ANALYSIS OF A CONSUMER GOODS COMPANY'S SUPPLY CHAIN, IDENTIFICATION OF AREAS OF IMPROVEMENT AND RECOMMENDATIONS FOR OPTIMIZATION

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Abstract

The nature of this capstone project is to apply the academic knowledge obtained through the Master of Science Integrated Supply Chain Management program to optimizing an organizations supply chain. In collaboration with a Consumer Goods Company (CGC) in the Pacific Northwest a review of their current supply chain was conducted along with a network analysis. The network analysis compared different scenarios to evaluate what would be their optimal model moving forward. The objective was to compare network characteristics between baseline shipping from a single facility located in the Pacific Northwest with alternative multi-site scenarios. The results would showcase the differences in transportation characteristics between baseline shipping from a location in Oregon and variations featuring complementary locations in the eastern United States. A literature review will also be conducted as part of the project. The purpose of the review will be to address the impact of the supply chain on the efficiency and effectiveness of an organization. Enhancement of the supply chain can be done by optimizing several areas. The value such optimizations add to supply chain and the overall performance of the organization will be considered in the literature review.

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Project Overview

The nature of this capstone project is to use the academic knowledge obtained through the Master of Science Integrated Supply Chain Management program and apply it to optimizing an organizations supply chain. In collaboration with a Consumer Goods Company (CGC) in the Pacific Northwest a review of their current supply chain was conducted along with a network analysis. The network analysis compared different scenarios to evaluate what would be their optimal model moving forward. The objective was to compare transportation characteristics between baseline shipping from a single facility located in the Pacific Northwest with alternative multi-site scenarios. The results would showcase the differences in transportation characteristics between baseline shipping from a location in Oregon and variations featuring complementary locations in the eastern United States.

The organization examined is a consumer good company that uses both a business to business and business to consumer distribution models. Manufacturing is done both domestically and internationally. For the purpose of this project only outbound transportation will be examined. A baseline was established through diligently reviewing purchasing, sales, operations, finance and customer service. Additional information about data collection, scenarios reviewed, project information and assumptions will be detailed in the Approach and Methodology section of this project.

As the marketplace continues to redefine itself, factors such as increasing globalization, competition increasing from different sources, the rising influence of the end customer and the

increased pressure to innovate and get to market faster present challenges for organizations. Combined with the need to increase visibility, flexibility and decrease cost has put the spotlight on organizations' supply chains. A literature review of scholarly journals will be included in the project to affirm the impact of the supply chain on the overall success and profitability of an organization. The importance of optimization of the supply chain to every organization regardless of industry or complexity. Visibility within the supply chain is also an important element of successful organizations and the link between visibility and improved performance will also be discussed.

Literature Review

Several factors have caused an increased focus on organization's supply chain and supply chain management. An increase in globalization and competition has required organizations to increase their vigor on optimization and cost savings to remain competitive. Consumer buying habits also influence the market and help drive the need for organizations to increase how fast they go to market to meet the increased demands of the consumer.

Cutting cost and increasing profitability is not a new concept for organizations. Technology, competitive landscape and globalization has contributed to a paradigm shift on how that quest for savings and increased profitability is conducted. Accounting, customer service, marketing, manufacturing, purchasing and operation departments of an organization are no longer silos within an organization. The supply chain is now understood to be integrated in a web like fashion that connects each one of these departments. These departments understand how the decisions they make impact others and vice-versa. Working together for the overall best interest of the organization is necessary in order for the organization to meet their goals.

The literature review section of the project will address the impact of the supply chain on the efficiency and effectiveness of an organization. Enhancement of the supply chain can be done by optimizing several areas. The value such optimizations add to the company's supply chain and the overall performance of the organization will be considered in the literature review. Discussion of network optimization, inventory optimization and transportation will be the focus of this review but should not be seen as the only areas within a supply chain in which optimization can be realized.

Supply Chain Management's Impact on Organizations

Increased globalization has dynamically changed the market landscape. Technological improvements have opened the doors to global partners, new consumers and additional sourcing options. The business environment has become highly competitive and organizations need to focus on surviving through innovative strategic thinking. Supply chain management (SCM) stated becoming more visible during the1980s when it started appearing more in management literature (Zokaei & Hines, 2007). The importance if SCM has increased over the last several decades and an improved understanding has been achieved over the last several decades on how SCM impacts the overall performance of the organization.

