



New U.S. Distribution Center Proposal

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Executive Summary

Chainsaw Inc. is a manufacturer of forestry equipment, with chainsaws being our primary set of products. Our headquarters is located in Virginia Beach, VA. Chainsaw Inc. operates mainly in the United States, with approximately 75% of product manufactured in Virginia Beach, VA and 25% of product manufactured in Shenzhen, China. All products are currently distributed from one distribution center located in Virginia Beach, and demand is located throughout the contiguous US. As we continue to grow, we have found it necessary to add an additional distribution center in order to support our growing demand and expanding operations. The selected location will provide an economic advantage in distributing products to regions west of the Mississippi river, where approximately 40% of the company's sales occur. We have analyzed multiple factors in order to select an optimal location for our new DC:

1. Demand distribution
2. Product transportation cost
3. Labor availability
4. Warehouse cost
5. Cost of Labor
6. Cost of living
7. Quality of life

Based on these criteria, we identified Wichita, KS as our suggested location for our second distribution center. Throughout this project we will present our methods and analysis in selection Wichita, the impact of this additional DC on different aspects of our company, as well as insights and conclusions we developed in the process.

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Business Scenario Overview

Chainsaw Inc. is a leading forestry equipment manufacturer. Our most popular chainsaw model is the 10” Lithium Ion model (See Appendix A for more information). The relatively inexpensive price (\$97), manageable size and stellar reviews makes this chainsaw a popular one among both professionals and non-professional users. Our manufacturing operations are located primarily in the United State. Approximately 75% of our products are manufactured in Virginia Beach, VA. An additional 25% are manufactured in Shenzhen, China. All of our products are currently being distributed in our sole distribution center, also located in Virginia Beach. Our geographical sales include every state in the mainland United States, with the majority of sales volume occurring in states rich in forest cover and timber industries. As our market share continues to grow steadily, we are interested in selecting a second distribution center that will streamline our operations, increase our agility and reliability, and decrease our overall supply chain costs.

The objective for this project is to select an optimal location for our second distribution center. The selected location will provide a gateway to the west coast of the United States, where approximately 40% of our sales take place.

Today, the product being manufactured overseas arrives by sea freight to the east coast, where it is consolidated with the rest of the product in our Virginia Beach distribution center. From there, it is distributed across the continental United States to secondary sellers and end users. In our current supply chain model, Chainsaw Inc. incurs unnecessary shipping costs due to long stretches of Less-Than-Truckload shipments from our DC to our customers. By contrast, adding another strategically located distribution location will decrease shipping costs due to shortening our LTL shipments and instead ship long stretches of TL.

We selected our final location for our new distribution center using the following criteria:

1. Demand distribution
2. Product transportation cost
3. Labor availability
4. Warehouse cost
5. Cost of labor
6. Cost of living
7. Quality of life

Demand Distribution

The first criteria we considered in determining a location for the new distribution center was chainsaw sales volume in each state. At the beginning of the project, we gathered consumer demand data for each state in the continental United States. We included values for demand, number of shipments, and average shipment size. Using these demand values, we constructed a map to help visualize the density of demand; this map is shown in Figure B1 (See Appendix B).

Figure 1: The map shows the demand for chainsaws in the United States, based on tree population in each state. Darker colors represent high demand and lighter colors represent low demand. Map created on (<https://mapchart.net/usa.html>).

The map reveals that a large portion of the eastern U.S. has fairly high demand, as well as states in the northwest. However, there are many states in the Midwest and southwest that have demands with very low values. The current distribution center is in Virginia Beach, so less-than-truckload shipment costs from this DC all the way to western states are very high. These costs could be decreased by having the new DC closer to the west coast. Since the new DC has to supply at least 40% of demand volume, we calculated what percentage of the demand was west of the Mississippi River to see if a substantial amount of demand was in the western United States.

Table 1: Consumer Demand

	Western U.S.	Eastern U.S.
Consumer Demand	1,733,157 Units	2,226,843 Units
Demand Percentage (%)	44.33%	55.67%

The total demand of 4 million chainsaws has approximately 44% of demand coming from states west of the Mississippi River. Since our current DC is all the way on the east coast, we decided that our new DC would supply this western 44% of consumer demand. Figure B1 shows how the continental U.S. was split into Western and Eastern states for the purpose of this project (See Appendix B). Considering the fact that Virginia Beach is going to service the eastern region (56% of demand), we chose to focus on the Western United States as the prime region for our new DC to service the remaining 44% of demand.

