to be realized. Increases in the number of customer service assistants, logistics support staff, product management and purchasing support, as well as a growing warehouse footprint were necessary to handle the ever-increasing demands of a growing customer base.

What started as two company owned warehouses in the Chicago, IL region, became 37 dry storage warehouses across the Continental United States (Table 1.1). The warehouses are a mix of company owned and contracted 3PL services. They are managed by the operations department with inventory monitored by regional inventory planners in concert with product management and purchasing staff. These warehouses are supplied through a network of inter-site stock transfers from company owned and operated distribution hubs or through purchases and shipments directly from the manufacturer to the

warehouse. This network of sales representatives and warehouses has accomplished the vision that senior management wanted. Company ABC is a nationwide food ingredient distributor with local and regional service. Except for areas in the West, most customers found themselves within only a few hours or less of a company warehouse facility.

Table 1.1: Company ABC Warehouse Locations End of 2016

Warehouse	City	State	Warehouse	City	State
2	Chicago	IL	48	Dallas	TX
6	West Chicago	IL	49	Denver	CO
11	Lakeland	FL	51	Salt Lake City	UT
12	Brownsville	TX	53	Union City	CA
14	Milwaukee	WI	54	Garland	TX
15	Charlotte	NC	55	Tulsa	OK
16	Hopkins	MN	56	Garland	TX
18	Honey Brook	PA	59	Union City	CA
20	Brownsville	TX	62	Lakeville	NY
26	Commerce	CA	63	San Antonio	TX
30	Miami	FL	65	Aurora	CO
32	Erlanger	KY	79	Hayward	CA
34	Akron	OH	83	Union City	CA
39	Lithia Springs	GA	84	Salt Lake City	UT
41	Joliet	IL	86	Edison	NJ
410	Bolingbrook	IL	92	Saint Louis	MO
42	Kent	WA	94	Fort Madison	IA
43	Lenexa	KS	97	Wayne	MI
44	Vancouver	WA			

1.3 Unsustainable Logistical Costs

A high level of responsiveness to customer demand and local warehousing comes at a cost. Company ABC spent in excess of $30 million every year maintaining warehouse operations with the expressed purpose of servicing all levels of their customers. In order to provide superior, rapid service, personnel costs soared as staff was added to serve the growing customer base.

Working capital costs escalated as inventory was needed in these warehouses. As the number of warehouse locations expanded, the number of product combinations making up the inventory grew, resulting in increased inventory costs per location, as well as increasing inventory management complexity. The management of company inventory was the responsibility of the product line manager and a purchasing assistant. It was a manual process that required the product manager to know what products were needed in each of the warehouses as well as how often the products were ordered and needed replenishment. The combination of growth in both new products offered and warehouse facilities added, along with current inventory, quickly overwhelmed this very basic inventory management process described above. Frequently, inventory was overlooked at various locations, resulting in extensive overstocked and aged product. This material could no longer be sold resulting in growing costs surrounding inventory loss and disposal. To combat this, personnel were hired into the newly created Inventory Planning Department which was directed to maintain effective oversight of all company inventory. While overstocked and aged products costs decreased, it was proving insufficient to offset the cost of increased manpower.

In 2017, to combat escalating costs, The Operations Department began to rationalize warehouse locations. Some locations were eliminated that could not meet rising regulatory and food safety standards. Other locations were closed outright or through consolidation with nearby facilities. Two new locations were added (Tolleson and Erie). By the beginning of 2018, company warehouse locations had shrunk dramatically (Table 1.2) (Figure 1.2).

Table 1.2: Company ABC Warehouse Locations in 2018

Warehouse	City	State	Warehouse	City	State
16	Hopkins	MN	45	South Plainfield	NJ
26	Commerce	CA	51	Salt Lake City	UT
30	Tolleson	AZ	59	Union City	CA
35	Wilmington	IL	610	Erie	PA
39	Lithia Springs	GA	64	Garland	TX
40	Portland	OR			

Figure 1.1: Company ABC 2018 Warehouse Site Map

★ Company Owned/Operated

▲ Company Leased Operations

1.4 New Directions

In the Spring of 2018, the company's Executive Management team decided to take a different approach to how the company viewed its customers. Company ABC began to study the gross margin contribution being generated by customers and how much service was being provided. Gross margin contribution is the primary financial indicator used by Company ABC to determine company health. Simply stated, gross margin contribution is the sales revenue by product less the product cost. Product cost that is used in the gross

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margin calculation is the invoice cost of the item from the vendor landed in the respective

warehouse location. If the product was delivered by the vendor, the cost of transportation

would be included in the invoice cost. If the product was shipped by Company ABC, the

cost of freight would later be added by Logistics. Any warehousing costs would also be

included (Figure 1.2).

Figure 1.2: Components Making Up Product Cost for Gross Margin Calculation

Vendor Delivered: Invoice Cost + Warehouse Cost = Product Cost

Batory Delivered: Invoice Cost + Batory Freight Cost + Warehouse Cost = Product Cost

The Executive Management Team was surprised to learn how relatively few

customers generated the majority of Company ABC's gross margin dollars. They also

found the costly customer service, and extensive sales and technical support for which

Company ABC had become so well-known, was being equally distributed among all

customers, regardless of margin contribution. A customer who may contribute $10,000 of

gross margin annually was being provided levels of service and support equal to the

customer adding hundreds of thousands of dollars of margin contribution. The high-level

service provided to these low margin customers resulted in many unprofitable accounts.

The cost incurred servicing these customers far exceeded the gross profit dollars collected.

At the same time, the company's top customers were provided levels of service and support

disproportionate to the gross margin dollars contributed to the company.   These high value

customers were being underserviced and, at times, neglected as service support was

directed to the smaller customers. Senior management decided that the company would

focus on those key customers that provided the greatest gross profit contribution by

developing plans to deliver to them high levels of service and building a support structure

to cater to those customers, while at the same time providing varying levels of service for the other, "non-key" customers as defined by gross profit contribution.

Starting in 2019, customers have been prioritized based primarily on margin contribution. Priority 1 and 2 are the company's premier customers generating over 50% of the gross operating margin. Priority 3 customers are considered critical customer and are responsible for the next 20% of the company's margin, Priority 4 are good customers, but margin generation is considerably less, while Priority 5 customers are the smallest, providing the least gross margin contribution annually. Levels of service have been determined for each priority tier. Of critical importance is the time to deliver product to their top customers. It was determined that to provide premium service all Priority 1 and 2 customers would be delivered in 24 hours of pick up. Priority 3 customers in 48 hours and, Priority 4 in three days. However, in view of the fewer warehouse assets the company had at the beginning of 2018, there were questions whether Company ABC could meet those aggressive delivery schedules. The warehouse closures accomplished earlier were not done based upon customer locations. This question was particularly important for the Priority 1 and 2, which were to be "over serviced."

1.5 Purpose and Objectives

The purpose of this thesis is to determine if current company warehouse assets, both owned/operated sites and 3PL facilities, can support one day delivery of orders from priority 1 and priority 2 customers. To accomplish this, several objectives must be met. First, those customers that meet the criteria of a priority 1 or priority 2 status must be identified, and their customer ship-to destinations ascertained. Next, as it is such a critical factor, it will be necessary to determine what constitutes one day delivery. There are

potentially priority 1 and 2 customer ship-to locations that are currently being serviced within the one-day goal. Those customers whose orders are currently delivered within one day must be identified. Likewise, those customer locations that exceed the one-day delivery criteria will be examined in relation to all company warehouse locations to establish if other company facilities could meet the desired delivery standards. Should the analysis identify customer ship-to locations that cannot meet the goal of one-day delivery from any of the company warehouse locations, optimization techniques will be applied to identify the optimal placement of new warehouse sites to achieve the company's desired objective of one day delivery of priority 1 and priority 2 customers. Finally, based upon the results of the objectives outlined above, all current warehouse assets will be reviewed for the potential of site elimination with a calculated cost savings identified.

To determine whether Company ABC's warehouse locations are effectively located to allow Priority 1 and 2 customers to receive delivery of their orders within a day, it will be necessary to collect the appropriate data necessary to meet the objectives identified above. Data collected will include customer gross profit information for calendar year 2018, all physical customer ship-to locations by city/state/zip, the physical locations of Company ABC warehouses by city/state/zip, the distance between locations and the current transportation industry standard for a single day's delivery transit. For potential cost saving calculations, annual operating costs of each of the warehouses will need to be identified.

Once complete, the company's Executive Management will be presented a report outlining the ability of Company ABC to meet the delivery service goals that have been mandated for these critical Priority 1 and 2 customers. Should the company's ability to meet these goals with current warehouse assets fall short, alternative warehouse locations

will be identified and presented that will allow one-day delivery to these high value

customers. Should the study indicate more assets in operation than are needed to fulfill

service goals, recommendations for potential warehouse closure will be offered along with

potential savings realized from these closures. Finally, the recommendation for further

study to evaluate warehouse assets relative to priority 3 customers will be made.

CHAPTER II: LITERATURE REVIEW

This chapter will examine the role of distribution in the food ingredient marketplace, the possible choices the food ingredient manufacturer has of either direct sales or distribution to bring the products they produce to the end user in the market place and ways in which distributors might tailor their distribution approach to best serve their markets. A discussion follows of the company's objectives as it relates to costs and how best to adjust its warehouse operations to meet company priorities. Finally, the chapter concludes with a examination of the processes which the company may follow that will help it to achieve its goals.

2.1 Distribution

In the food ingredients business within the United States, distribution plays a vital role. Distribution is defined as the steps needed to move and store product from the supplier stage to the customer stage in the supply chain (Chopra and Meindl 2016). There are many manufacturers of food ingredients. These businesses are defined as companies that take raw agricultural goods or chemicals and through production processes specific to the ingredients being manufactured create end products that can be used in the production of food sold to consumers. Most of these companies produce product in large volumes, typically tens of millions of pounds or more annually that need to be sold to food manufacturers. To go to market, ingredient manufacturers are faced with essentially four channel decisions: Direct Outside Sales, Direct Inside Sales, Regional Distributors and National Distributors (Friedl 2015). The Direct Outside Sales Channel is likely the

costliest to an organization, but is often preferred as it can provide the manufacturer the greatest control over the sales process and could lead to greater profits through their ability to directly set margins. In this case, the manufacturer invests in the hiring, training and equipping of an outside sales staff and incurs travel expense in the prospecting and sales effort. These individuals are tasked with direct sales contact with end users of the company's product. They are often located outside the company headquarters or plant locations typically operating out of their homes. The Direct Inside Sales Channel is similar to the Outside Sales Channel but instead of being located remotely, the sales team is located within company offices. Sales personnel are hired and trained to effectively sell the manufacturers products, but it is done internally with no direct customer contact. As with the Direct Outside Sales channel, Direct control is maintained over the sales process to include margin determination. Costs to operate this type of sales force are reduced because it is no longer necessary to provide those tools typically assigned to an outside sales force: company car or stipend, phone, computer and home office equipment and supplies. Since all sales are conducted in company facilities, travel expenses are no longer incurred. There is some effectiveness lost in the sales process without direct customer contact, which an outside sales force can provide.