Technological improvements have changed consumer buying habits with e-commerce. Consumers have availability to a vast amount of information and a plethora of new channels in which to purchase from. Organization's supply chains can no longer be thought of as the flow of raw material through manufacturing and ending at the dock of a distribution point. Rather the supply chain is a "consumer driven value chain management" (Zokaei & Hines, 2007) process in which efficiencies have a direct correlation to the consumer's perception of the brand.

Understanding the link between the supply chain and the customer experience shows the significant impact supply chain efficiency and SCM has on the success of an organization. SCM as a core competency for an organization provides integration of business processes which can be used as a competitive advantage. Marcus Brandenburg and Stefan Seuring describe the value-based SCM as consisting of four drivers of value creation. These include operating cost reduction, sales growth and efficiency of fixed and working capital (Brandenburg & Seuring, 2011).

Providing superior value to the end consumer coupled with the rise in popularity of Japanese production philosophies and lean production attracts higher levels of scrutiny on the supply chain and SCM (Zokaei & Hines, 2007). A side effect of the rapid growth of globalization is the increase complexity of supply chains. The extended supply chain increases the stress on the entire business environment. Management's awareness of the entire supply chain intensifies and possible threats and areas of vulnerability become the focus of serious concern (Stonebraker, Goldhar, & Nassos, 2009). Balancing the need for a stellar customer experience with a focus on lean thinking SCM needs to align profits and sustainability to contain risk within the supply chain.

C-level executives within organizations clearly see the importance of their supply chain and its influence on the overall success of the organization. They are focused on providing a strong infrastructure that will lower cost, increase productivity all while maximizing customer satisfaction and maintaining efficient integration of the supply chain (Shaikh, Rafiq, & Iyer, 2014).

The importance of SCM has been strongly linked to the success, profitability and increased customer satisfaction through respected research on the subject. Optimization of the supply chain and continuous evaluation of processes are also valuable to ensure that the quickly changing business environment is being supported through the organization's supply chain.

Supply Chain Optimization

Gaining a competitive advantage is crucial for an organization competing in today's business environment to not only to rise to the top but to survive. The importance of SCM to an organization has already been established. The focus will now move to improving supply chain effectiveness and efficiencies through supply chain optimization. Research conducted by Keiven Zoakaei and Peter Hines (2007) describes efficiency as it relates to performance and processes. They discuss effectiveness as it relates to consumer satisfaction. Balance between the two-dimensions is essential to successful optimization and long term realization of positive results.

Optimization of the supply chain is not looked at as a single operation. The supply chain is an integrated, multi-faceted part of the overall organization including production, sourcing, distribution, transportation, warehousing and customer contact points (Shapiro & Wagner, 2009).

Supply chain optimization can be broken into several optimization dimensions. Areas that relate to the focus of this project and that will be discussed in more detail are: network optimization, inventory optimization and transportation optimization. The optimization process, regardless of the focus area, begins with a baseline established through examination of the current processes and evaluation of performance. The importance of this first step will provide performance indicators in which improvement objectives will be set, performance will be evaluated and future plans and actions will be developed from (Ambe, 2014).

Supply chain optimization has an interrelationship with network, inventory and transportation optimization (Ambe, 2014). The network optimization that was conducted as part of this project shows the impact that optimization has on a particular focus area of the supply chain. The statement that these focus areas are interrelated refers to the fact that changes in one area will likely effect the other areas as well. Modifications to any part of the supply chain should be done with a full spectrum view to fully understand the overall impact to the organization.

Network optimization takes a strategic level analysis of the global supply chain design (Schlegel, 2000). Focusing on this aspect of the supply chain reveals answers to several questions about distribution centers (DC), plants and suppliers such as: How many DCs are needed? Where should they be located? What size do they need to be? An organizations supply chain network optimization analysis model examines the consideration of different options for both expanding and contracting the current network (Shapiro & Wagner, 2009).