Product Transportation Costs

Our packaged product dimensions measure 16.7 * 8.8 * 9.6 inches and a weight of 10 lbs. Assuming a conservative 2-meter stacking height, a pallet can hold up to 100 units. Using this pallet scheme, we can ship 2520 units on an ocean container and 2600 units on a 53' wedge truckload (TL). Without pallets, we can ship 4477 units on a 53' wedge TL.

For ocean shipments, we considered the following ocean freight routes; port of Virginia Beach, port of Los Angeles, and port of New Orleans. We used these ports to calculate total inbound transportation costs from Shenzhen, China to various cities in the west region. We focused on cities with the highest population in each state in order to run our cost calculations. These cities are listed in Table C1. The port of Virginia Beach was found to be the most cost efficient for supplying our existing DC in Virginia Beach. Additionally, we found that the port of New Orleans was the most cost effective to supply our new potential DC. A detailed summary of calculations for shipment dimensions and choice of port can be found in Appendix C.

Cost of transportation for inbound TL shipments without using pallets was calculated as a function of number of miles, number of shipments, and cost per mile. We used TL shipments for all inbound shipments. Cost of transportation for outbound TL and less-than-truckload (LTL) shipments were calculated as a function of number of miles, number of shipments, cost per pallet per mile, and number of pallets per shipment. The following tables show the break even number of pallets per shipment between TL and LTL shipments.

Table 2: *TL costs of shipping*

	Cost per mile	Cost per pallet per mile
0 – 300 miles	\$ 3.6 per mile	\$ 0.138 per pallet per mile
300 – 600 miles	\$ 4.2 per mile	\$ 0.162 per pallet per mile
600+ miles	\$ 4.9 per mile	\$ 0.188 per pallet per mile

Table 3: *LTL costs of shipping*

	Cost per pallet per mile	Break even # of pallets compare to TL shipment
0 – 300 miles	\$ 0.20 per pallet per mile	18
300 – 600 miles	\$ 0.24 per pallet per mile	17
600+ miles	\$ 0.28 per pallet per mile	17

The current cost of transportation with only one distribution center in Virginia Beach is approximately \$23.5 million. We then calculated the total cost of transportation when adding a potential DC in each of the cities considered in the Western region. Figure 2 below shows the cost of transportation comparison for the cities considered with inbound and outbound cost breakdown.

Figure 2: *Comparison of Total Cost of Transportation for Cities with Two DCs*

These cities were found to be the most cost effective in terms of transportation cost with two DCs (one in Virginia Beach and the other in following cities):

- | | |
|------------------|-----------|
| 1. Wichita, KS | \$17.92 M |
| 2. St. Louis, MO | \$17.93 M |
| 3. Omaha, NE | \$17.94 M |
| 4. Aurora, CO | \$18.42 M |

Labor Availability

The next criteria we considered was the population and its labor availability. We chose to set the criteria for city population to have a minimum population of 100,000 people or above in order to reflect the labor rich areas. All four cities in consideration met this specific criteria.

For each of the four cities mentioned above, we analyzed the population, as well as unemployment rate in order to determine the total available workforce. Unemployment rate defined as 1.0 or below (<10% of the population) being the lowest and 10.0 (100% of the population) being the highest unemployment rate, we determined that the desirable rate to range between 3.0 and 4.0 to ensure a sufficient workforce and a solid economy within the city. For example, unemployment rate below 3.0 may indicate insufficient labor availability due to lack of workers within a city while the rate above 4.0 may be a sign of unstable economy. As Omaha has an unemployment rate of 2.6%, only three meet our labor availability criteria: St. Louis, Wichita, and Aurora.

Following the unemployment rate, the total available workforce for each city and the number of employees required were factored into the decision criteria. First, the total available workforce for each city was determined by multiplying the total population of the city by the employment rate in percentage (i.e. 1- unemployment rate). We compared this number for the total available workforce for each city to the number of employees required for the distribution center, which was determined using the employee-to-demand ratio for the distribution center at the STIHL company, a similar manufacturing company located in Oxford Connecticut. STIHL holds the 56 employees-for-12 percent demand ratio, and thus we calculated that our employee-to-demand ratio would have to be 187 employees-for-44 percent demand that Chainsaw Inc.'s new distribution center will require. Detailed calculation

The table below shows the above calculations for the cities that meet the requirements.