Using a distribution channel to bring their products to market often reduces the amount of direct control a manufacturer may have over the sale of their products. Sales planning, sales targets and product priorities become the responsibility of the distributor as they must balance this manufacturers line of products with the others companies they represent. With direct sales, a manufacturer has the ability to set the selling price through their sales representatives customer-by-customer. This can become too complex when

working with a distributor, so there is typically distributor pricing established with the distributor setting the final price to the customer. The distributor pricing is often lower than the prices a manufacturer may charge a direct customer. This lower distributor pricing may yield less margin than direct-to-customer sale and, therefore, the potential for slightly lower profits. This lower profit on an individual order basis is often offset by the broader market reach that distribution companies can provide. Distributors often employ many more sales representatives regionally and nationally than a manufacturer typically can. There are a greater number of customers accessible to the distributor who purchase less-than-truckload (LTL) quantities of the products offered that would likely be ignored by the manufacturer. Manufacturers cannot efficiently manage this type of customer due to small order quantities, yet, these smaller customers can be effectively handled by a distributor. The distributor, in turn, purchases more truckloads to replenish stock consumed by numerous smaller quantity orders generated by a greater number of customers.

Regional Distributors focus their sales effort in smaller portions of the country, typically geographic regions: Southeastern U.S., the Midwest, the Northeast, etc. The manufacturer may choose to work with Regional Distributors to avoid being locked in with one distributor. The administration of numerous regional distributors tends to be more complicated, however, as product lines, prices, order quantity minimums and terms must be established and managed with each distributor. There are additional problems that must be resolved when distributors cross into territories belonging to another distributor.

A National Distributor has sales reach into all parts of the country. They typically have a larger sales force than a manufacturer can have as they are selling many more products. A national distributor provides the producer greater sales reach with less

complexity. There is only one distributor relationship to manage. Some flexibility is lost because all sales within the distribution channel is through only one company.

Food manufacturers, those producing finished goods, will purchase these ingredients for their production needs. Some are large enough to buy product direct from the manufacturer, typically in rail car, container or truckload quantities. These customers are easily handled through the direct outside and inside sales. Virtually all food manufacturers will need to purchase ingredients in LTL quantities. Because handling small volumes of product tends to be inefficient for large manufacturers, either regional or national food ingredient distributors fill this need. These companies specialize in the movement of smaller quantities of product through the supply chain. How a distributor does this depends upon who they wish to serve in the market. The distribution network selected can achieve objectives ranging from low cost to high responsiveness (Chopra and Meindl 2016). In the case of Company ABC, high responsiveness means rapid delivery of products from the time of loading, accommodating frequent, short notice order changes and reacting to condensed lead times, building a complete product line that would anticipate nearly any customer ingredient need and have those products as close as possible.

2.2 Company ABC and Logistic Costs

From the beginning, responsiveness to customer needs was the priority for Company ABC management. The company provided superior service to all customers regardless of profit contribution to the company. This drove the degree of dedicated customer service to all customers, as well as decisions on how many warehouses the company should employ and where to place them. The problem became superior responsiveness and service to every customer regardless that overall value to the company

was not financially sustainable. While company growth remained the primary focus, the costs associated with the implementation of its vision was now a topic of management discussion. Senior management questioned whether the strategy chosen to service customers through this large warehouse network was a sustainable use of the company's resources. This is not a new concept. Many companies face these same decisions. As markets become more competitive, efficiency driven cost savings must become a greater focus, pushing firms to rethink their warehouse network. By rebalancing assets and consolidating and phasing out warehouse locations, companies can realize savings in transportation, inventory and physical warehouse costs (Melachrinoudis, Messac and Hokey 2005).

At Company ABC, a discussion began as to whether the company supply chain should be more efficient. Operational efficiency is an admirable goal as the alleviation of cost from the system can translate to bottom line profit; however, the company built a reputation of being a food ingredient distributor that is highly responsive to the needs of the customer. The argument to focus on efficiency may adversely impact the company's responsiveness and, thereby, reduce its competitive advantage and company profitability.

2.3 Process of Optimizing Warehouses to Customers

Identification of priority customers would be a relatively straight forward process determined by a set of parameters unique to the individual company. Quite often, the customer location is not only the company headquarters, but also can be one of many additional locations that would receive ingredient deliveries. This latter number is quite often much larger than the number of company headquarter locations. Typically, from internal company data, customer ship-to addresses would be determined and compared

with existing warehouses to determine whether one-day delivery was possible. What

constitutes a one-day delivery? Five hundred miles is the accepted distance that the

transportation industry considers to be a single day transit (Parise 2019). Initial

determination of one-day transit for priority customers can often come from a company's

internal transportation data. Most companies today moving large volumes of freight

typically utilize a transportation management system. Simply stated a transportation

management system (TMS) is a logistics platform that coordinates the planning, execution

and optimization of the physical movement of goods (TechTarget 2018). Compiling this

data from the TMS and sorting by 500 miles or less will eliminate those ship-to addresses

already served within a day of warehouse assets.

There are several methods a researcher could use to approach the remaining ship-to

locations ranging from basic to complex. If relatively few customer ship-to locations are

involved, selecting a site might be as simple as looking at a map and "eye-balling" a

location. It is also possible that some customer locations serviced by a company warehouse

are closer to another company asset but have been overlooked. There are several programs

available that can sort bulk postal codes and compare them with others with a mileage

constraint that could determine whether other warehouses closer to the customer receiving

site might be available. This process could be valuable when proximity to the customer

and warehouse is of primary concern.

Typically, logisticians must consider many factors to ensure a comprehensive

solution to locating warehouses: what will be inventoried, who will own the warehouse(s),

proximity to customers and customer assignment to particular warehouses (Geoffrion and

Powers 1980). Models can consider multiple variables when determining the optimal

locations for facility placement such as current warehouse locations, inventory demand

from the warehouses and inventory complexity (single item or multiple), distance to

customer locations, distance from supply sources, and transportation costs (Chopra and

Meindl 2016).   In many situations it is necessary to consider the entire supply chain when

determining warehouse locations. There are often a substantial number of variables that

should be contemplated when selecting the most effective site for a warehouse within the

structure of the supply chain. There are several location models available to determine

optimal facility locations within a supply chain (Melo, Nickel and Saldanha-da-Gama

2008).

      If, however, the primary goal is to identify warehouse locations that can achieve

delivery to priority customers within a day, then the bulk postal code sorting tools

described above might be an effective way. Sites determined by this process in which one-

day delivery could not be achieved would then require a model that considers locating a

facility based on the shortest distance possible. This type of location model can be used to

determine a geographic position that minimizes the distance between two or more points

(Ragsdale 2015). In this case, the points from which to minimize distance would be

customer ship-to locations.

CHAPTER III: METHODS & DATA

In this chapter there will be a discussion of the relevant data used for this study. The types of data collected, sources of that data as well as definitions particular to this business and paper will be reviewed. Also described in this section will be the methods used to evaluate the data with the primary goal of identifying the optimal warehouse locations need to deliver the company's highest priority customers within 24 hours of shipment departure.

3.1 Definitions

There are terms utilized throughout this section that are used routinely within Company ABC, but that may not be familiar to others. Definitions of these frequently employed terms follow.

3.1.1 Gross Margin

Described earlier in the paper (section 1.4), gross margin is the primary means used by Company ABC for determining customer value on an ongoing basis. Quite simply, product gross margin is the sale price of the products sold to a customer less the cost of the products sold. Customer gross profit would be the total gross margin of all products sold.

3.1.2 Price

Product price is determined by the Company ABC account managers and sales managers. It is expressed as dollars per unit or dollars per pound. At its base is the product

cost. The account managers will then add gross margin which is a percentage of product

cost. If Company ABC provides a delivered price, freight costs are included.

3.1.3 Cost

Total cost of the product expressed as dollars per unit or dollars per pound. It

includes invoiced price from the vendor plus freight cost to deliver to the company

warehouse. Appropriate warehouse cost is allocated to the product when received into

inventory.

3.1.4 Gross Profit Contribution

Customer gross profit contribution is the profit a customer provides reported on a

monthly and annual basis. It is the sum of the gross margin of all transactions conducted

during the reporting period. It is the prime determinant of customer value to Company

ABC.

3.1.5 Third Party Logistics Warehouse (3PL)

Warehousing services utilized by Company ABC on a contracted basis. Contracts

are of a specified timeframe. All operations and staffing is done by the contract warehouse

with costs billed regularly to the company based on storage and handling of inventory.

3.1.6 Company ABC Owned/Operated Warehouse

A warehouse that is either physically owned and staffed by Company ABC or is a

leased location but is fully staffed and operated by Company ABC employees. Warehouse

costs are more complex than those of a 3PL and include personnel salary and benefit, equipment procurement and maintenance costs, rent, utilities, depreciation and taxes.

3.2 Empirical Modeling

In order to determine if the delivery of all Company ABC's priority 1 and priority 2 customer ingredient orders could be accomplished within one day of shipment, it will be necessary to identify three critical pieces of information. First, how is a priority customer determined; what information is used to make this determination? Next, customer ship to locations and the identification of those that are beyond 500 miles that is the accepted shipping distance for a one-day transit need to be determined. Finally, the development of a warehouse/customer sorting model that would identify the optimal existing company warehouse site in relation to a customer ship to point that would allow for transit distance of less than 500 miles.