Inventory Optimization can be used to determine the inventory leveling throughout the supply chain. Analysis in this area will assist firms in achieving the optimal level of inventory deployment not necessarily the lowest level of inventory levels. Synergy between several issues needs to me managed to achieve maximum results. Long-term inventory planning needs to allow for changes in demand and availability of products. Organizations need to evaluate how they will meet the optimization objective of decreasing supply chain costs while maintaining the required service levels (Schlegel, 2000)

Transportation optimization takes a strategic look at mode shift evaluation. Analysis could be conducted to evaluate the benefits and risk of consolidation and deconsolidation of

carriers and services (Stonebraker, Goldhar, & Nassos, 2009). Multi-stops, pool distribution and continuous move evaluation could be conducted to how things logistically move through the supply chain.

Approach and Methodology

The approach that was used in this project was both a strategic and an operational approach. Supply chain optimization has an interrelationship with the optimization of the network, transportation and inventory. These are considered to be strategic in nature. The project also used an operational approach. The operational approach consisted of areas such as product sourcing and distribution center optimization. The analysis of the company's current supply chain distribution model was conducted to develop an understanding of the existing processes used by the CGC. Network improvement opportunities were explored in detail. The deliverable report contains recommendations that reduce time in transit to the consumer while offering the most optimal cost and efficiencies. The data provided by the consumer organization was used to determine a baseline. The baseline allowed for a comparison of the other scenarios' results and network optimization recommendations to be made.

Assumptions made in the network analysis are that the shipping data used represents the outbound shipments from the 2012 calendar year. Shipment data for the analysis was provided by the organization being review and represented outbound shipments from the Oregon location. The organization provided the cost of the shipments, not including additional delivery surcharges nor fuel surcharges. The analysis focused on domestic shipments to the lower 48 states. Alaska, Hawaii and Puerto Rico have been excluded from the data set by the company based on the small percentage of shipments to these areas.

Time in transit information was reviewed to examine the number of days the delivery would take to reach the end consumer based on the scenario parameters. Details of each scenario are described and analysis for each were conducted using the same methods and approach.

Cost of shipping was determined through extrapolation of the data provided by the organization. Average weight and cost of shipping from the baseline was used in all scenarios. Recommendation of which scenario offer the optimal results are done through comparison of results.

The recommendation was based on the information provided and only the optimal scenario and locations were determined. Areas outside the scope of work described were not considered in the recommendation including but not limited to warehouse operating cost, labor or taxes.

Scenario One-Baseline Scenario - The baseline shipping characteristics were developed using the 2012 historical data provided by the consumer goods customer. The historical distribution was pulled from the package level detail for the Oregon origin using the customer provided net spend information.

Scenario Two-Oregon and Pennsylvania - The volume modeled in the Baseline Scenario was assigned to the company's location in Oregon and their Pennsylvania location were chosen as anchored sites to establish the best case shipment characteristics. Ties in the determination of zone and transit distinctions were broken in favor of the baseline origin. Inbound transportation cost to the warehouse locations and inventory carrying cost have been excluded from this analysis.

Scenario Three-Oregon and Tennessee - The baseline volume was modeled with the location in Oregon as an anchored location to determine the best complementary distribution location. A Tennessee location was determined as the second anchor site for CGC based on information provided by the organization based on existing company locations. Volume was assigned to the optimal origin based on zone and transit with ties broken in favor of the baseline origin. Inbound transportation cost to the warehouse locations and inventory carrying cost have been excluded from this analysis.

Analysis of Results

The network optimization analysis was done in collaboration with a CGC based in the Pacific Northwest. The organization's goal was to improve time in transit to the consumer by adding an additional distribution location. They also wanted to decrease shipping cost to the consumer. Collaboration with the organization determined the scenarios that were reviewed in the network analysis.

Scenario One-Baseline Scenario

The CGC provided the data set from the 2012 calendar year including 52,147 outbound shipments comprised of 58,255 packages. To determine the baseline in which analysis of the additional sceneries were compared against the data was plotted based on ground zone distribution. The lower 48 states are divided into eight zones. Table 1 shows the baseline data broken into the appropriate zone distinction. The baseline shipments and baseline packages are shown in the appropriate ground zone. A baseline cost was also developed to assist in the scenario comparison and recommendation. The current baseline cost is $748,854 for the data provided reflecting the 2012 shipping data.

