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AN ANALYSIS OF INVENTORY DISTRIBUTION:
LOGISTICS HEAT MAP USING TABLEAU

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ABSTRACT

Companies are now more than ever looking for ways to increase the efficiency of their supply chain networks, which in return usually leads to higher profit margins. To achieve the higher levels of efficiency, companies are turning to network design software programs to obtain insights into their networks by focusing on opportunities such as identifying bottleneck areas, inefficient shipments, and geographical locations that a company could pursue to construct a new distribution center. With the desire companies now have for finding the "ideal" network design software program to create stocking strategies, this thesis explored a new methodology that utilizes a software program called Tableau to create a network design model.

The data used for this thesis to exhibit the steps necessary in creating a distribution heat map in Tableau was provided by a global Pharmaceutical Wholesaler. In addition, to showcase the steps required to create the visualization in Tableau, this thesis provided the steps taken to clean and format the data to ensure that Tableau accurately displayed the data points. To conclude, this thesis provided the findings of the Pharmaceutical Wholesaler that were obtained from the Tableau visualizations.

The findings for the Pharmaceutical Wholesaler in this thesis identified inefficient stock transfers the company performed. In addition, on the outbound side, the major findings illustrated the Wholesaler was shipping to their customers across the entire U.S. versus utilizing their distribution centers located in the central part of the U.S. To this point, Tableau's capability in creating customizable heat maps enables companies to address current issues in their supply chain networks and identify opportunities to improve current operations.

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Chapter 1

Introduction & Methodology

Companies today are no longer satisfied with being just the best company within their own country. Instead, companies strive to expand globally and penetrate new markets. As companies expand their presence, their supply chains become exponentially more complex leading to new strategies in order to combat this complexity, while maintaining the company's on-time delivery goals. Specifically, the increase in complexity within the supply chain network often leads to capacity issues among warehouses and impacts the amount of required safety stock to achieve the on-time delivery targets. These issues are also impacted by companies expanding their product portfolio, customers requiring lower prices and demanding faster delivery cycle times. These challenges are a result of global expansion and reinforce the need to evaluate the current stocking strategies being utilized.

When determining a new stocking strategy for a supply chain network, executives have four important inventory decisions: what products, when to order, where to locate and appropriate quantities. However, a company needs to understand their markets, competition and internal constraints which could affect the answer to these decisions.

This thesis seeks to provide a new stocking strategy for a company operating within the scientific products distributor industry and is facing severe pressure internally as well as externally for a new supply chain strategy implementation. The strategy will be a result of in-depth analysis of company data and an on-site visit to one of the company's distribution centers (DC). In addition, this thesis will be based on the company's current factors: transportation costs, network layout, customer demand by region and constraints, including capital for site expansion

as well as DC capacity. Although these findings are inclusive of one company, the resulting analysis will be transferable to other companies within various industries.

Research sources for this thesis are from the company developing a new stocking strategy, university faculty and online content. Insights and knowledge obtained from the data provided by the company will illustrate how this company addressed the task of developing a new stocking strategy. For confidentiality reasons, the company will remain anonymous (referred to as "Company X" for the remainder of this paper). Ultimately, the intent of this thesis is to share insights on the process Company X used to determine a new stocking strategy for supply chain optimization for usage today and the foreseeable future.

Chapter 2

Background

Analyzing data is nothing new in supply chain management and is becoming more essential for companies to focus on if they want to excel in their respective industries, especially when conducting business in a global economy. However, performing high level data analysis by itself is no longer considered a competitive advantage as new software has been released into the market which provides avenues to analyze data in greater detail. Companies are now using analytical modeling software, such as JDA Network Design and SAP Advanced Planning Optimizer (APO), to gain insights on how to solve capacity issues or the selection of which distribution centers (DCs) to stock inventory as well as quantity levels based on expected demand. JDA and SAP APO are considered to be among the top ten supply chain design software platforms according to PAT Research. PAT calculates the top software based on an evaluation point system (PAT Research, 2019). The objective of this thesis is to provide a new methodology on how to create a network model and highlight possible findings the model can identify, utilizing Company X's findings. The software being utilized in this thesis is Tableau. In order to understand why Tableau is the best suited software for Company X, it is important to recognize what are the capabilities of JDA and SAP APO as well as their limitations. In addition, an important element will be to understand why Company X is not suited for JDA or SAP APO.