3.2.1 Computing Gross Margin and Customer Prioritization

There was a cursory discussion of gross margin in the introduction section. Gross margin is the value derived by the difference between the revenue generated by the sale of products to a customer and the cost of those products. The sales representative determines a sale price to the customer, typically in price per pound, for a specific volume of that product. The price is the product cost that the sales representatives finds in the company's Enterprise Resource System (ERP) with a gross margin value added to that cost. That gross margin value is determined through discussions between the sale representative and the sales manager with guidance from the product manager responsible for the product being sold. Product cost is calculated within the ERP system by taking the product invoice

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price from the vendor, adding warehousing charges when the product is received into the warehouse and adding the freight cost incurred to deliver that product to the warehouse (Table 3.1).

Table 3.1: Sample Product Gross Margin Calculation

Input	Cost/Lb.
Customer Quoted Price	$1.000
Product Invoice Cost	$0.750
Warehouse Cost	$0.020
Freight Cost	$0.035
Total Product Cost	$0.805
Total Product Gross Margin	$0.195

Product gross margin is the value used to determine the customers' order gross margin. The customer places orders for specific volumes of individual products. Those product volumes are multiplied by the customer price to determine the customers' order total. At the same time, internally to the ERP system, the volume of each product ordered is multiplied by the total product cost to determine order cost. The difference between customers' order total and order cost is the order gross margin (Table 3.2).

Table 3.2: Sample Customer Order Gross Margin Calculation

	Product 1	Product 2	Product 3
Product Price/lb.	$ 2.250	$ 1.000	$ 4.855
Product Cost/lb.	$ 1.920	$ 0.805	$ 4.082
Product Gross Margin	$ 0.330	$ 0.195	$ 0.773
Order Volume (pounds)	10,000	27,000	5,000
Total GM by Product	$ 3,300.00	$ 5,265.00	$ 3,865.00
Total Order Gross Margin		$12,430.00	

Additional costs are typically applied to the invoice a customer would receive reflecting the total charges. Freight cost should Company ABC be delivering the product, placarding and shrink-wrapping charges should the customer request these and pallet charges for the pallets upon which all product is stacked. These charges rarely impact the total order gross margin as they are applied one-to-one. The freight, placarding and pallets charges added by the sales representative are offset by equal charges applied internally by the Operations Department to total costs independent from warehouse charges.

Customer prioritization is used by Company ABC as the primary means to determine value to the company and is calculated on the annual total of the gross margin from all orders made by customers. Customers are classified into five priority levels, 1 through 5. There is no formula used to develop these gross margin levels. They are based upon qualitative observations and the appearance of natural breaks in the annual gross margin from customers. Other factors are considered by Executive Management when determining a customers' priority level: Dunn & Bradstreet reports and credit status, invoice past due frequency and duration, strategic value of the customer and whether the customer was also a vendor. All of these would be evaluated; however, annual customer gross margin contribution is the primary determinant.

Once all of their customers are segmented and assigned a priority level, data will be filtered to identify only customer priority segments 1 and 2. The focus of the research is on these customers; those viewed by the company as the most valuable. Once the dataset is filtered, those customers in the priority 3 through 5 categories will be eliminated.

3.2.2 Customer Ship-to Locations

Company ABC has 2,955 active customers. This count is derived from internal information from the company's ERP system Microsoft Dynamics 365 and earlier from Microsoft Dynamics Great Plains. These customers are the actual business locations, the physical address of the company. In most cases, these locations are also the sites of the customers manufacturing operations. A single address is both "bill-to" and "ship-to". This is not true in all cases. Many customers own multiple manufacturing sites or utilize the services of a contract manufacture or copacker to produce their products. In some cases, a firm may use their own facility as well as multiple copackers. To effectively determine Company ABC's ability to service the customer as required under the new strategy, it will be necessary to discover all customers' manufacturing sites. This will be done through a review of their shipping records for calendar year 2018.

Company ABC uses the services of an external transportation management company. These companies specialize in the planning, execution and optimization of the physical movement of goods. In this situation, the movement of food ingredients. The specialized transportation management system (TMS) software automates all the tasks typically associated with a transportation system such as coordinating inbound and outbounds shipments, load planning and dispatching requirements. All the information generated in the TMS system is stored in databases for ready access in planning, as well as for historical purposes.

Records will be drawn from the TMS database for calendar year 2018. These records contain all information on shipments from vendors to customers directly, vendors to company warehouses, warehouse to warehouse for stock transfers, warehouses to customers, as well as any returns that were needed throughout the year. Using data sorting

and filtering tools in Microsoft Excel, all transactions other than those related to sales order

shipments from company warehouse origination points to a customer ship to addresses will

be eliminated. Data will be further filtered to obtain customer name, customer ship to

address including city, state and zip code, warehouse origination address and zip code,

distance and customer priority. This dataset would also include multiple shipments to the

same destination. Some customers of Company ABC could receive multiple shipment per

year, per month or per week. This data for optimization purposes would be redundant.

Multiple spreadsheet line items from the same shipping warehouse to the same customer

destination will be eliminated by use of spreadsheet sorting tools.

3.2.3 Warehouse to Customer Sorting Model

Since the goal of the project is to ensure that priority 1 and 2 customer receive

orders within a one-day of shipping from company warehouse and as discussed earlier, that

would equate to a 500 mile or less transit distance, making it necessary to eliminate those

shipments to locations in the dataset that are less than 500 miles from a warehouse location.

The dataset that remains once all ship-to locations less than 500 miles are removed will

contain all priority 1 and 2 customer ship to locations from the company warehouses that

exceeds 500 miles or a single day's transit (Table 3.3).

Table 3.3: Example of Final Working Dataset Observations

LOAD DISTANCE	WHSE	WHSE ZIP	CUSTOMER NAME	DROP CITY	DROP STATE	DROP ZIP	STATUS
1,057	W35	60481	CUSTOMER 1	ABILENE	TX	79601	PRI 2
638	W64	75041	CUSTOMER 2	CASEYVILLE	IL	62232	PRI 1
1,993	W35	60481	CUSTOMER 3	SANTA ANA	CA	92701	PRI 2

At this point, the project becomes a location problem. This step will determine if

the customer ship to locations that were found to be greater than 500 miles from the

originating warehouse can be served by another Company ABC warehouse within the 500-mile constraint. The goal will be to discover those customer locations that were less than 500 miles from a given company warehouse. Unlike a traditional a location problem where the objective is to find an unknown X-Y coordinate (X_1, Y_1) on an X-Y graph with known locations also on the same graph within a predetermined constraint, this model must sort among multiple location coordinates to determine which is within a 500 mile constraint of known warehouse coordinates.

To perform this sorting model a Microsoft Excel add-on tool will be used. This program, developed by CDX Technologies a wholly owned subsidiary of Hughes Financial Services, Inc., is called CDXZipStream™ Excel Zip Code Add-in (CDX Technologies 2019). With this tool, multiple zip code locations can be analyzed to target zip codes that meets a desired distance constraint. The program searches a database of thousands of zip codes determining which of the addresses are within the constraint radius of the target zip code. Distance calculations are based on the centroid location of each zip. All zip codes in the database have a corresponding geocode expressed in latitude and longitude from which the distance calculations are made. The final working dataset will be analyzed using this technology for each of the company's warehouse locations using a 500-mile distance constraint.

3.3 Data

Company ABC is a distributor of food ingredients but at its roots it is a service company. Company ABC was founded and grew to the company today by providing exemplary service to its customers. In 2018, a review of Company ABC's customer database showed 2,955 active customers. These customers ranged in size from very small,

buying one to two products infrequently to extremely large, purchasing dozens of products and receiving shipments on a monthly or weekly basis.

3.3.1 Gross Margin and Customer Prioritization

Despite consistently growing revenue to the company, profit showed very little year-over-year growth. Management sought the services of a consulting firm to investigate why this was occurring. The study commissioned assessed all aspects of Company ABC's sales and service. An evaluation of customer value of, as well as the overall level of service each was being provided. Gross margin dollar contribution was to be the benchmark used to evaluate and value the company's customer base. At the beginning of 2018, Company ABC switched to a new Enterprise Resource System so it was necessary to extract data from two different systems. Data from 2017 came from Microsoft Dynamics GP while 2018 data came from the new Microsoft Dynamics 365.   The consulting firm examined sales history data from calendar years 2017 to 2018. The customer gross margin data revealed that 472 customers of the 2,955 provided 86% of gross margin dollars while 2,483 contributed only 14%. During this customer sales analysis, another internal team looked levels of service provided to the company's customers. Service levels were based upon a qualitative review of a number of activities that surround a customer: consistent and unlimited contact with dedicated sales representatives and customer service agents to handle requests and orders, access to the services and the technical expertise of product managers, all levels of document support, short notice changes to orders, emergency order picking, and staging and one day or as near to one day delivery from loading as possible. Again, data came from the company's ERP systems, as well as company dispatch and shipping information from its transportation and warehouse management systems. The

study confirmed that all customers were provided very similar levels of service consuming relatively equal amounts of time and resources regardless of customer size or gross margin contribution. Customers contributing few gross profit dollars to the company were receiving service levels equivalent to those providing hundreds of thousands of dollars annually. The consulting firm developed an initial quadrant graphic to illustrate the findings (Figure 3.1).

Figure 3.1: Initial Customer Segmentation by Gross Margin (GM) with Estimated Service Level

GROUP A CUSTOMERS	GROUP B CUSTOMERS
• Most valuable customers	• Valuable customers
• GM contribution: >60%	• GM contribution: 20%
• Service time provided: 25%	• Service time provided: 25%
GROUP C CUSTOMERS	GROUP D CUSTOMERS
• Base level customers	• Least valuable customers
• GM Contribution: 16%	• GM Contribution: <4%
• Service time provided: 25%	• Service time provided: 25%

The cost to the company of services provided small to medium sized customers could not be supported by the gross margin dollars from those same customers. Conducting routine business with the smaller customers contributing lower gross margin dollars was being done at a loss.

These four groups were further segmented by the consulting firm into five discrete categories or levels of priority to the company. A team consisting of sales and product management along with Finance representation developed the criteria upon which gross margin contribution ranges could be established. Those ranges allowed for the establishment of priority levels. This information allowed for further segmentation of customers t be conducted using Microsoft Excel (Table 3.4).