Table 1
Distribution by Ground Zone – Baseline Scenario

	Ground Zone							
	2	3	4	5	6	7	8	Totals
Baseline Shipments	4055	361	4510	9841	2031	7273	24076	52147
Baseline Packages	4869	383	4983	10340	2448	7749	27483	58255
Baseline Cost	$32,973.65	$2,683.20	$46,460.95	$106,189.02	$22,954.96	$83,946.78	$453,645.88	$748,854.00

The baseline scenario has the origin location for all outbound shipments as the existing CGC location in Oregon. The current one distribution model of CGC, which originates in the Oregon location, services all shipments for the lower 48 states. Package level detail data provided from the CGC was used to determine the baseline shipping totals detailed in Table 2. The average shipment weight, average package weight and total number of packages will remain constant in the analysis of the remaining scenarios. The baseline time-in-transit days and cost per package were compared to the results of the other scenarios to determine the recommendation of the optimal scenario being reviewed.

The baseline cost of shipping a package is $12.85. The packages are delivered to the end consumer within an average time-in-transit of 3.80 days. The baseline time-in-transit map is displayed in Figure 1. The map is a visual way to interpret the number of days it will take for the consumer to receive the package when shipped from the Oregon location. The number of days is to be interpreted as business days. Weekend and holidays should not be considered when reviewing days in transit.

Table 2
Scenario One-Baseline Shipping Totals

	Shipment Totals
Total Charge	$748,854
Total Number of Packages	58,255
Cost per Package	$12.85
Shipment Weight (lbs.)	11.60
Package Weight (lbs.)	10.38
Time-In-Transit (days)	3.80