JDA provides insights to supply chain departments on end-to-end operations. These insights include procurement, manufacturing, distribution, transportation and even mergers and acquisitions that a company pursues (Business Wire, 2011). The numerous advantages of JDA are explained throughout an article called *JDA Software Enhances Network Design Solution With*

Strategic Inventory Modeling Features. One of the major advantages JDA offers is providing

insights into the overall supply chain for a company by creating a visualization that displays

stores, distribution centers and vendors of a specific company on a geographical map. In addition

to the geographical map, the visualization allows stochastic inputs for inventory to gain a deeper

understanding of the effect inventory has throughout the entire supply chain. The overall

outcome of the visualization is a more holistic view of a company's supply chain and a clear

direction of where the supply chain must strengthen to be able to handle potential growth in

demand. JDA is a powerful tool that has been used across industries; however, it lacks the

customization and flexibility that is needed when a company has an in-house warehouse

management system (WMS) since it is inadequate in handling cross application support

(Business Wire, 2011).

SAP APO is an application that is utilized to strategically design a supply chain network

for a company and is functionally similar to JDA. The application accomplishes this by

connecting to another SAP software platform - SAP Enterprise Resource Planning (ERP) system.

SAP APO integrates the data and information from SAP ERP on transactions, production, sales,

materials as well as data on transportation, purchasing, manufacturing, and distribution within a

company's supply chain (Murray, 2018). It is important to note that SAP APO is not a stand-

alone application; it needs to be connected to SAP ERP to be functional. However, when

companies implement both SAP software systems, SAP APO is able to display supply network

planning models. These models use advanced optimization techniques such as constraints and

penalties to determine the optimal product flow for the entire network (Murray, 2018). The result

of the optimization techniques allows companies to reduce transportation costs, determine

optimal inventory levels and to be able to simulate future demand growth to determine where new DCs need to be built (Murray, 2018).

Overall, JDA and SAP APO are both network designing software platforms that have provided benefits for numerous companies; however, neither are well suited for Company X. To better understand this claim, one must know the background of Company X. Company X is a global Pharmaceutical Wholesaler and is expecting their sales to grow five percent year over year for the next five years. In addition, Company X is facing capacity constraints that are well over their capacity goal of seventy percent-since some of the DCs are currently at ninety-six percent capacity. The Vice President of Procurement and Planning for Company X believes the company has an opportunity to create a new stocking strategy to better utilize some of their DCs that have more capacity to handle the future demand growth. This capacity utilization strategy is especially true for the company's Midwest DCs since they are operating around fifty percent capacity. In addition, it is also important to note that Company X identifies their product inventory into three major categories: 1) production and research and development critical; 2) consumables and non-critical equipment; and 3) maintenance, repair, and operation types of products. Lastly, Company X is expecting to switch to SAP ERP within the next five years so the network design software that was chosen for this thesis needed to be able to handle the integration of the new Warehouse Management System (WMS).

The current operation state of Company X is the leading reason why the company requires a new methodology that has yet to utilized. The company is not positioned to use SAP APO since the company has not yet implemented SAP ERP and is not planning for this to happen for at least a few years. In addition, Company X has a desire for a network design software system that is flexible and customizable. The conditions explained above that Company

X is facing assisted in selecting Tableau as the network design software to be used in the development of a new stocking strategy. This thesis will detail the necessary steps taken to utilize Tableau for Company X so similar companies could utilize the same strategy.