Table 3.4: Customer Priority, Customers and Criteria Used for Priority Determination

Priority	Customers	Gross Margin Range	GM %
1	16	Greater than $500,000	28%
2	147	$100,000 to $499,000	33%
3	309	$40,000 to $99,000	25%
4	569	$10,000 to $39,000	14%
5	1,914	Less than $10,000	6%

A summary of descriptive statistics for each of the priority datasets above is provided (Table 3.5).

Table 3.5: Mean, Max, Min and Standard Deviation for Each Priority Dataset

	Priority 1	Priority 2	Priority 3	Priority 4	Priority 5
Mean	$1,391,930	$182,072	$64,695	$20,024	$2,575
Max	$5,307,248	$449,637	$99,754	$39,765	$9,990
Min	$508,782	$101,786	$28,922	$10,001	$0
St Dev	1,385,876.1	148,712.0	17,729.69	8,090.43	2,549.92

The 163 customers in the top two priority tiers, priority 1 and 2, were identified as most valuable to Company ABC. These customers provided the greatest amount of individual margin contribution. In nearly all cases, these customers purchased large volumes of many different products. Customers in these tiers would receive superior service ranging from dedicated Tier 1 and 2 sales and customer service support, rapid access to product managers, as well as priority access to inventory on-hand and "head-of-line" privileges for order fulfillment. This degree of service was exclusive for this customer level and available at a declining rate to tiers 3 and 4. For the purposes of this study, this also included rapid processing and delivery of their product orders. Each of the tiers would receive guarantees that their products would be delivered within a specified time from loading at the warehouse.

Priority 1 and 2 customers would receive their products within 1 day of departing the

warehouse (Table 3.6).

Table 3.6: Company ABC Customer Priority Tiers with Shipping Goals

Priority	Customers	GM%	Shipping
1	16	28%	1 Day
2	147	33%	1 Day
3	309	25%	2 Days
4	569	14%	3 Days
5	1,914	6%	Pick Up Only

3.3.2 Customer Ship-to Locations

Frequently, the customer headquarters location is only one of many locations that

would receive ingredient deliveries. The 163 customers identified above often have

multiple manufacturing locations or may utilize the services of a contract manufacturer or

copacker. From internal customer data, all customer ship-to addresses were identified

developing a list of all priority 1 and 2 customer ship-to locations. TMS data from the

company's contracted logistics service provider showed a total of 39,759 individual

shipments to all priority 1 and priority 2 customers in the 2018 calendar year. This number

includes multiple shipments to the same ship-to location. TMS data was evaluated to

identify those that were greater than 500 miles. Of the 39,759 shipments, 8% exceeded 500

miles. A total of 3,200 shipments from a company warehouse to the customers desired

destination were greater than 500 miles. Most of the 3,200 shipments were multiple

shipments to the same locations. Refinement of this data revealed 147 discrete deliver

destinations that fall outside of the 500-mile maximum, making these locations beyond the

company goal of one-day transit (APPENDIX A).

3.3.3 Warehouse to Customer Sorting Model

Next, the 147 delivery destinations were analyzed against all company warehouse

sites to determine if one-day deliver transit was possible from an alternative company

facility. This was done using the CDXZipStream™ Excel Zip Code Add-in software.   All

147-customer ship to sites were entered in the Analysis Template (Figure 3.2)

Figure 3.2: Example of CDXZipStream™ Excel Zip Code Add-in Analysis Modeling Template

The customer name, city, state and zip code of all 147 ship-to locations were

entered in the address data section of the Radius Analysis Template as shown above. This

was done by Cut and Paste to avoid entry errors. The company owned/operated warehouse

zip code or 3PL zip code was entered in the Target Zip Code box and a Radius Distance of

500 mile was set. This process was repeated for each their warehouse or 3PL facility. The

output of the model would be all warehouses that could be serviced from within the 500-

mile constraint.

3.3.4 Company ABC Owned/Operated and 3PL Facility Expense

The results of the modeling could point to redundancies in the warehouse locations

in use by Company ABC. This could present potential opportunities for cost savings by

reducing or eliminating warehouse operations. Accounting data for calendar year 2018 was

analyzed to identify operating costs of each of the target warehouse locations. The first

reviewed were the company owned/operated facilities. These were the largest warehouse

operations within the company and tended to be the costliest (Table 3.7).

Table 3.7: Company ABC Owned/Operated Warehouse Expense Calendar Year 2018

WAREHOUSE	WHSE ID	CITY	STATE	ZIP	ANNUAL EXPENSE
Batory Hopkins	16	Hopkins	MN	55343	$1,177,744
Batory Commerce	26	Commerce	CA	90040	$1,658,133
Batory Garland	64	Garland	TX	75041	$1,450,176
Batory Lithia Springs	39	Lithia Springs	GA	30112	$2,540,544
Batory Union City	59	Union City	CA	94587	$1,450,176
Batory Wilmington	35	Wilmington	IL	60481	$12,347,911

These warehouse locations had the most complex costs associated with it and was

the reason why they were the most expensive. All locations had property expense, such as

rent and utilities, while the company owned locations had property tax expense as well.

Company owned/operated facilities also had personnel expense (salary and benefits,

pensions and payroll taxes) and operational expenses, such as fork trucks, palletizers,

equipment and facility repair and maintenance cost and office management expense. The

other large expense incurred with these facilities are depreciation, insurance and interest

expense.

By contrast, Third Party Logistic services contracted by Company ABC tended to

be less expensive than the owned and operated locations. All of the costs associated with

owning or renting and staffing a warehouse for full operations are incurred by logistics

company and not by Company ABC. For these locations the company would be charged

fees based upon the services provided. Typically based on the inventory that was received,

stored and shipped. There would typically be a inbound handling charge per

hundredweight (CWT) of material received, a recurring monthly charge by CWT

depending upon how long the material was stored with a one month minimum, and then an

outbound handling charge, again per CWT. There were also charges for incidentals such as

restacking bags on pallets, shrink wrapping and placarding pallets, and preparing and

shipping individual bags of material via parcel services such as Federal Express or United

Parcel Service. These were fixed fees. The Company received monthly invoices detailing

the charges. Since these operations were smaller and did not have all the expenses incurred

with the owned/operated facilities, expenses were much smaller (Table 3.8).

Table 3.8: Company ABC 3PL Warehouse Expense Calendar Year 2018

WAREHOUSE	WHSE ID	CITY	STATE	ZIP	ANNUAL EXPENSE
States Logistics	30	Tolleson	AZ	85353	$134,666
Halls	45	South Plainfield	NJ	07080	$371,344
ADM	51	Salt Lake City	UT	84119	$273,900
Oregon Transfer	61	Portland	OR	97203	$453,391

It must be noted that one warehouse location is not reflected in the cost data. Team

Hardinger East Erie in Erie, PA (warehouse 610) while in operation in 2018 was contracted

late in 2018. There was insufficient cost data to allow for any significant analysis so this

location was omitted.

CHAPTER IV: RESULTS

In this chapter, there will be a description of the optimization work that was conducted, and the results presented that were obtained. The focus will be on pairing customer ship-to locations with the optimal warehouse location within the 500-mile constraint, and potentially identifying any locations that could not be serviced from a company warehouse location. After realigning customer ship-to locations with the optimal warehouse, potential redundancies will be identified, and possible cost savings will be found from the closure of one or more warehouse locations. Additionally, with customer ship-to locations now closer to the appropriate company warehouse, potential savings in freight expense savings from reduced load distances will be determined.

The zip code of the first Company ABC warehouse location, Wilmington, was entered in the Target Zip box and a distance radius of 500 miles was selected as the limiting constraint. The data from this process are reflected in Table 4.1.

Table 4.1: Customer Ship-to Locations Within 500 Miles of the Wilmington Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 2	CASEYVILLE	IL	62232	210.90	WILMINGTON
CUSTOMER 6	HODGKINS	IL	60525	35.17	WILMINGTON
CUSTOMER 16	KNOXVILLE	TN	37901	431.32	WILMINGTON
CUSTOMER 38	LE MARS	IA	51031	429.22	WILMINGTON
CUSTOMER 39	CRETE	IL	60417	26.30	WILMINGTON
CUSTOMER 41	FAIRMONT	MN	56075	365.20	WILMINGTON
CUSTOMER 46	CHICAGO	IL	60603	46.58	WILMINGTON
CUSTOMER 51	CAROL STREAM	IL	60128	42.57	WILMINGTON
CUSTOMER 58	TRAVERSE CITY	MI	49684	268.50	WILMINGTON
CUSTOMER 69	SPRINGDALE	AR	72762	484.39	WILMINGTON
CUSTOMER 74	JACKSON	OH	45640	328.15	WILMINGTON
CUSTOMER 76	CHANDLER	MN	56122	438.16	WILMINGTON
CUSTOMER 88	FRIDLEY	MN	55421	367.41	WILMINGTON
CUSTOMER 93	ALSIP	IL	60803	31.25	WILMINGTON
CUSTOMER 99	LAKE FOREST	IL	60045	65.97	WILMINGTON
CUSTOMER 102	BOLINGBROOK	IL	60440	27.66	WILMINGTON
CUSTOMER 112	BRIDGETON	MO	63044	214.38	WILMINGTON
CUSTOMER 113	BRISTOL	VA	24201	452.87	WILMINGTON
CUSTOMER 114	EAU CLAIRE	WI	54701	294.91	WILMINGTON
CUSTOMER 118	SPRINGDALE	AR	72762	484.39	WILMINGTON
CUSTOMER 123	NASHVILLE	TN	37201	361.46	WILMINGTON
CUSTOMER 127	ELMA	NY	14059	495.91	WILMINGTON
CUSTOMER 134	MILWAUKEE	WI	53201	120.59	WILMINGTON
CUSTOMER 138	CEDAR RAPIDS	IA	52401	190.52	WILMINGTON
CUSTOMER 144	HILLSBORO	WI	54634	199.36	WILMINGTON

The information from the modeling is reflected as customer name, city, state, zip code and the calculated distance from the target warehouse. All customer locations beyond the 500-mile constraint were omitted from the output.

This process of modeling was continued for the following Company ABC owned/operated target warehouse locations: Hopkins, Lithia Springs, Garland, Commerce and Union City. Additionally, modeling was done for the following 3PL locations target locations: Halls, ADM and Oregon Transfer. Results of these models are reported in APPENDIX B.