Table 4: *Cities that meet all three criteria for labor availability*

Cities	Total Population	Unemployment Rate	Total Available Workforce	# of Employees Required	Criteria Met
St. Louis, MO	315,685	3.4	$315,685 \times (1-0.0034) = 314,611$	187	✓
Wichita, KS	389,902	3.4	$389,902 \times (1-0.0034) = 388,576$	187	✓
Aurora, CO	361,710	3.0	$361,710 \times (1-0.0030) = 360,624$	187	✓

Warehouse Cost

Warehouse Lease

We used STIHL as a comparable company to Chainsaw Inc. because STIHL's primary product are also chainsaws. STIHL currently operates a 120,000 Square Foot distribution center in Oxford, Connecticut that serves the chainsaw demand of the following states: Connecticut, Maine, Massachusetts, New Jersey, New Hampshire, New York, Rhode Island, Pennsylvania and Vermont. This means that they are currently using 120,000 Sq Ft of space in order to satisfy 13.32% of United State's total demand (The summation of this percentage can be found in Table E1 in Appendix E).

Chainsaw Inc.'s new distribution center is looking to satisfy 44.33% of United State's total demand with our new distribution center. Thus, we determine that our distribution center will need to be approximately 399,346.19 sq ft given the previous information found about STIHL's DC. We round up this number to 400,000 total sq ft needed in order to provide an additional buffer in warehouse space needed and to simplify calculations moving forward.

With this information, we utilize www.loopnet.com to determine the expected annual triple net lease of a 400,000 Square Foot commercial warehouse space in each one of our three prospective distribution center locations. The approximate annual triple net lease we should expect for the amount of space needed is \$3.10 million in Aurora, \$2.00 million in Wichita, and \$1.20 million in St. Louis.

Utilities

The average non-refrigerated warehouse in the United States uses an average of 6.1 kWh/SqFt of electricity annually. This value is used in our calculation to find the average annual cost of industrial electricity we should expect from each one of our three prospective locations. Table E2 (see Appendix E) is a calculation of the average annual cost. Additional utilities include water rates and sewage rates. The average monthly rates for each location can be found on www.saws.org. We derive the annual rates by multiplying the monthly rates by 12. Table E3 (see Appendix E) lists the average annual water and sewage rates. The following table demonstrates the summation of total annual utility costs we should expect for opening a warehouse in each location.

Table 4: Total Annual Utilities

Location	Annual Industrial Electricity Rate	Annual Water Rate	Annual Sewage Rates	Summation of Total Annual Utilities
Aurora, CO	\$147,376	\$321,076	\$390,000	\$849,452
Wichita, KS	\$153,720	\$196,104	\$347,067	\$696,891
St. Louis, MO	\$122,488	\$477,216	\$614,395	\$1,214,099

Property Taxes

We used expected annual triple net lease of the DCs to estimate the value of the property using net present value calculation (See Appendix E). We used the value of the property and the commercial property tax of the city to calculate annual expense in commercial property taxes. We found that St. Louis at the lowest property tax with \$0.32 million followed by Wichita and Aurora with \$0.55 million and \$0.73 million respectively. (For more information, see Table E4 Appendix E).

Cost of Labor

We estimated that we would need 187 warehouse associates for the second DC. Using manager to employee ratio of 1:15, we would need 12 managers (Weiss, D. 2018, April 05). The following table summarizes the result of the cost calculation for the above analysis:

Table 5: *Estimated Annual Labor Cost for the Three Cities*

	Annual Wage per Management Employee	Average Wage per Warehouse Employee	Annual Cost (12 managers and 187 warehouse associates)
Aurora, CO	\$137,940	\$28,990	\$7.08 million
Wichita, KS	\$98,880	\$27,010	\$6.23 million
St. Louis, MO	\$116,090	\$31,790	\$7.34 million

Employment and wage data of management and laborer of Freight, Stock, and Material Movers, Hand, Source: Bureau of Labor Statistics

Total Savings

In order to calculate our expected total savings from opening a new distribution center, we start by finding our current total distribution center costs (Virginia Beach as sole DC). We then find the cost of running Virginia Beach in conjunction with our additional distribution center and compare the two costs to find our total savings.

The current costs of running Virginia Beach is \$44.10 million per year shown below.

Table 6: *Total Annual Cost of Current Distribution Center (Virginia Beach)*

Annual Product Transportation Cost	Annual Lease	Annual Utilities	Annual Property Taxes	Annual Cost of Employees	Total Annual Cost
\$23.60 M	\$3.52 M	\$0.34 M	\$0.36 M	\$16.28 M	\$44.10 M

The total cost of running an additional distribution center out of one of our three potential cities in combination with Virginia Beach is \$42.34 million per year for Aurora, \$39.58 million per year for Wichita, and \$41.38 for St. Louis. Thus, Our annual savings by opening an additional DC is \$1.76 million for Aurora, \$4.52 million for Wichita, and \$2.72 million for St. Louis.