Chapter 3

Inventory Distribution Model in Tableau

Data Cleansing

The first step in using Tableau or any other network design software is ensuring the data that will be used is standardized and has no irregularities among it. The formal name for standardizing data sets is data cleansing. A definition for this process is, "Data cleansing is the process of recognizing mistaken or unethical data from a database. The process is mainly used in databases where improper, unfinished, inaccurate or irrelevant part of the data is identified and then altered, replaced or deleted (Singh, 2017)." To eliminate redundant steps, this thesis will only exhibit the steps necessary to clean and format the "Purchase Order" data set as the steps can be repeated for the "Demand" data. It is also important to note that this thesis used two primary data sets which Company X provided to create the visualizations in Tableau: "Purchase Order" and "Demand" data set as well as three secondary data sets. The three secondary data sets were "Plant Master (DC information)", "Vendor Master" and "Customer Master". The "Plant Master", "Vendor Master" and "Customer Master" data sets are critical as they contained the zip codes and cities of where they are geographically located. This location information was needed later in the data cleansing process. Lastly, for simplicity, this thesis focused on one month of data.

To begin the data cleansing process, the initial step taken was to use Microsoft Excel to filter the "Purchase Order" data based on time frame, as the original data set was broken down by quarters. Specifically, filtering was based on the "Creation Date", of the purchase orders from January 1st, 2018 to January 31st, 2018 since this thesis focused on Company X's purchase order

and demand data for January of 2018. Once the filtering process was complete, the data was copied and pasted to a new Excel Worksheet. The data was pasted as values since the data regarding the other months for purchase orders were irrelevant. In addition to this step, the "Creation Date" of the purchase orders was deleted as it was no longer needed.

The next major step in the data cleansing process was to use the filter feature of Excel again; however, this time it was done to identify and delete any blank rows that were in the original "Purchase Order" data set. After deleting the empty rows, it was critical to remove any extra spaces, or as some data analysts call them, hidden spaces, that were in the data. This was accomplished with the Trim function in Excel. The removal of the extra spaces was necessary when performing different functions in Excel such as VLOOKUP, especially if there were extra spaces in the data since the values would not be found when executing the Excel function.

After ensuring the data was accurate and the irregular data was removed, the majority of the data cleansing process focused on selecting only relevant data that was needed to accurately create the network design visualization in Tableau.

The original "Purchase Order" data set that Company X provided was a master data set, meaning that all fields were included which resulted in a total of forty-two columns. Most of the columns were unneeded or provided no value to the final visualization. As a result, the unnecessary columns were removed and a pivot table was used to easily format the data. The pivot table's main purpose was to condense the numerous orders Company X had for a single purchase order and Excel's pivot table report layout, "Tabular Form" was used. More importantly, the pivot table reduced the number of columns from forty-two of the original "Purchase Order" data set to twelve columns as the pivot table provided the capability to select only relevant columns. Table 1 provides a snapshot of what the pivot table showcased. Also, to

keep Company X's data anonymous, the vendor names are referred to as Vendor 1, Vendor 2, etc.

Table 1. Company X's Purchase Order Data

Purchase Orders	PO Type	Vendor ID	Plant ID	Vendor Name	Vendor Category	Vendor Account Group	Stock Transfer	Market Source	Sum of Net Value	Sum of Purchase Order Quantity	Sum of Gross Weight
4507929524	DFS	11333	8013	Vendor1	12	G103560000	(Blank)	X	$46.70	2	1
4507929526	DFS	11722	8612	Vendor2	2	G101360000	(Blank)	(Blank)	$39.81	1	2
4507929527	DFS	11186	8011	Vendor3	1	G102980000	(Blank)	(Blank)	$27.60	1	1
4507929528	DFS	12207	8012	Vendor4	1	G102140000	(Blank)	(Blank)	$62.05	1	1
4507929529	DFS	12215	8011	Vendor5	1	G101130000	(Blank)	(Blank)	$234.25	1	4

The next step in the data cleansing process was to add additional fields, cities and zip codes of Company X's plants and vendors. This portion of the data cleansing process was modifying the data to showcase where the shipment was going and not where the shipment was leaving. It was important to note that to avoid repeated steps, this thesis would showcase only how to modify the data set to show where the shipments were going, as the same steps were used to identify where shipments were departing. The new data fields were added to the right of the pivot table as seen in Table 1. To pull the additional information, the VLOOKUP function was used since it referenced the unique "Vendor ID" and "Plant ID" to attain the needed information. For Company X, the city and zip code information were found in the "Plant" and "Vendor" data sets. The new information would be added to the right of the pivot table and under column names; "From City", "From Zip Code", "To City" and "To Zip Code". "From City" and "From Zip Code" indicates the vendor's city location as the vendor was shipping the purchased items to

Company X's plants and this is why "To City" and "To Zip Code" column names were used to represent the plant locations[1].