Each individual execution of the model by target warehouse discovered those priority 1 and 2 customer ship-to locations that could be delivered within the company's

goal of one day from that warehouse. Viewed independently, it is not possible to determine

if all priority 1 and 2 customer can be served. It is necessary to view them in aggregate to

ascertain complete coverage. The data tables of Table 4.1 as well as those in APPENDIX

B were modified adding the target warehouse location name following the distance. The

complete customer list in APPENDIX A was merged with the modified data sets in Table

4.1 and APPENDIX B to create one large table. That table was then sorted by customer

resulting in groups of customers and the associated warehouse or warehouses that could

service that site (Table 4.2).

Table 4.2 Example of Merged Datasets

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 99	LAKE FOREST	IL	60045		
CUSTOMER 99	LAKE FOREST	IL	60045	65.97	WILMINGTON
CUSTOMER 99	LAKE FOREST	IL	60045	333.02	HOPKINS
CUSTOMER 98	LINDON	UT	84042		
CUSTOMER 98	LINDON	UT	84042	27.33	SLC
CUSTOMER 96	EUREKA	CA	95501		
CUSTOMER 96	EUREKA	CA	95501	248.06	UNION CITY
CUSTOMER 96	EUREKA	CA	95501	339.93	PORTLAND
CUSTOMER 97	DALLAS	TX	75212		
CUSTOMER 97	DALLAS	TX	75212	15.22	GARLAND
CUSTOMER 95	VERNON	CA	90058		
CUSTOMER 95	VERNON	CA	90058	328.53	UNION CITY
CUSTOMER 95	VERNON	CA	90058	3.49	COMMERCE
CUSTOMER 94	AUSTIN	TX	73301		
CUSTOMER 94	AUSTIN	TX	73301	191.39	GARLAND
CUSTOMER 93	ALSIP	IL	60803		
CUSTOMER 93	ALSIP	IL	60803	31.25	WILMINGTON
CUSTOMER 93	ALSIP	IL	60803	362.63	HOPKINS

In this example, all rows in red font were from the customer ship-to locations found

in APPENDIX A. Font color was changed to better differentiate from the model datasets

of Table 4.1 and APPENDIX B. In the example in Table 4.2, each red colored row is

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matched to at least one row that is normal font color. That row will also have a warehouse location at the end. This is a demonstration that this customer ship-to location can be serviced by this warehouse in less than 500 miles. For example, Customer 98 of Linden, UT can be service by the Salt Lake City warehouse at 27.33 miles. Note that some customer ship-to locations have more than one warehouse that can service it within the 500-mile constraint. Customer 99, for example, can be serviced by both Wilmington and Hopkins. Analysis of the entire merged dataset finds this to be a common occurrence.

One feature that was searched for and was not found to be present was a single red font row by itself with no corresponding black rows. That would have indicated that no company warehouse or 3PL could reach that ship-to location within the specified 500-mile constraint (Figure 4.1). This demonstrates that all customer priority 1 and priority 2 ship-to locations were within 500 miles of a Company ABC warehouse facilities and could be serviced within the Management Teams goal of one day from shipment departure.

Figure 4.1: 500-Mile Coverage Radius of Company ABC Warehouse Locations
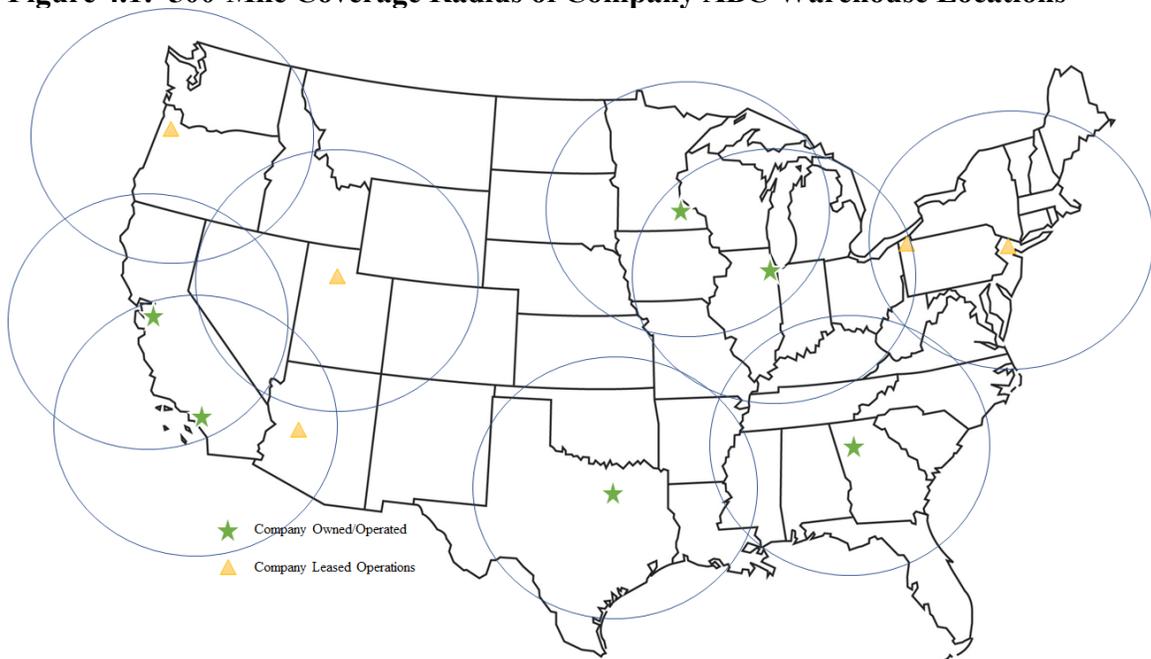
It was noted that while all customer ship-to locations could be serviced by one or more warehouse locations, some locations could only be serviced by one site. It was also found that while most warehouse sites served at least one location, there were a few that did not. With all priority 1 and 2 customers achieving one-day delivery from current company warehouse locations and some locations serviced by two or more. All warehouse locations except for two served at least one customer independent of another warehouse. Those two warehouses were States Logistics, a 3PL in Tolleson, AZ and Hopkins, a company operated site in Hopkins, MN. These locations were redundant to other locations but serviced none on their own. It could be suggested that these two warehouse locations are unnecessary in the Company ABC network and could be eliminated.

Based on financial data, the closure of State Logistics could save the company approximately $134,000 annually. Closure of Hopkins, since it is a company operated warehouse, could result in an even larger savings. Its closing would likely be more complex as there are issues surround employees and potential severance packages along with the disposition of equipment, furniture and supplies, however, a savings of over $1.1 million annually could be realized with its closure. The closure of these two locations could save Company ABC over $1.2 million.

Another result that stood out was the substantial amount of redundancy between the warehouses Commerce and Union City. Of the 34 total Priority 1 and 2 customer ship-to locations in that region, 30 or 88% of them can be serviced by either Union City or Commerce. Commerce served three locations to the east of Commerce, CA in Tempe, Phoenix and Tolleson, AZ that Union City could not reach and, likewise, Union City

services one location north of the San Francisco Bay Area in Eureka, CA that Commerce could not reach.

An alternative model would place a warehouse in either Fresno or Visalia, CA with distribution to all sites within California (Figure 4.2).

Figure 4.2: Company ABC Warehouse Map Eliminating Union City and Commerce and Placing a Facility in Fresno/Visalia, CA

In this example, Union City and Commerce locations are eliminated and a new, centrally located facility is created to provide coverage to California. In this scenario, States Logistics in Tolleson, AZ would remain in operation as consistent service to that area could be a concern. The annual operating expense of Union City is $1.45 million,

while Commerce annual operations cost the company $1.66 million. The closure of both locations would potentially save over $3 million. There would be expense at the new location. A Company ABC operated facility replacing the two closed could be assumed to cost as much as one of the others. There would still be a substantial net savings that could be realized.

With the realignment of priority 1 and 2 customers to warehouses that are within the 500-mile constraint, freight costs incurred by the company should be reduced. Information obtained from the Transportation Management company demonstrated that many of the shipments a customer received in 2018 came from one or more warehouses in excess of 500 miles. Transit distances of 1,000 miles or more were common. Freight expense to the priority customers identified in APPENDIX A for the 2018 calendar year was $1,417,808. This value includes actual freight cost plus applicable fuel surcharge. After customer ship-to locations were realigned so ship-to locations were associated with warehouses within the 500-mile constraint, freight costs totaled $751,315, a reduction of $666,493 annually. The revised freight cost was determined by using internal company freight tables developed by the Logistics Department and deriving an average cost for each freight lane. This average lane cost was multiplied by the same number of shipments that were made in 2018 to each of the customer ship-to locations. This ensured the costs calculated were based on the same number of shipments made that year.

CHAPTER V: CONCLUSIONS

The purpose of this thesis was to determine if the current mix of locations of Company ABC warehouses could support delivery shipments of less than 500 miles which would constitute one-day delivery of customer ingredient orders. These one-day deliveries would be for Company ABC's top tier customers designated priority 1 and priority 2 and was an important part of their new customer service strategy.

Company transportation management system data indicated that timely deliveries from the closest warehouse was not always occurring. By accurately identifying the ship-to locations of the customers exceeding 500 miles, it was possible to develop a model that proved all priority 1 and 2 customer could be successfully shipped their orders within one day of departure. All customer locations could be served by at least one company warehouse and in some cases, there was enough redundancy to deliver from two or even 3 warehouses. It was demonstrated from the results of this study that Company ABC could meet their service guarantee to their top tier customers.

With the realignment of customer ship-to sites with at optimal warehouse, the analysis of the data suggested redundancies that may result in the obsoleting and closure of some the company warehouses for a potential savings to the company. Additionally, the same analysis suggested that a new warehouse location could be created in the West enabling the closure of two Company ABC operated locations for additional cost savings.

The customer/warehouse realignment also can result in freight efficiencies as well. With ingredients shipped from several different warehouses other than the location optimally suited, longer transits and greater freight expense was incurred. By identifying

the optimal warehouse locations for each customer, freight distance was lessened, and freight costs greatly reduced. This could be implemented immediately.