Cost of living for Employees

Cost of living is an important factor to consider when determining the location of a new distribution center, as a lower cost of living will result in employees getting more for their money. Cost of living can be broken down into different categories, the most significant of which being housing, food, transportation, healthcare, and utilities. Figure 3 gives a breakdown of cost of living values as percentages of the national average.

Figure 3: *A breakdown of cost of living expenses as percentages of the national average. Note that the bottom series for each category is the U.S. Average, which is automatically set to 100%. Data was gathered from payscale.com.*

Figure 3 above reveals that Aurora is the most expensive location for housing, transportation, and healthcare. St. Louis is the most expensive for food and utilities. The wide margin in housing costs is notable, as Aurora housing costs are 105% of the national average, and both St. Louis and Wichita have costs less than 75% of the national average. This breakdown is useful in determining what Chainsaw Inc. employees will be spending their money on, but the most important value is the total amount employees will be spending at each potential distribution center location. Overall cost of living expenses are shown in Figure H1 as percentages of the national average (See Appendix H).

Figure H1 shows that cost of living in Aurora is 5% higher than the national average, whereas Wichita and St. Louis are 8% and 6% lower than the national average. Therefore, Wichita, Kansas is the most affordable location for employees of the new Chainsaw Inc. distribution center, with St. Louis, Missouri coming in a close second place.

Quality of Life

In order to compare the quality of life between cities, the following criterion were considered: Education, Crime rate, Transportation, Parks and Recreation, Public events, Essential amenities, Attractions, and Weather. In performing this analysis, we were able to quantify education and crime rate. The other factors were qualitative so a weighted decision matrix was utilized. For the complete weighted decision matrix, see Appendix I Table 1.

In Education, Wichita Kansas was determined to have the best resources. The factors involved with this decision are expenditure per student, student-teacher ratio, and graduation rates for high school and college. For Crime rate, a similar analysis was performed and the factors considered included property crime, violent crime, and total crime. Aurora, Colorado by far had the least amount of crime in these categories. For a breakdown of our analysis in these two areas, please see Appendix I Tables 2 and 3.

Wichita Dwight D. Eisenhower National Airport (ICT) has easy access from the local highways and other public transportation systems. The sixth largest railway system in the United States is located in Wichita. Decreasing quality of roads is an issue due to decreasing federal and state funding. Considering these factors, transportation was given a score of 4. Wichita has 144 parks spanning 5,007 acres of land. The city has a grid of “Green corridors” that connect major parks and offers biking and walking opportunities. There are 8 recreational centers that offer amenities such as picnic spots, swimming pools, golf courses, sports fields and athletic classes. Considering these factors, Parks and Recreation was given a score of 8. Wichita is host to monthly Final Friday Art Crawls and a yearly Riverfest. This is a 9 day festival consisting of live music, food, and various competitions. Music/concert goers will be happy to learn that Wichita's largest venue has enough indoor seating for 15,000. Wichita only has two concerts listed on StubHub on a typical weekend. Considering these factors, Public Events was given a score of 8. HealthGrades Top 50 Cities for Hospital Care ranks Wichita Kansas at 40. A table of other health information collected about Wichita Kansas is located in Appendix I Table 4. Considering these factors, Essential Amenities was given a score of 6. From TripAdvisor, Wichita Kansas has 12 Nature and Parks, 17 Museums, 15 Sights and Landmarks, and 6 Outdoor Activities. The top four attractions include the Sedgwick County Zoo, Botanica: The Wichita Gardens, The Keeper of the Plains, and Museum of World Treasures. These attractions together have received 2,743 reviews. Considering these factors, Attractions was given a score of 6. Wichita, Kansas, gets 34 inches of rain, 26 inches of snow, 221 sunny days, and 53 rainy days per year. The July high is 91 degrees, and the January low is 22. Sperling's comfort index for Wichita is a 47 out of 100. Considering these factors, Weather was given a score of 4.7.

Aurora is located 20 minutes from Denver International Airport (DEN) which is the 19th busiest in the world and a major hub for United, Southwest, and Frontier. Front Range Airport delivers a full range of services for commercial, corporate, and private aircraft, 24-hour a day air cargo operations, railway track access, and business airport opportunities. Burlington Northern Santa Fe and Union Pacific Railroad provide freight service all extended from the Denver region. Three major highway corridors, E-470, I-70 and I-225, give Aurora workers and businesses fast access to the region. Considering these factors, Transportation was given a score of 9. Aurora's close proximity to the Rocky Mountains National Park means that it is surrounded by beautiful nature and recreational activities. In the winter, skiing and other snow activities become available.