With the city and zip code data added to the pivot table, the next step was to extract the latitude and longitudes corresponding to the vendor and plant zip codes. This process was similar to attaining the zip codes as the VLOOKUP function was used. VLOOKUP was referencing the zip codes and pulling from the data set that contained zip code, longitude and latitude data. This thesis used data sets found online that compiled a complete list of latitudes and longitudes for zip codes[2]. The longitude and latitude data were critical for Tableau to plot every single data point since Tableau was unable to identify all zip codes within the U.S. as well as other countries. The longitude and latitude data were added to the right of the "To Zip Code" and "To City" columns. For this thesis, the longitude and latitude data used was where the purchase orders were shipped from and shipped to under the column names "From Latitude", "From Longitude", "To Latitude" and "To Longitude". With the longitude and latitude data added, the zip code columns were deleted. In addition, there were two columns created that were named "Latitude" and "Longitude" and the "To Latitude" and "To Longitude" data were copied and pasted as values within the newly created columns. This step was needed to meet Tableau's complex mapping requirements and this step was reversed when showcasing shipment origins. "From Latitude" and "From Longitude" data was pasted with the "Latitude" and "Longitude" column names. Lastly, there was a column added between the "To City" column and the "To Latitude" column. This new column was labeled "From City-To City" and the data that needed to be added was

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[1] To understand the importance of how data sets need to be set-up to be properly plotted in Tableau, visit https://onlinehelp.tableau.com/current/pro/desktop/en-us/maps_howto_origin_destination.htm.
[2] The data set that this thesis used for longitude and latitude data can be found at https://www.zip-codes.com/account_database.asp and https://www.zipcodesoft.com/postal-codes-canada.

entered by using the Excel Concatenate function in order to combine the "To City" with the "From City". Table 2 displays a snapshot of how the new data set appeared; starting from the "Sum of Gross Weight" column, as seen in Table 1. Company X's Purchase Order Data, and ending with "Longitude".

Table 2. Longitude & Latitude Data for Company X's Vendors & Plants

Sum of Gross Weight	From City	To City	From City - To City	To Latitude	To Longitude	From Latitude	From Longitude	Latitude	Longitude
21.00	Upland	West Henrietta	Upland – West Henrietta	43.0464	-77.6893	34.1038	-117.6640	43.0464	-77.6893
1.95	Tucker	West Henrietta	Tucker – West Henrietta	43.0464	-77.6893	34.1038	-117.6640	43.0464	-77.6893
7.00	Tewksbury	Batavia	Tewksbury – Batavia	41.8408	-88.3380	42.6111	-71.2316	41.8408	-88.3380
14.00	Tewksbury	Batavia	Tewksbury – Batavia	41.8408	-88.3380	42.6111	-71.2316	41.8408	-88.3380
38.10	Center Valley	Batavia	Center Valley – Batavia	41.8408	-88.3380	42.6111	-71.2316	41.8408	-88.3380

The last few data cleansing steps in regard to displaying the "shipping to" portion of the "Purchase Order" data was to create any additional data fields that were needed to ensure Company X's shipments would properly be displayed in Tableau. To achieve accuracy, a column, "Node Direction", was created to avoid confusion when the "shipping to" portion of the data was added to the "shipping from" portion. The cell values for all the "shipping to" data under "Node Direction" had the value of "To" entered, and for identifying where the shipment is coming from, it would have "From" entered. Lastly, to properly display the data in Tableau, a column, "Order Path" was created. For all cell values identifying where the order was "shipping to", the number "2" was entered and for the "shipping from", the number "1" was entered under

the column name "Order Path". The "Order Path" step was critical since it was a clear indicator to Tableau that "shipping to" and "shipping from" were entirely different data points.