Before these potential closures would be made, additional important studies that should be performed first. The research question asked if the priority 1 and 2 customers could be delivered within a day. It did not consider those customers that are priority 3 which have a 2-day delivery guarantee. Priority 3 customers, while not rising to the level of priority 1 or 2, are still valuable to the company. Identifying and modeling those customers should be done to see how these suggested changes might affect them. Another critical question that would need to be answered is which of the Company ABC customers utilize the warehouse as Just-in-Time pick up points. This study assumes deliveries of products to the customers by Company ABC. There are, in fact, many customers that provide their own transportation. The may have their own in-house carrier assets or their own dedicated freight carriers and use the ingredients pickup as a backhaul. A separate logistics study would need to be performed before closure decisions were made.

Since the model suggests that 1-day delivery is possible for all priority 1 and priority 2 customers from current Company ABC warehouse assets, why are so many orders shipped from warehouses which necessitate 2- or 3-day transits. There are some possible explanations.

During this period, Company ABC transportation strategy was changing. The company utilized a combination of individual carrier contracts along with broker services. This strategy became strained over the past several years as driver shortages sidelined carriers resulting in missed pickups and last-minute shifts of delivery to alternate

warehouse locations were there was inventory and carriers could be secured. These shifts resulted in transit distances far in excess of 500 miles. Recent changes in transportation strategy has greatly improved the delivery picture by focusing dedicated carrier contracts out of Company ABC warehouses in key lanes. Since its implementation, the dedicated carry concept has resulted in a much more reliable carriers, allowing product to ship from the originally assigned warehouses.

Transportation issues was only one cause for the need to use alternate warehouse locations. Insufficient inventory at the designated warehouses appears to play a large role. When orders could not be filled, some customers would simply wait for the order or receive a partial shipment. Many times, the decision was made to ship product from an alternate warehouse. This was frequently done for the priority 1 and 2 customers. While the customers would receive their orders, it was typically late, and the cost of the additional freight incurred by Company ABC, as has been demonstrated, was substantially higher. A small, separate study appears to support this assertion. It found that the company's order fill rate was inadequate resulting in delays, partial order fulfilment and rerouting of the order to different warehouse locations.

Since Company ABC has developed an effective method for defining and identifying priority customer and this research has demonstrated that all priority 1 and 2 customers can be delivered within a day, performing inventory optimization studies might be the next step. Understanding the products these valuable customers use, the quantities ordered and their frequencies, optimizing inventory by warehouse would be a logical next step.

As discussed, the research identified several redundant warehouse locations. The Hopkins warehouse is redundant to the Wilmington location. Tolleson is redundant to Commerce and there was significant redundancy between Commerce, CA and Union City, CA. There were also many locations that experienced redundancies on a lesser scale: Wilmington and Halls, Wilmington and Lithia Springs, Lithia Springs and Garland, and substantial crossover among Salt Lake City, Portland, Commerce and Union City.

As suggested in the results, these overlaps or redundancies are situations that should be minimized. The cost savings from eliminating redundant warehouses is tangible and should be considered as a part of any facility rationalization program. While recognizing that there are savings that can be gained by increasing efficiencies among warehouses, there are potential benefits that is presented through these same redundancies.

Overlapping distribution centers could be a competitive advantage in the ingredient distribution market. Particularly with the company's priority 1 and priority 2 customers, there are reassurances that could be provided to these critical customers that their production facilities could be served by more than one warehouse. Sales management could take advantage of these warehouse overlaps during the sales planning process for larger prospects by incorporating the value of these redundancies into the sales plan. It could be submitted, that the prospective customer can better manage risk to their ingredient supply chain through Company ABC's redundant warehouse network.

This advantage could be taken further by evaluating the company's competitors, knowing their warehouse locations and comparing these to the company's warehouses. A graphic representation of Company ABC's warehouse coverage in relation to the

competition could provide an additional value proposition making the company a more

attractive supplier.

Finally, this research was based on a specific period covering calendar year 2018.

The results provide the opportunity for improvements in customer service to the company's

top customers and indicate potential efficiency enhancements and cost savings. The

research also suggests that the redundancies in the warehouse network may provide the

company with a value proposition for current and future priority 1 and 2 customers by

minimizing ingredient supply chain risk. However, as the company's business is not static,

nor should this type of evaluation be static. The tools and processes identified can continue

to provide benefits if incorporated into the business planning process.

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APPENDIX A:

147 Customer Delivery Locations Outside 500 Mile Constraint Radius

Table A1: 1 to 37 of 147 Delivery Locations Exceeding 500 Miles

CUSTOMER	SHIP TO CITY	STATE	ZIP
CUSTOMER 1	ABILENE	TX	79601
CUSTOMER 2	CASEYVILLE	IL	62232
CUSTOMER 3	GRAND PRAIRIE	TX	75050
CUSTOMER 4	SANTA ANA	CA	92701
CUSTOMER 5	SAN ANTONIO	TX	78201
CUSTOMER 6	HODGKINS	IL	60525
CUSTOMER 7	SANTA ANA	CA	92701
CUSTOMER 8	CAYCE	SC	29033
CUSTOMER 9	LOS ALAMITOS	CA	90720
CUSTOMER 10	TOLLESON	AZ	85353
CUSTOMER 11	GOLDEN	CO	80413
CUSTOMER 12	MOORESVILLE	NC	28115
CUSTOMER 13	CHATSWORTH	CA	91311
CUSTOMER 14	DURANT	OK	74701
CUSTOMER 15	WOODBURN	OR	97071
CUSTOMER 16	HOOVER	AL	35216
CUSTOMER 17	KNOXVILLE	TN	37901
CUSTOMER 18	IRWINDALE	CA	91702
CUSTOMER 19	LATHROP	CA	95330
CUSTOMER 20	ROBBINSVILLE	NJ	08691
CUSTOMER 21	CAMDEN	NJ	08101
CUSTOMER 22	SALT LAKE CITY	UT	84101
CUSTOMER 23	ATLANTA	GA	30340
CUSTOMER 24	AURORA	CO	80017
CUSTOMER 25	CHAMPLAIN	NY	12919
CUSTOMER 26	FLETCHER	NC	28732
CUSTOMER 27	GARLAND	TX	75040
CUSTOMER 28	SAGINAW	TX	76131
CUSTOMER 29	PORTLAND	OR	97086
CUSTOMER 30	RED LION	PA	17356
CUSTOMER 31	UNION CITY	CA	94587
CUSTOMER 32	HOUSTON	TX	77051
CUSTOMER 33	DOUGLASVILLE	GA	30134
CUSTOMER 34	ONTARIO	CA	91758
CUSTOMER 35	TIGARD	OR	97224
CUSTOMER 36	PHOENIX	AZ	85023
CUSTOMER 37	SEATTLE	WA	98108

Table A2: 38 to 74 of 147 Delivery Locations Exceeding 500 Miles

CUSTOMER	SHIP TO CITY	STATE	ZIP
CUSTOMER 38	YORK	PA	17401
CUSTOMER 39	LE MARS	IA	51031
CUSTOMER 40	CRETE	IL	60417
CUSTOMER 41	YOAKUM	TX	77995
CUSTOMER 42	FAIRMONT	MN	56075
CUSTOMER 43	SAN CLEMENTE	CA	92672
CUSTOMER 44	NEWARK	CA	94560
CUSTOMER 45	ATLANTA	GA	30303
CUSTOMER 46	WEST VALLEY CITY	UT	84118
CUSTOMER 47	CHICAGO	IL	60603
CUSTOMER 48	CONYERS	GA	30013
CUSTOMER 49	CITY OF INDUSTRY	CA	91715
CUSTOMER 50	SHELLEY	ID	83274
CUSTOMER 51	LOGAN	UT	84322
CUSTOMER 52	CAROL STREAM	IL	60128
CUSTOMER 53	AGAWAM	MA	01001
CUSTOMER 54	DENVER	CO	80022
CUSTOMER 55	SPRINGVILLE	UT	84663
CUSTOMER 56	BOISE	ID	83701
CUSTOMER 57	SAN ANTONIO	TX	83701
CUSTOMER 58	REEDSVILLE	PA	17084
CUSTOMER 59	TRAVERSE CITY	MI	49684
CUSTOMER 60	NORCROSS	GA	30003
CUSTOMER 61	OGDEN	UT	84201
CUSTOMER 62	WEYMOUTH	MA	02188
CUSTOMER 63	VERNON	CA	90058
CUSTOMER 64	WESTON	OR	97886
CUSTOMER 65	SPOKANE	WA	99201
CUSTOMER 66	HOUSTON	TX	77081
CUSTOMER 67	UNION CITY	CA	94587
CUSTOMER 68	MIRA LOMA	CA	91752
CUSTOMER 69	HENDERSONVILLE	NC	28739
CUSTOMER 70	SPRINGDALE	AR	72762
CUSTOMER 71	LEHI	UT	84005
CUSTOMER 72	NEWARK	NY	14513
CUSTOMER 73	GRIFFIN	GA	30223
CUSTOMER 74	MOOSIC	PA	18507

Table A3: 75 to 110 of 147 Delivery Locations Exceeding 500 Miles

CUSTOMER	SHIP TO CITY	STATE	ZIP
CUSTOMER 75	JACKSON	OH	45640
CUSTOMER 76	WILMINGTON	MA	01887
CUSTOMER 77	CHANDLER	MN	56122
CUSTOMER 78	SCHULENBURG	TX	78956
CUSTOMER 79	MARTINSVILLE	VA	24112
CUSTOMER 80	MOORESVILLE	NC	28115
CUSTOMER 81	TAMPA	FL	33601
CUSTOMER 82	HILLSIDE	NJ	07205
CUSTOMER 83	FRUITLAND	ID	83619
CUSTOMER 84	TEMPE	AZ	85280
CUSTOMER 85	JACKSONVILLE	FL	32099
CUSTOMER 86	WILKES BARRE	PA	18701
CUSTOMER 87	OKEENE	OK	73763
CUSTOMER 88	SPANISH FORK	UT	84660
CUSTOMER 89	FRIDLEY	MN	55421
CUSTOMER 90	BOHEMIA	NY	11716
CUSTOMER 91	LYNDHURST	NJ	07071
CUSTOMER 92	ESCONDIDO	CA	92025
CUSTOMER 93	NORCROSS	GA	30003
CUSTOMER 94	ALSIP	IL	60803
CUSTOMER 95	AUSTIN	TX	73301
CUSTOMER 96	VERNON	CA	90058
CUSTOMER 97	EUREKA	CA	95501
CUSTOMER 98	DALLAS	TX	75212
CUSTOMER 99	LINDON	UT	84042
CUSTOMER 100	LAKE FOREST	IL	60045
CUSTOMER 101	CARROLLTON	TX	75006
CUSTOMER 102	SPEARFISH	SD	57783
CUSTOMER 103	BOLINGBROOK	IL	60440
CUSTOMER 104	BENICIA	CA	94510
CUSTOMER 105	PENNSAUKEN	NJ	08109
CUSTOMER 106	SAVANNAH	NY	13146
CUSTOMER 107	CARROLLTON	TX	75006
CUSTOMER 108	DENVER	CO	80012
CUSTOMER 109	DENISON	TX	75020
CUSTOMER 110	FLORENCE	SC	29501