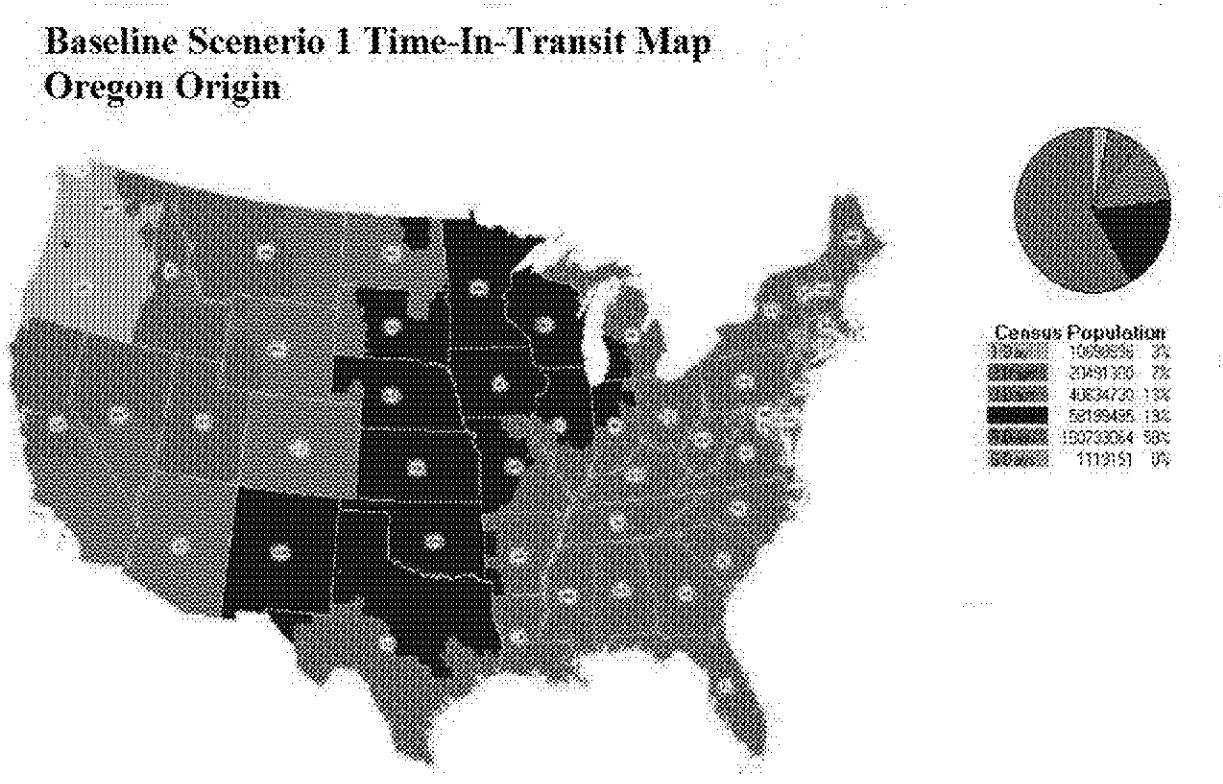

Figure 1 Scenerio1 Time-In-Transit Map

Scenario Two-Oregon and Pennsylvania

In this scenario one additional distribution sight was added to the Oregon location. The two distribution sight model reviewed in this scenario plotted the additional location in Pennsylvania. The total volume of packages would be distributed from the two locations. The distribution of shipments were assigned to the appropriate location based on optimal time-in-transit and cost of shipping. The Pennsylvania location was selected by the customer based on existing infrastructure and resources already available to the organization.

The volume modeled in the Baseline Scenario was optimally assigned to an origin location of either Oregon or Pennsylvania to establish best case shipment characteristics. Ties in package origin location was broken in favor of the baseline origin in Oregon. Inbound transportation cost to the two warehouse locations and inventory carrying cost have been excluded from this analysis.

Shipping totals for this scenario are shown in Table 3. The total shipping charges were calculated to be $551, 059 with the average shipping cost of a package for this scenario being $9.46. The cost breakdown by zone and shipping locations is seen in Table 4 with the total cost for the scenario reflected.

Table 3
Scenario Two-Oregon and Pennsylvania Shipping Totals

	Shipment Totals
Total Charge	$551,059
Total Number of Packages	58,255
Cost per Package	$9.46
Shipment Weight (lbs.)	11.60
Package Weight (lbs.)	10.38
Time-In-Transit (days)	2.18

The scenario also required that an understanding of the change from one distribution location verses the addition of the second location in Pennsylvania included the impact on time-in-transit. The time-in-transit for this scenario is 2.18 days compared to the baseline's 3.80 days in transit. Figure 2 shows the distribution of days in transit on a map.

Improvements were seen in the results of the data analysis with this two distribution sites scenario. Comparison of scenario one and scenario two reveal a decrease in deliveries exceeding two or three days in transit. Figure 1 displays 19% of shipments being delivered in four days and 58% being delivered in five days. Figure 2 shows this decreased to only 9% being delivered in four days and 4% being delivered in five days.

Table 4
Distribution by Ground Zone– Scenario 2

	Ground Zone							
	2	3	4	5	6	7	8	Totals
Baseline Shipments	4055	361	4510	9841	2031	7273	24076	52147
Baseline Packages	4869	383	4983	10340	2448	7749	27483	58255
Oregon Cost	$32,973.65	$2,683.20	$46,460.95	$106,189.02	$22,954.96	$3,709.78	$0.00	$214,623.46
Pennsylvania Cost	$67,714.08	$19,871.62	$138,765.30	$64,834.92	$44,871.45	$378.50	$0.00	$336,435.87
							Total Cost	$551,059.33

Comparison of scenario one to scenario three are seen in Figure 1 and Figure 3. Figure 1 displays 19% of shipments being delivered in four days and 58% being delivered in five days. Figure 3 shows there are less than 1% of the packages being delivered in four days.