Aurora has several recreational center offering sports, massage therapy, and group classes. Considering these factor, Parks and Recreation was given a score of 9. Aurora Colorado typically has 8 concerts listed on stubhub per weekend. Aurora is home to an annual Punkin Chunckin competition that involves catapulting a gourd through the air, farthest toss wins. Aurora Colorado is only 35 minutes away from Red Rocks Amphitheater, a world famous open air concert venue located high in the rocky mountains. Every January there is the National Western Stock Show, a 16 day event that includes the second largest rodeo in the US. Other yearly events include a St. Patty's Day Parade, Cinco De Mayo Festival, and Cherry Creek Arts Festival. Considering these factors, Public Events was given a score of 9. From Trip Advisor, there are 7 Nature and Parks Attractions, 16 outdoor activities, and 15 nightlife facilities. The highest ranking attractions, Cherry Creek State Park and Wings Over the Rockies Air and Space Museum have been reviewed 985 times. Considering these factors, Attractions was given a score of 6. HealthGrades Top 50 Cities for Hospital Care Rank: 35. A table summarizing other health related indicators for Aurora Colorado is located in Appendix I Table 5. Considering these factors, Essential Amenities was given a score of 7.

St. Louis has easy-to-navigate transportation infrastructure that includes four interstate highways. St. Louis features MetroLink, the city's commuter rail system. It is home to the nation's second-largest inland port (by tonnage) situated at the confluence of the Mississippi, Missouri, and Illinois river. St. Louis also has one of the nation's largest rail lines including six Class I railroads. Considering these factors, Transportation was given a score of 6. A city of only 62 square miles, St. Louis has 2,956 acres of park land. St. Louis has 8 Recreation Centers featuring playgrounds and various sports fields. Brightside St. Louis (formerly Operation Brightside) is the region's oldest and most comprehensive not-for-profit cleaning and greening initiative. Considering these factors, Parks and Recreation was given a score of 8. At 9, St. Louis has the most concerts listed on Stubhub per weekend. The Pageant is a small music venue but frequently host big names such as The Wood Brothers and Walk the Moon. Annual events include the St. Louis Earth Day Festival, the Shakespeare Festival St. Louis, the Great Forest Park Balloon Race, and the Whitaker Jazz Festival. Fun Fact, St. Louis was the first city in America to host the Olympics. Considering these factors, Public Events was given a score of 7. The HealthGrades Top 50 Cities for Hospital Care ranks St. Louis at number 20. A table summarizing other health related factors is included in Appendix I Table 6. Considering all of this, Essential Amenities was given a score of 10. St. Louis has 74 Sights and Landmarks, 48 Nature and Parks, 48 Museums, and 26 Outdoor Activities. The top 4 things to do here include The Gateway Arch, The Cathedral Basilica of Saint Louis, Missouri Botanical Garden, and Forest Park. These attractions combined have over 17,847 reviews. Considering these factors, Attractions was given a score of 9. St. Louis, Missouri, receives 43 inches of rain, 15 inches of snow, and 202 sunny days per year. The July high is 88 and the January low is 23. Sperling's comfort index for St. Louis is 50. Considering these factors, Weather was given a score of 5.

In summary, Aurora Colorado came in first place with a score of 71. St. Louis is a close second with 66 and Wichita, Kansas trails behind at 55. For the complete weighted decision matrix please see Appendix I Table 1.

Final Decision

In making our final decision on the new distribution center location, we have looked at the following three criterion as discussed previously in the report: Business Operation Savings, Cost of Living for the Employees, and the Quality of Life Rankings. As shown on the Table J1(See Appendix J), Business Operations Savings criteria represents the total business cost saving on factors like Transportation Cost, Warehouse Cost, and the Labor Cost. We decided that the This criteria would account for 60% of the total weight calculation because the total cost of operation is the most the crucial determining factor for any business. The next criteria, Employee Cost of Living, looks at five different factors like Housing, Food, Healthcare, Transportation, and Utilities. Lastly, the Quality of Life Rankings criteria accounts for the following factors: Education, Crime rate, Transportation, Parks and Recreation, Public events, Essential amenities, Attractions, and Weather. We decided that both of these criterion would hold an equal weight of 20% each in the total weight calculation, where both of them account for factors that would benefit or incentivize employees to move out to the new distribution center location. The sub-scoring and ranking methods for each criteria and the total score calculations are described below as well as in Table J2 (See Appendix J).