After the above steps were completed for the "shipping to" portion of the "Purchase Order" data, the exact steps were repeated to showcase the "shipping from" locations. Once the "shipping from" portion was finished, the two data tables were combined. This step was accomplished by copying and pasting both data tables to a new Excel Worksheet in a new Excel Workbook. This procedure was followed to ensure maximum efficiency when the data was imported to Tableau. At this point, the data was now ready to be imported into Tableau.

Data Input

Importing data into Tableau was extremely straight forward since this thesis focused on the steps taken to pull data into Tableau from Microsoft Excel; however, the process would be almost identical if the data was being pulled from a different software program (e.g. Microsoft Access). The initial step was to have Tableau Desktop open on the Data Source page. Within the Data Source page, there was a "connections" section with an "Add" hyperlink that needed to be clicked. After the hyperlink was clicked, Tableau displayed a pop-up screen. Displayed in the pop-up screen was various connection types. For this thesis, the add connection type was Microsoft Excel. Following the selection of Microsoft Excel, the next step was to select the specific Excel files to be used and for this thesis it was the "Purchase Order" and "Customer Demand" data files. For this thesis, "Purchase Order" and "Customer Demand" data files were imported into Tableau into separate Tableau Workbooks to avoid confusion on what data was being showcased. Illustrated below in Figure 1 is the Tableau screen display.

Figure 1. Tableau's Data Source Screen for Purchase Orders


Formatting Data in Tableau

With the data in Tableau, the last step needed to be accomplished before creating the visualizations was to ensure the data fields imported from Excel were correctly classified as dimensions or measures[3]. For this thesis, the only data fields that needed to be reclassified were "Latitude", "Longitude", "Order Path", "Plant ID" and "Purchase Orders". Initially, these fields were classified as measures when the data was imported into Tableau; however, they needed to be reclassified as dimensions to ensure the data was accurately displayed. To achieve the new classification, Tableau just required to right click "Latitude", "Longitude", "Order Path", "Plant ID" and "Purchase Orders" data fields in the "Measures Pane" in Tableau and select "Convert to Dimension" from the drop-down window. After the reclassification process was completed for all five data fields, the data was now prepared to create the distribution visualizations.

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[3] To understand the difference between dimensions and measures in Tableau as well as other characteristics of the software, visit https://onlinehelp.tableau.com/current/pro/desktop/en-us/datafields_typesandroles.htm.

Creating Distribution Visualization in Tableau

The next action was to exhibit the steps required to create a distribution visualization for the "Purchase Order" data as it can be replicated for the "Demand" data. However, this thesis provides images of possible findings for both the "Purchase Order" data and "Demand" data. The first step in creating a distribution visualization was to click and drag the data field "Latitude" to the "Rows Shelf" and "Longitude" to the "Columns Shelf" from the "Measures Pane". Illustrated in Figure 2 is the Tableau screen displayed at this point in the process.