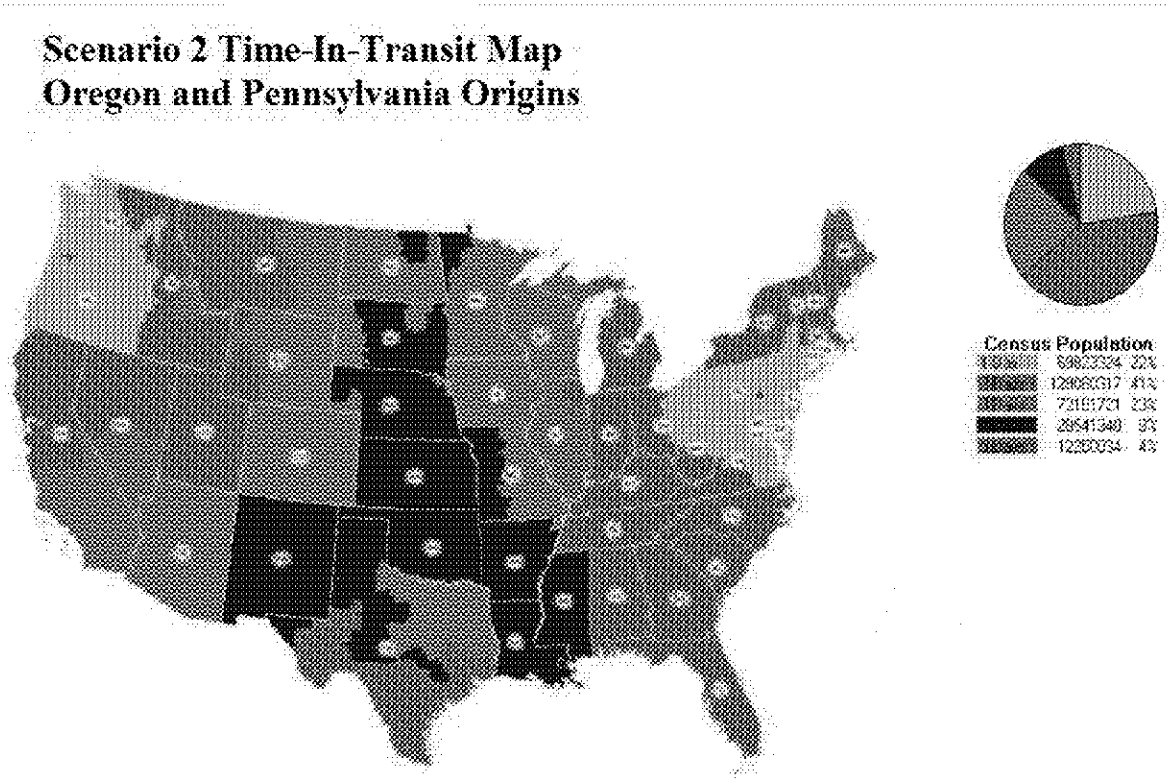

Figure 2 Scenario 2 Time-In-Transit Map

Scenario Three-Oregon and Tennessee

The last scenario that was reviewed assesses Tennessee as a possible second distribution warehouse location. Tennessee was selected by the CGC because it was the sight of a 3P warehouse they were considering.

Volume was assigned to the optimal origin based on zone and transit with ties broken in favor of the baseline origin. The baseline volume was modeled with the location in Oregon as an anchored location to determine the best complementary distribution location. Inbound transportation cost to the two warehouse locations and inventory carrying cost have been excluded from this analysis.

Tennessee as the second of a two location distribution scenario resulted in the shipping totals found in Table 5. Time-In-Transit is 2.07 days with this scenario compared to the Baseline Scenario Time-In-Transit of 3.80 days. A decrease from the baseline's total charges is also seen in this scenario. The distribution by ground and the cost impact of the Scenario 3 can be reviewed in Table 6.

Having an anchor distribution center in Oregon and one in Tennessee, as shown in Figure 3, eliminates almost all areas with a four day time-in-transit. There is only a small area in the upper Northeast part of Maine and a small part of the northwest part of Minnesota.

Table 5
Scenario Three-Oregon and Tennessee Shipping Totals

	Shipment Totals
Total Charge	$543,282
Total Number of Packages	58,255
Cost per Package	$9.33
Shipment Weight (lbs.)	11.60
Package Weight (lbs.)	10.38
Time-In-Transit (days)	2.07

Table 6
Distribution by Ground Zone– Scenario 3

	Ground Zone							
	2	3	4	5	6	7	8	Totals
Baseline Shipments	4055	361	4510	9841	2031	7273	24076	52147
Baseline Packages	4869	383	4983	10340	2448	7749	27483	58255
Oregon Cost	$32,973.65	$2,683.20	$46,460.95	$106,189.02	$16,846.89	$0.00	$0.00	$205,153.71
Tennessee Cost	$28,151.58	$68,992.27	$150,490.97	$88,608.95	$1,884.98	$0.00	$0.00	$338,128.75
							Total Cost	$543,282.46