Business Operation Savings

Aurora, Colorado's total annual savings on their business operation cost would be \$1.76 million, while Wichita, Kansas would save \$4.52 million and St. Louis, Missouri \$2.72 million. Therefore, we used highest saving of \$4.52 million as the cap, or a score of 100 on the 60% of the total weight, which gave Wichita a score of 60.0 from its \$4.52 million in cost savings. Likewise, Aurora received a score of 23.4 from its \$1.76 million annual cost savings and St. Louis a score of 36.11 from its \$2.72 million savings.

Cost of Living

Cost of Living was weighted on a scale from 125% to 90% of the national average. A city with an overall cost of living as low as 90% of the national average would be an ideal city, whereas a city with an overall cost of living higher than 125% would be too high, and would not even be considered as a potential city for the new distribution center. This created a 35 point scale, wherein a city with a 90% overall cost of living would get all 35 out of 35, and a city with 125% overall cost of living would get 0 out of 35. For example, Wichita had an overall cost of living that was 92% of the national average, so they scored 33/35. This resulted in a fractional score of 0.943. This fractional score was then multiplied by 20, since cost of living is 20% of overall city score. The final weighted values for cost of living for Aurora, Wichita, and St. Louis were 11.4, 18.9, and 17.7, respectively.

Quality of Life Rankings

The Quality of Life ranking analysis from earlier in the report, refer to Table I1 in Appendix I. Aurora received a score of 77.0, while Wichita and St. Louis received scores of 55.0 and 66.0. These score took into account following factors: Education, Crime rate, Transportation, Parks and Recreation, Public events, Essential amenities, Attractions, and Weather. The individual scores that each city received were then weighted in as 20% of the total score, which transformed the scores into 14.2, 11.0, and 13.2 all out of 20.0 (20% of the total score of 100).

As we can observe in Table J2, Appendix J, Aurora's total scores are added up to be: 23.4 (Business Operation Savings score) + 11.4 (Cost of Living score) + 49.0 (Quality of Life score) = 49.0. In the same way, the total scores for Wichita and St. Louis were calculated to be 89.9 and 67.02. The Figure 4 below shows the total score that each city received, with the subscore of all three criterion we studied. It is apparent that Wichita comes in first place with the drastically higher score of 89.9, with St. Louis coming in second with the total score of 67.02.

Figure 4: *Graph of Total Scores for Aurora, Wichita, and St. Louis*

About Wichita, Kansas

From all the previous analysis, Wichita, Kansas outperformed other potential cities in all the different factors we decided crucial and significant for the business and the employees. With the total annual cost savings of \$4.52 million, Wichita could provide Chainsaw Inc. an opportunity to maximize its profit and potentially invest in other future projects for the company. Wichita not only saves some significant bucks for the business but also stands as the most cost-friendly city to work and live in for the employees. With its cost of living 30% less expensive than Chainsaw Inc.'s current distribution center in Virginia Beach, the city of Wichita stands as the most appealing location for the employees with budget. Along with the low cost of living, Wichita also guarantees a great quality of life, which may be the most significant factor for the employees and their families. Wichita not only provides all the essential amenities and public services, but also offers extensive and exceptional benefits when it comes to commute, outdoor/indoor activities, and weather for any families with different demographic compositions. In conclusion, we are more than confident that the city of Wichita will make a great new home for Chainsaw Inc. and its employees.

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Appendix A

Figure 1 *Model of Chainsaw Product*

Appendix B

Figure 2 *The black line demonstrates where we chose to split the U.S. into a western territory with 44% of our product demand and an eastern territory with 56% of our product demand.*

Appendix C

Table 1: *Cities Considered for the Second DC (Most Populous Cities of the States)*

Atlanta, GA	Des Moines, IA	Nashville, TN	Wichita, KS
Baltimore, MD	Detroit, MI	New Orleans, LA	Wilmington, DE
Billings, MT	Fargo, ND	New York City, NY	
Birmingham, AL	Houston, TX	Newark, NJ	
Boise, ID	Indianapolis, IN	Oklahoma City, OK	
Boston, MA	Jackson, MS	Omaha, NE	
Bridgeport, CT	Jacksonville, FL	Philadelphia, PA	
Burlington, VT	Kansas City, MO	Phoenix, AZ	
Charleston, SC	Las Vegas, NV	Portland, ME	
Charleston, WV	Little Rock, AR	Portland, OR	
Charlotte, NC	Los Angeles, CA	Providence, RI	
Cheyenne, WY	Louisville, KY	Salt Lake City, UT	
Chicago, IL	Manchester, NH	Seattle, WA	
Columbus, OH	Milwaukee, WI	Sioux Falls, SD	