Figure 2. Company X Vendors & Plants Displayed
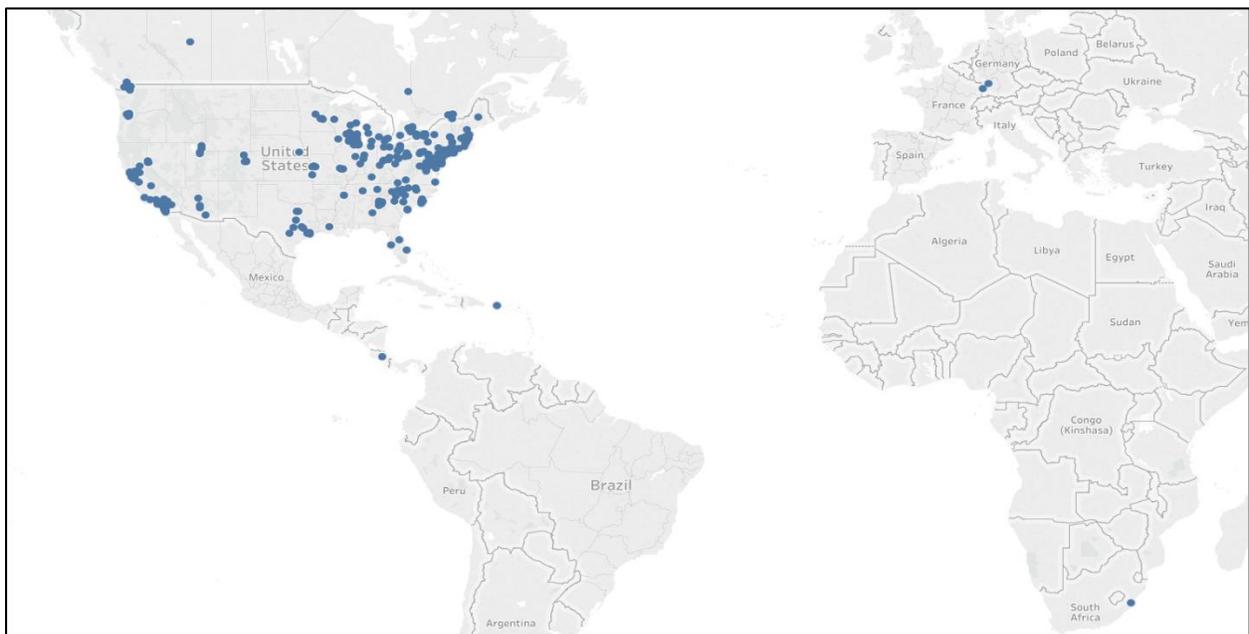
The next step in creating the visualization was to click the drop-down arrow in the "Marks Pane" and the "Line" option was selected. The "Line" feature has the capability to display the individual shipments for Company X. Following the selection of "Line", the "Stock Transfer" data field was brought over from the "Dimensions Pane" to the "Filters Pane" as one of the findings for this thesis would focus on the transfers for Company X's plants. Once "Stock

Transfer" was placed in the "Filters Pane", a pop-up window appeared and the check-box next to

"X" needed to be clicked since this action achieved the goal of only displaying transfers that

happened and eliminated the rest of the data points. After the filter process was completed, the

"From City-To City", "To City", "Purchase Orders" and "Order Path" data fields were brought

over from the "Dimensions" pane to the "Marks Pane". Specifically, the "From City-To City"

data field was taken to the "Path Indicator", "To City" and "Purchase Orders" data fields were

taken to the "Detail Indicator" and "Order Path" were taken to the "Color Indicator". These

fields all were in the "Marks Pane"[4]. After the "Order Path" was included to the visualization,

"Order Path" needed to be converted to an attribute. To accomplish this, right clicking on the

"Order Path" data field was required in the "Marks Pane" and the selection of "Attribute" was

chosen from the drop-down menu. Tableau at this point displayed a "Color Pane" in the upper

right corner of the screen that was altered for this thesis. Changing the color was simple. All that

needed to be done was to click the drop-down arrow in the "Color Pane" and green was selected.

The last step before adding another layer to the visualization was to bring the "Sum of Purchase

Order Quantity" data field from the "Measures Pane" to "Size Indicator" in the "Marks Pane".

The result of the above steps is displayed in Figure 3.

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[4] To understand Tableau's different visualization features, such as, the Marks Pane visit
https://onlinehelp.tableau.com/current/pro/desktop/en-us/view_parts.htm.