Table A4: 111 to 147 of 147 Delivery Locations Exceeding 500 Miles

CUSTOMER	SHIP TO CITY	STATE	ZIP
CUSTOMER 111	RIVERSIDE	CA	92501
CUSTOMER 112	BRIDGETON	MO	63044
CUSTOMER 113	BRISTOL	VA	24201
CUSTOMER 114	EAU CLAIRE	WI	54701
CUSTOMER 115	BOULDER	CO	80301
CUSTOMER 116	SYLMAR	CA	91342
CUSTOMER 117	LYNDHURST	NJ	07071
CUSTOMER 118	SPRINGDALE	AR	72762
CUSTOMER 119	COSTA MESA	CA	92626
CUSTOMER 120	STATESVILLE	NC	28625
CUSTOMER 121	BETHLEHEM	PA	18017
CUSTOMER 122	MIDDLESEX	NJ	08846
CUSTOMER 123	NASHVILLE	TN	37201
CUSTOMER 124	ONTARIO	CA	91710
CUSTOMER 125	CHARLOTTE	NC	28201
CUSTOMER 126	UNION CITY	CA	94587
CUSTOMER 127	ELMA	NY	14059
CUSTOMER 128	RIVERSIDE	CA	92501
CUSTOMER 129	ONTARIO	CA	91710
CUSTOMER 130	OAKLAND	CA	94601
CUSTOMER 131	THE WOODLANDS	TX	77354
CUSTOMER 132	TEXAS CITY	TX	77510
CUSTOMER 133	EDISON	NJ	08817
CUSTOMER 134	MILWAUKEE	WI	53201
CUSTOMER 135	WHEATLAND	CA	95692
CUSTOMER 136	HANOVER	PA	17331
CUSTOMER 137	HANOVER	PA	17331
CUSTOMER 138	CEDAR RAPIDS	IA	52401
CUSTOMER 139	LAWRENCEVILLE	GA	30042
CUSTOMER 140	TORRANCE	CA	90501
CUSTOMER 141	SAGINAW	TX	76131
CUSTOMER 142	WEST CALDWELL	NJ	07006
CUSTOMER 143	CORONA	CA	92877
CUSTOMER 144	HILLSBORO	WI	54634
CUSTOMER 145	WHARTON	NJ	07885
CUSTOMER 146	FORT GIBSON	OK	74434
CUSTOMER 147	CALDWELL	ID	83605

MODEL RESULTS OF CUSTOMER SHIP-TO LOCATIONS WITHIN 500 MILE RADIUS OF TARGET WAREHOUSE

Table B1: Customer Ship-to Locations Within 500 Miles of the Hopkins Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 92	ALSIP	IL	60803	362.63	HOPKINS
CUSTOMER 101	BOLINGBROOK	IL	60440	348.09	HOPKINS
CUSTOMER 111	BRIDGETON	MO	63044	451.63	HOPKINS
CUSTOMER 51	CAROL STREAM	IL	60128	336.20	HOPKINS
CUSTOMER 2	CASEYVILLE	IL	62232	468.00	HOPKINS
CUSTOMER 137	CEDAR RAPIDS	IA	52401	221.31	HOPKINS
CUSTOMER 75	CHANDLER	MN	56122	142.74	HOPKINS
CUSTOMER 45	CHICAGO	IL	60603	357.99	HOPKINS
CUSTOMER 38	CRETE	IL	60417	378.94	HOPKINS
CUSTOMER 113	EAU CLAIRE	WI	54701	93.60	HOPKINS
CUSTOMER 40	FAIRMONT	MN	56075	94.76	HOPKINS
CUSTOMER 87	FRIDLEY	MN	55421	12.52	HOPKINS
CUSTOMER 143	HILLSBORO	WI	54634	172.76	HOPKINS
CUSTOMER 5	HODGKINS	IL	60525	353.17	HOPKINS
CUSTOMER 98	LAKE FOREST	IL	60045	333.02	HOPKINS
CUSTOMER 37	LE MARS	IA	51031	202.32	HOPKINS
CUSTOMER 134	MILWAUKEE	WI	53201	302.70	HOPKINS
CUSTOMER 58	TRAVERSE CITY	MI	49684	376.47	HOPKINS

Table B2: Customer Ship-to Locations Within 500 Miles of the Garland Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 1	ABILENE	TX	79601	177.88	GARLAND
CUSTOMER 94	AUSTIN	TX	73301	191.39	GARLAND
CUSTOMER 100	CARROLLTON	TX	75006	15.07	GARLAND
CUSTOMER 106	CARROLLTON	TX	75006	15.07	GARLAND
CUSTOMER 96	DALLAS	TX	75212	15.22	GARLAND
CUSTOMER 108	DENISON	TX	75020	62.92	GARLAND
CUSTOMER 12	DURANT	OK	74701	79.79	GARLAND
CUSTOMER 145	FORT GIBSON	OK	74434	218.58	GARLAND
CUSTOMER 26	GARLAND	TX	75040	4.28	GARLAND
CUSTOMER 3	GRAND PRAIRIE	TX	75050	20.94	GARLAND
CUSTOMER 31	HOUSTON	TX	77051	234.73	GARLAND
CUSTOMER 65	HOUSTON	TX	77081	229.49	GARLAND
CUSTOMER 86	OKEENE	OK	73763	242.68	GARLAND
CUSTOMER 27	SAGINAW	TX	76131	40.91	GARLAND
CUSTOMER 141	SAGINAW	TX	76131	40.91	GARLAND
CUSTOMER 5	SAN ANTONIO	TX	78201	260.21	GARLAND
CUSTOMER 77	SCHULENBURG	TX	78956	221.11	GARLAND
CUSTOMER 69	SPRINGDALE	AR	72762	266.73	GARLAND
CUSTOMER 118	SPRINGDALE	AR	72762	266.73	GARLAND
CUSTOMER 132	TEXAS CITY	TX	77510	261.01	GARLAND
CUSTOMER 131	THE WOODLANDS	TX	77354	193.09	GARLAND
CUSTOMER 40	YOAKUM	TX	77995	253.42	GARLAND

Table B3: Customer Ship-to Locations Within 500 Miles of the Lithia Springs Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 22	ATLANTA	GA	30340	24.44	LITHIA SPRINGS
CUSTOMER 44	ATLANTA	GA	30303	14.52	LITHIA SPRINGS
CUSTOMER 112	BRIDGETON	MO	63044	472.27	LITHIA SPRINGS
CUSTOMER 113	BRISTOL	VA	24201	241.59	LITHIA SPRINGS
CUSTOMER 2	CASEYVILLE	IL	62232	450.18	LITHIA SPRINGS
CUSTOMER 8	CAYCE	SC	29033	206.14	LITHIA SPRINGS
CUSTOMER 125	CHARLOTTE	NC	28201	238.96	LITHIA SPRINGS
CUSTOMER 47	CONYERS	GA	30013	39.80	LITHIA SPRINGS
CUSTOMER 32	DOUGLASVILLE	GA	30134	7.71	LITHIA SPRINGS
CUSTOMER 25	FLETCHER	NC	28732	169.97	LITHIA SPRINGS
CUSTOMER 110	FLORENCE	SC	29501	278.13	LITHIA SPRINGS
CUSTOMER 72	GRIFFIN	GA	30223	38.92	LITHIA SPRINGS
CUSTOMER 68	HENDERSONVILLE	NC	28739	158.43	LITHIA SPRINGS
CUSTOMER 15	HOOVER	AL	35216	125.25	LITHIA SPRINGS
CUSTOMER 74	JACKSON	OH	45640	380.63	LITHIA SPRINGS
CUSTOMER 84	JACKSONVILLE	FL	32099	290.13	LITHIA SPRINGS
CUSTOMER 16	KNOXVILLE	TN	37901	157.82	LITHIA SPRINGS
CUSTOMER 139	LAWRENCEVILLE	GA	30042	40.08	LITHIA SPRINGS
CUSTOMER 78	MARTINSVILLE	VA	24112	338.21	LITHIA SPRINGS
CUSTOMER 11	MOORESVILLE	NC	28115	254.22	LITHIA SPRINGS
CUSTOMER 79	MOORESVILLE	NC	28115	254.22	LITHIA SPRINGS
CUSTOMER 123	NASHVILLE	TN	37201	205.34	LITHIA SPRINGS
CUSTOMER 59	NORCROSS	GA	30003	28.30	LITHIA SPRINGS
CUSTOMER 92	NORCROSS	GA	30003	28.30	LITHIA SPRINGS
CUSTOMER 120	STATESVILLE	NC	28625	258.75	LITHIA SPRINGS
CUSTOMER 80	TAMPA	FL	33601	421.91	LITHIA SPRINGS

Table B4: Customer Ship-to Locations Within 500 Miles of the South Plainfield Warehouse