Table 2: *Cost of Transportation of Products to the Potential Cities of the Second DC from Different Ports*

City, State	port of New Orleans	port of Virginia Beach	port of Los Angeles
Wichita, KS	\$1,527,628.10	\$2,088,506.00	\$1,602,133.20
St. Louis, MO	\$1,444,979.80	\$1,992,407.20	\$1,707,252.90
Omaha, NE	\$1,536,849.90	\$2,049,095.30	\$1,523,385.30
Denver, CO	\$1,787,078.20	\$2,488,963.40	\$1,261,127.50
Sioux Falls, SD	\$1,624,491.30	\$2,190,582.80	\$1,571,277.90
Oklahoma City, OK	\$1,448,292.20	\$2,150,177.40	\$1,522,797.30
Cheyenne, WY	\$1,837,636.40	\$2,281,703.20	\$1,308,696.70
Des Moines, IA	\$1,541,823.40	\$2,063,163.20	\$1,804,096.50
Little Rock, AR	\$1,246,595.60	\$1,849,013.60	\$1,608,718.80
Albuquerque, NM	\$1,743,115.40	\$2,445,000.60	\$1,143,993.00
Billings, MT	\$2,058,954.70	\$2,481,167.50	\$1,399,792.60

New Orleans, LA	\$0.00	\$1,875,532.40	\$1,741,871.40
Salt Lake City, UT	\$2,041,917.40	\$2,743,797.70	\$1,085,540.90
Houston, TX	\$1,418,015.10	\$2,119,900.30	\$1,556,783.70
Phoenix, AZ	\$1,823,014.80	\$2,524,895.10	\$895,924.20
Las Vegas, NV	\$1,968,172.40	\$2,670,052.70	\$842,971.20
Fargo, ND	\$1,740,934.90	\$2,260,162.80	\$1,695,757.50
Minneapolis, MN	\$1,873,509.30	\$2,139,784.50	\$1,811,681.70
Milwaukee, WI	\$1,747,412.70	\$2,013,683.00	\$2,069,828.40
Los Angeles, CA	\$2,005,814.20	\$2,707,694.50	\$0.00
Boise, ID	\$2,236,751.20	\$2,938,631.50	\$1,280,379.60
Portland, OR	\$2,445,883.20	\$3,147,768.40	\$1,489,511.60
Seattle, WA	\$2,479,433.50	\$3,181,313.80	\$1,523,057.00

Table 3: *Ocean cargo container information*

Interior Length	39 '5" = 473"
Interior Width	7'8" = 92"
Interior Height	7'9.875" = 93.875"
Tare WT	8,775
Max Gross	67,200 lbs

Table 4: *Ocean cargo container capacity*

Number of products in a container	2,520 items
Weight of products	25,200 lbs

Table 5: *Ocean freight costs and times*

China to WC (15 days)	\$1,860/container
China to EC (28 days)	\$3,220/container
China to Gulf of Mexico (22 days)	\$2,540/container

Table 6: *53' wedge truck dimension*

Length	624"
Inside Width	99"
Inside Height	110"
maximum weight allowed	45,000 pounds

Table 7: *53' wedge truck packing without pallets*

Number of items on TL	4,477 items
Weight of 4477 items	44,770 lbs.

Table 8: *Pallet dimensions*

Length	48"
Width	40"
Height	6.5"

Table 9: *Pallet capacities*

Number of products on a pallet	100 (20 items/tier, 5 tiers)
Number of pallets on a LTL	22
Number of pallets on a TL	26

Appendix E

Table 1: Breakdown of Demand Units and Percentages Served by STIHL's Distribution Center

State	Units of Demand	Demand as Percentage of Total U.S. Demand
Connecticut	14,521	0.36%
Maine	145,366	3.63%
Massachusetts	26,535	0.66%
New Jersey	16,499	0.41%
New Hampshire	35,100	0.88%
New York	132,976	3.32%
Rhode Island	3,758	0.09%
Pennsylvania	121,960	3.05%
Vermont	36,103	0.90%
Total:	532,818	13.32%