Figure 3. Company X's Stock Transfers
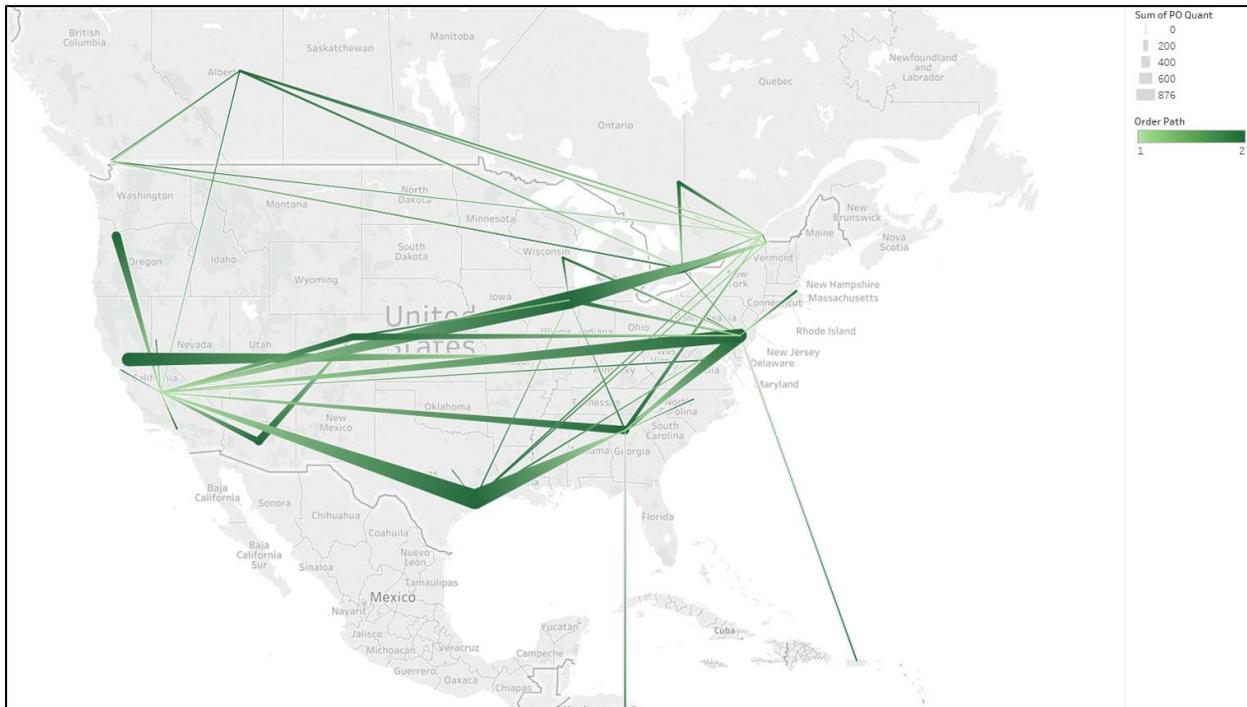
The last steps that needed to be accomplished for the stock transfer visualization for this

thesis was to bring the "Latitude" data field from the "Dimensions Pane" to the "Rows Shelf".

Tableau now showcased two identical maps. To format the second map, the "Latitude (2)"

needed to be selected from the "Marks Pane". Once the selection of "Latitude (2)" was

completed, the drop-down arrow in the "Marks Pane" was clicked and the "Circle" option was

selected from the drop-down menu. Next, "From City-To City", "Purchase Orders" and "Order

Path" data fields were removed from the "Marks Pane" and replaced with "Sum of Purchase

Orders" and "Plant ID" data fields. The "Sum of Purchase Orders" was placed to the "Color

Indicator" in the "Marks Pane" and "Plant ID" was placed to the "Detail Indicator". To change

the color, the steps taken prior were repeated with "Path Order" in the first map; the color red

was chosen to showcase "Sum of Purchase Orders". The last step in the creation of the stock

transfer visualization for Company X was right clicking the second "Latitude" data field in the

"Rows Shelf" and selecting "Dual Axis" from the drop-down menu. Below in Figure 4 are the

results of these steps.