CUSTOMER	DROP CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 52	AGAWAM	MA	01001	138.91	S. PLAINFIELD
CUSTOMER 121	BETHLEHEM	PA	18017	51.52	S. PLAINFIELD
CUSTOMER 89	BOHEMIA	NY	11716	68.89	S. PLAINFIELD
CUSTOMER 20	CAMDEN	NJ	08101	58.17	S. PLAINFIELD
CUSTOMER 24	CHAMPLAIN	NY	12919	307.23	S. PLAINFIELD
CUSTOMER 133	EDISON	NJ	08817	3.77	S. PLAINFIELD
CUSTOMER 127	ELMA	NY	14059	267.39	S. PLAINFIELD
CUSTOMER 136	HANOVER	PA	17331	146.29	S. PLAINFIELD
CUSTOMER 137	HANOVER	PA	17331	146.29	S. PLAINFIELD
CUSTOMER 81	HILLSIDE	NJ	07205	12.70	S. PLAINFIELD
CUSTOMER 74	JACKSON	OH	45640	448.47	S. PLAINFIELD
CUSTOMER 90	LYNDHURST	NJ	07071	21.93	S. PLAINFIELD
CUSTOMER 117	LYNDHURST	NJ	07071	21.93	S. PLAINFIELD
CUSTOMER 78	MARTINSVILLE	VA	24112	396.55	S. PLAINFIELD
CUSTOMER 122	MIDDLESEX	NJ	08846	4.45	S. PLAINFIELD
CUSTOMER 11	MOORESVILLE	NC	28115	487.36	S. PLAINFIELD
CUSTOMER 79	MOORESVILLE	NC	28115	487.36	S. PLAINFIELD
CUSTOMER 73	MOOSIC	PA	18507	85.34	S. PLAINFIELD
CUSTOMER 43	NEWARK	NY	14513	221.25	S. PLAINFIELD
CUSTOMER 104	PENNSAUKEN	NJ	08109	54.90	S. PLAINFIELD
CUSTOMER 29	RED LION	PA	17356	122.37	S. PLAINFIELD
CUSTOMER 57	REEDSVILLE	PA	17084	168.08	S. PLAINFIELD
CUSTOMER 19	ROBBINSVILLE	NJ	08691	26.16	S. PLAINFIELD
CUSTOMER 105	SAVANNAH	NY	13146	211.82	S. PLAINFIELD
CUSTOMER 120	STATESVILLE	NC	28625	477.58	S. PLAINFIELD
CUSTOMER 142	WEST CALDWELL	NJ	07006	20.64	S. PLAINFIELD
CUSTOMER 61	WEYMOUTH	MA	02188	211.90	S. PLAINFIELD
CUSTOMER 145	WHARTON	NJ	07885	26.70	S. PLAINFIELD
CUSTOMER 85	WILKES BARRE	PA	18701	89.75	S. PLAINFIELD
CUSTOMER 75	WILMINGTON	MA	01887	216.74	S. PLAINFIELD
CUSTOMER 37	YORK	PA	17401	129.41	S. PLAINFIELD

Table B5: Customer Ship-to Locations Within 500 Miles of the Union City Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 103	BENICIA	CA	94510	34.36	UNION CITY
CUSTOMER 12	CHATSWORTH	CA	91311	299.40	UNION CITY
CUSTOMER 48	CITY OF INDUSTRY	CA	91715	326.87	UNION CITY
CUSTOMER 143	CORONA	CA	92877	359.59	UNION CITY
CUSTOMER 119	COSTA MESA	CA	92626	356.94	UNION CITY
CUSTOMER 91	ESCONDIDO	CA	92025	421.46	UNION CITY
CUSTOMER 96	EUREKA	CA	95501	248.06	UNION CITY
CUSTOMER 17	IRWINDALE	CA	91702	332.79	UNION CITY
CUSTOMER 18	LATHROP	CA	95330	42.07	UNION CITY
CUSTOMER 9	LOS ALAMITOS	CA	90720	344.90	UNION CITY
CUSTOMER 67	MIRA LOMA	CA	91752	355.23	UNION CITY
CUSTOMER 43	NEWARK	CA	94560	5.63	UNION CITY
CUSTOMER 130	OAKLAND	CA	94601	15.29	UNION CITY
CUSTOMER 33	ONTARIO	CA	91758	346.83	UNION CITY
CUSTOMER 124	ONTARIO	CA	91710	348.90	UNION CITY
CUSTOMER 129	ONTARIO	CA	91710	348.90	UNION CITY
CUSTOMER 111	RIVERSIDE	CA	92501	361.18	UNION CITY
CUSTOMER 128	RIVERSIDE	CA	92501	361.18	UNION CITY
CUSTOMER 42	SAN CLEMENTE	CA	92672	385.98	UNION CITY
CUSTOMER 4	SANTA ANA	CA	92701	355.20	UNION CITY
CUSTOMER 7	SANTA ANA	CA	92701	355.20	UNION CITY
CUSTOMER 116	SYLMAR	CA	91342	306.94	UNION CITY
CUSTOMER 140	TORRANCE	CA	90501	334.16	UNION CITY
CUSTOMER 30	UNION CITY	CA	94587	0.00	UNION CITY
CUSTOMER 66	UNION CITY	CA	94587	0.00	UNION CITY
CUSTOMER 126	UNION CITY	CA	94587	0.00	UNION CITY
CUSTOMER 62	VERNON	CA	90058	328.53	UNION CITY
CUSTOMER 95	VERNON	CA	90058	328.53	UNION CITY
CUSTOMER 135	WHEATLAND	CA	95692	106.07	UNION CITY

Table B6: Customer Ship-to Locations Within 500 Miles of the Commerce Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 103	BENICIA	CA	94510	359.86	COMMERCE
CUSTOMER 12	CHATSWORTH	CA	91311	32.44	COMMERCE
CUSTOMER 48	CITY OF INDUSTRY	CA	91715	7.11	COMMERCE
CUSTOMER 143	CORONA	CA	92877	34.60	COMMERCE
CUSTOMER 119	COSTA MESA	CA	92626	25.97	COMMERCE
CUSTOMER 91	ESCONDIDO	CA	92025	90.82	COMMERCE
CUSTOMER 17	IRWINDALE	CA	91702	16.97	COMMERCE
CUSTOMER 18	LATHROP	CA	95330	317.82	COMMERCE
CUSTOMER 9	LOS ALAMITOS	CA	90720	14.54	COMMERCE
CUSTOMER 67	MIRA LOMA	CA	91752	35.56	COMMERCE
CUSTOMER 43	NEWARK	CA	94560	327.21	COMMERCE
CUSTOMER 130	OAKLAND	CA	94601	346.40	COMMERCE
CUSTOMER 33	ONTARIO	CA	91758	29.14	COMMERCE
CUSTOMER 124	ONTARIO	CA	91710	27.66	COMMERCE
CUSTOMER 129	ONTARIO	CA	91710	27.66	COMMERCE
CUSTOMER 35	PHOENIX	AZ	85023	348.67	COMMERCE
CUSTOMER 111	RIVERSIDE	CA	92501	44.37	COMMERCE
CUSTOMER 128	RIVERSIDE	CA	92501	44.37	COMMERCE
CUSTOMER 42	SAN CLEMENTE	CA	92672	54.83	COMMERCE
CUSTOMER 4	SANTA ANA	CA	92701	24.13	COMMERCE
CUSTOMER 7	SANTA ANA	CA	92701	24.13	COMMERCE
CUSTOMER 116	SYLMAR	CA	91342	26.06	COMMERCE
CUSTOMER 83	TEMPE	AZ	85280	361.03	COMMERCE
CUSTOMER 10	TOLLESON	AZ	85353	340.21	COMMERCE
CUSTOMER 140	TORRANCE	CA	90501	14.61	COMMERCE
CUSTOMER 30	UNION CITY	CA	94587	331.15	COMMERCE
CUSTOMER 66	UNION CITY	CA	94587	331.15	COMMERCE
CUSTOMER 126	UNION CITY	CA	94587	331.15	COMMERCE
CUSTOMER 62	VERNON	CA	90058	3.49	COMMERCE
CUSTOMER 95	VERNON	CA	90058	3.49	COMMERCE
CUSTOMER 135	WHEATLAND	CA	95692	393.04	COMMERCE

Table B7: Customer Ship-to Locations Within 500 Miles of the Portland Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 55	BOISE	ID	83701	349.82	PORTLAND
CUSTOMER 147	CALDWELL	ID	83605	328.13	PORTLAND
CUSTOMER 96	EUREKA	CA	95501	339.93	PORTLAND
CUSTOMER 82	FRUITLAND	ID	83619	308.16	PORTLAND
CUSTOMER 28	PORTLAND	OR	97086	15.39	PORTLAND
CUSTOMER 5	SAN ANTONIO	TX	83701	349.82	PORTLAND
CUSTOMER 36	SEATTLE	WA	98108	134.88	PORTLAND
CUSTOMER 64	SPOKANE	WA	99201	288.76	PORTLAND
CUSTOMER 34	TIGARD	OR	97224	14.49	PORTLAND
CUSTOMER 63	WESTON	OR	97886	215.28	PORTLAND
CUSTOMER 135	WHEATLAND	CA	95692	458.38	PORTLAND
CUSTOMER 14	WOODBURN	OR	97071	32.89	PORTLAND

Table B8: Customer Ship-to Locations Within 500 Miles of the SLC Warehouse

CUSTOMER	CITY	STATE	ZIP	DISTANCE	WAREHOUSE
CUSTOMER 23	AURORA	CO	80017	383.93	SLC
CUSTOMER 55	BOISE	ID	83701	297.00	SLC
CUSTOMER 115	BOULDER	CO	80301	357.18	SLC
CUSTOMER 147	CALDWELL	ID	83605	316.48	SLC
CUSTOMER 53	DENVER	CO	80022	381.70	SLC
CUSTOMER 108	DENVER	CO	80012	380.93	SLC
CUSTOMER 82	FRUITLAND	ID	83619	339.35	SLC
CUSTOMER 70	LEHI	UT	84005	26.17	SLC
CUSTOMER 98	LINDON	UT	84042	27.33	SLC
CUSTOMER 50	LOGAN	UT	84322	72.47	SLC
CUSTOMER 60	OGDEN	UT	84201	36.39	SLC
CUSTOMER 35	PHOENIX	AZ	85023	488.26	SLC
CUSTOMER 21	SALT LAKE CITY	UT	84101	4.59	SLC
CUSTOMER 5	SAN ANTONIO	TX	83701	297.00	SLC
CUSTOMER 49	SHELLEY	ID	83274	174.53	SLC
CUSTOMER 87	SPANISH FORK	UT	84660	46.74	SLC
CUSTOMER 101	SPEARFISH	SD	57783	485.52	SLC
CUSTOMER 54	SPRINGVILLE	UT	84663	40.26	SLC
CUSTOMER 45	WEST VALLEY CITY	UT	84118	4.97	SLC
CUSTOMER 63	WESTON	OR	97886	475.31	SLC