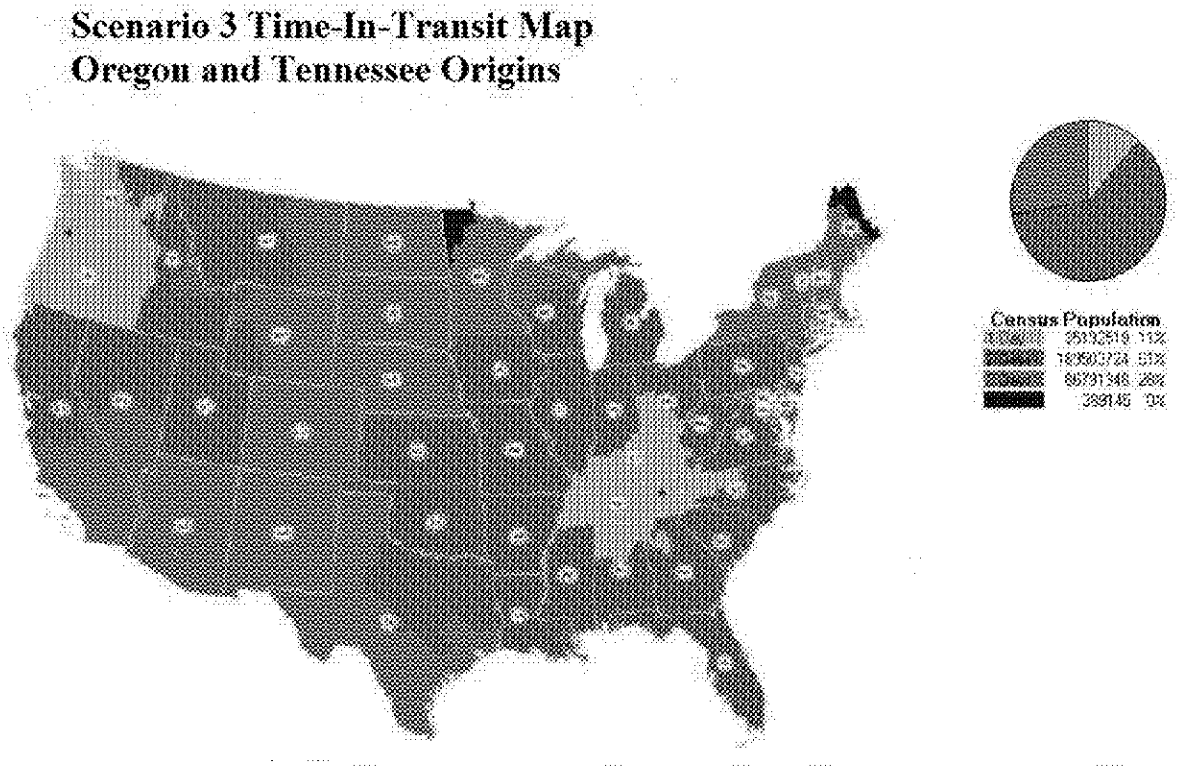

Figure 3 Scenario 3 Time-In Transit Map

Recommendations

Recommendations are based on the scenarios compared to the baseline that was developed from the data provided by the CGC. The summary of data is reviewed in Table 7.

By scenario cost and time-in-transit Scenario 3 with the distribution location in Tennessee is the optimal complement facility to the Oregon location. Time-In-Transit is directly related to zone distinction. Cost is a function of the zone and weight and Tennessee is the lowest zone complement to Oregon.