Table 2: Annual Industrial Electricity Rates

Location	Average Industrial Electricity Rates (www.electricity local.com)	Calculation (400,000 Sq Ft * 6.1kWh/Sq Ft per Year * Industrial Electricity Rate = \$ per Year)	Annual Industrial Electricity Rates (derived from Calculation)
Aurora, Colorado	6.04¢/kWh	400,000Sq Ft * 6.1kWh/Sq Ft per year * 0.0604\$/kWh	\$147,376 per Year
Wichita, Kansas	6.3¢/kWh	400,000Sq Ft * 6.1kWh/Sq Ft per year * 0.063\$/kWh	\$153,720 per Year
St. Louis, Missouri	5.02¢/kWh	400,000Sq Ft * 6.1kWh/Sq Ft per year * 0.0502\$/kWh	\$122,488 per Year

Table 3: Annual Water and Sewage Rates

Location	Annual Water Rate	Annual Sewage Rates
Aurora, Colorado	\$321,076	\$390,000
Wichita, Kansas	\$196,104	\$347,067
St. Louis, Missouri	\$477,216	\$614,395

Warehouse Cost Estimation using NPV Calculation

We assumed that the property developer prepared the warehouse for us according to our specification, and we entered into a 20 year lease contract where the developer expect to earn a 8% annual return.

A = Annual Triple Net Lease

I = 8% (Developer's expected annual return)

N = 20 years

P = Present Value (Value of property)

$$\begin{aligned} \text{NPV} &= (P/A, I, N) \\ &= A * [(1+I)^N - 1] / [I * (1+I)^N] \\ &= A * [(1.08)^{20} - 1] / [0.08 * (1.08)^{20}] \\ &= 9.8181 * A \end{aligned}$$

Table 4: *Commercial Property Tax for the three cities considered*

	Annual Warehouse Lease (Triple Net)	Estimated Value of Property	Commercial Property Tax Rate	Annual Warehouse Property Taxes
Aurora, CO	\$3.10 million	\$30.4 million	2.40%	\$0.73 million
Wichita, KS	\$2.00 million	\$19.6 million	2.83%	\$0.55 million
St. Louis, MO	\$1.20 million	\$11.78 million	2.75%	\$0.32 million

Commercial property tax rates from 2015; Source: Lincoln Institute of Land Policy

Appendix H

Figure 1: *Overall cost of living expenses for candidate cities as a percentage of the U.S. Average.*

Appendix I: Quality of Life

Table 1: *Quality of Life Weighted Decision Matrix*

Quality of Life Summary							
		Aurora, Colorado		Wichita, Kansas		St. Louis, Missouri	
	Importance	Score	Score x Ranking	Score	Score x Ranking	Score	Score x Ranking
Parks/Rec	5	9	45	8	40	8	40
Public Events	5	9	45	8	40	7	35
Essential Amenities	20	7	140	6	120	10	200
Education	20	6	120	8	160	7	140
Attractions	15	6	90	6	90	9	135
Weather	5	7	35	4	20	5	25
Crime Rate	20	7	140	2	40	1	20
Transportation	10	9	90	4	40	6	60
Final Score		71		55		66	

Table 2: *Education Factors Table*

	Expenditure Per Student	Pupil-Teacher Ratio	High School Graduates	4 Year Degree Graduates	Education Score
United States	\$12,383	16.8	86.30%	29.30%	
Aurora, Colorado	\$9,673	19.6	86.50%	27.10%	6/10
Wichita, Kansas	\$12,527	15.6	87.11%	28.80%	8/10
St. Louis, Missouri	\$13,284	13.5	83.20%	30.40%	7/10

Table 3: *Crime Rate Factors Table*

	Property Crime	Violent Crime	Total Crime	Crime Rate Score
United States	2,451	386	2,837	
Aurora, Colorado	3,060	529	3,589	7/10
Wichita, Kansas	5,382	1,057	6,439	2/10
St. Louis, Missouri	5,931	1,913	7,844	1/10

Table 4: *Wichita, Kansas Healthcare Factors***Table 5:** *Aurora, Colorado Healthcare Factors***Table 6:** *St. Louis, Missouri Healthcare Factors*

Appendix J: Final Decision

Table 1: *Total Score Weighting Criterion*

Table 2: *Total Score Calculations for Aurora, Wichita, and St. Louis*

	Business Operation Savings: 60% of total score	Cost of Living: 20% of total score	Quality of Life Scores: 20% of total score	TOTAL SCORE (Out of 100)
Aurora, Colorado	23.4	11.4	14.2	49.0
Wichita, Kansas	60.0	18.9	11.0	89.9
St. Louis, Missouri	36.1	17.7	13.2	67.0