Table 7
Summary Report All Scenarios

Scenario Shipment Totals	Scenario 1-Baseline Oregon	Scenario 2 Pennsylvania	Scenerio 3 Tennessee
Total Charge	$748,854	$551,059.00	$543,282.00
Total Number of Packages	58,255	58,255	58,255
Cost per Package	$12.85	$9.46	$9.33
Shipment Weight (lbs.)	11.60	11.60	11.60
Package Weight (lbs.)	10.38	10.38	10.38
Time-In-Transit (days)	3.80	2.18	2.07

The results illustrated in this network analysis represents the actual distribution from an agreed period of time in the past. Certain assumptions were applied to reflect potential past opportunity savings if the assumptions were applied in place of what actually occurred. Data presented regarding distribution and costing may not reflect future savings. Future factors that could cause the actual results to differ from the results in this analysis could include changes in package characteristics such as weight and dimensions. Changing customer demand could also cause a variation in the applied results.

The location recommended was based on the scenario locations that were presented by CGC and may not reflect the optimal location based on the provided data. The geographic center of customer demand is Springfield, MO. The results are presented as directional opportunities rather than a specific outcome.

The examination of the analysis show that a two warehouse model will have a positive impact on the objectives set forth by CGC. These were to improve time-in-transit to the consumer while decreasing the actual shipping cost to the customer. Scenario two with the secondary distribution site in Pennsylvania and Scenario three with the secondary distribution site in Tennessee would address the needs. Comparison of the results shows that Scenario Three with the Tennessee location is preferred based on the current analysis. A total cost analysis and

an economic analysis of the scenarios should be done to understand the full impact of the scenarios. The findings of further analysis would impact the final decision.

Summary

It was reviled in the network analysis that Tennessee provided the biggest cost savings of $205,572. Scenario 3 with the secondary warehouse location in Tennessee also had the most significant decrease in time-in-transit with 1.73 days improvement over the baseline scenario. Additional details can be found in Table 8. Overall the best scenario of the three examined was Scenario 3.

The network analysis was completed in a very thorough manor and offered an unbiased, factual analysis of the data provided. It was limited to the scope of work detailed for the project and the results should be considered as a base in which additional information should be gathered to confirm the recommendations or abort the addition of another warehouse.

Table 8
Savings over Scenario 1-Baseline

Scenario Shipment Totals	Scenario 2 Pennsylvania	Scenerio 3 Tennessee
Total Charge Savings	$197,795.00	$205,572.00
Total Number of Packages	0	0
Cost per Package	$3.39	$3.52
Shipment Weight (lbs.)	0	0
Package Weight (lbs.)	0	0
Improved Time-In-Transit (days)	1.62	1.73

Additional consideration should be given to inventory leveling methods, additional safety stock requirements and carrying cost associated with inventory. Other less tangible impacts should also be considered. These would include the increased satisfaction of the customers, increased brand recognition as it builds a bigger footprint.

Inbound transportation was also not included in the scope of the network analysis but should be considered prior to a final decision is made in regards to the analysis' findings. The CGC is currently located in the Pacific Northwest in close proximity to several ports of entry including ones in Oregon and California. The proximity to these ports allows for lower freight cost. Adding a second warehouse location in Tennessee would require additional inbound freight cost to support the required inventory needs. Adding the variable facility cost of labor, inventory cost and transportation cost may confirm or contradict the current recommendations.

Conclusion

The global business environment continuously needs to redefine itself because of influences from competition, consumer needs, technology and extended sourcing networks. This continual evolution has forced organizations to have a paradigm shift on the efficiencies and effectiveness of their supply chain. The competitive scenario brought on by globalization elevated supply chain management from a function of the organization to an opportunity to achieve a competitive advantage.

The literature review portion of this project developed the frame work of the importance of supply chain management. The supply chain is an integrated part of an organization impacting marketing, customer service, production, product development, accounting and brand image. Optimization of the supply chain can be used as a way to improve profitability and efficiencies. This should be done with the end customer in mind, ensuring that cost savings is not done at the cost of lowering service levels to the consumer.

The network optimization portion of this project demonstrates how an analysis should be conducted. Development of a specific scope of work draws emphasis on a specific area in which

the analysis will focus. A baseline is determined based on historical data in which comparison of different scenarios can be done to quantify results. Examination of the results are interpreted with the limitations of the scope of work in mind. In addition to the results of the network optimization conducted in this project further considerations should be reviewed before a course of action is decided. These include but are not limited to: changes in demand, inventory, sourcing rules, sustainability initiatives, opening/closing facility costs, regulations, labor market, service level agreements, taxes and inbound transportation costs.

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