Figure 4. Company X's Completed Stock Transfer Visualization
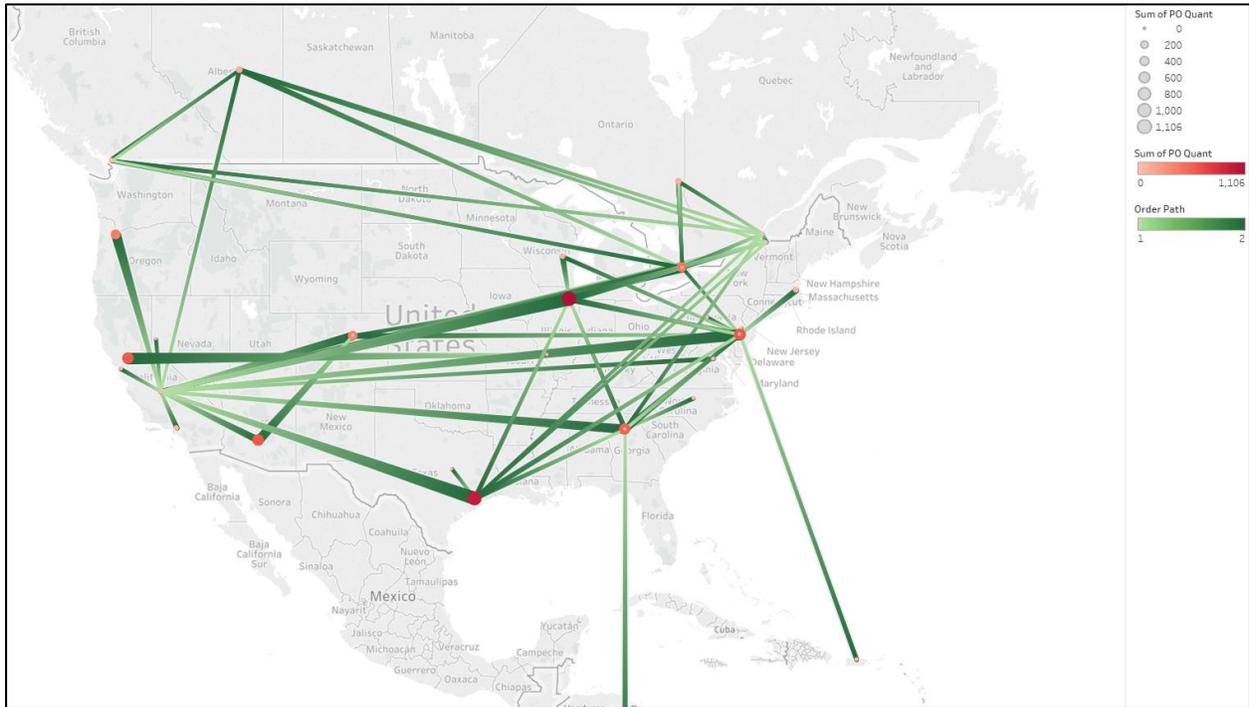
Chapter 4

Tableau Model Findings

Company X Purchase Order Findings

For the findings of the "Purchase Order" data, the Stock Transfer Visualization shown in Figure 4 was used for this thesis and displayed below as Figure 5 with slight modifications. Before explaining the findings, it would be best to understand what Figure 5 illustrates. Figure 5 illustrates the stock transfers of Company X between their plants and is depicted by the green lines. In addition, the green lines also illustrate where the shipment went as the light green section of line indicates the origin of the shipment and the dark green section indicates the destination of the shipment. The green line also indicates the volume of orders that were transferred among the shipping routes, which is indicated by the thickness of the green line. In addition to the green line, the various shades of red circles in Figure 5 represent Company X's plant locations. The circles, similar to the lines, provides information to the visualization; the size of the circle and the color indicates volume of orders, the darker the shade of red and bigger the circle represents higher volume.

With this understanding of what the visualization showcases, it is important to comprehend the findings a visualization similar to Figure 5 is capable of showing. One of the major findings for Company X in Figure 5 is Plant 8017. The plant, which is located in southern California, was having numerous outbound transfers (lighter green color of the lines). The numerous transfers that were being shipped out of Plant 8017 raises several questions for Company X on why this is occurring. Could this be due to inefficient stocking of certain materials? Should the materials being transferred be stocked in a different location? In addition

to Plant 8017, the visualization also provided another interesting issue for Company X to

address. This issue involves Plant 8616. Plant 8616 received and shipped stock transfers across

the entire U.S. This finding was alarming since Plant 8616 could be stocking product that may

not be efficient to stock at that plant. Instead, it may be more efficient to stock those items in a

plant located in the central part of U.S. If this was the case, it would benefit Company X since

the company has excess capacity in their plants located there. In addition, the current

inefficiencies of Plant 8616 exhibited may have been due to Company X's leadership not

realizing product being transferred across the entire U.S. With the findings Figure 5 showcased

and the subsequent questions raised for Company X, it was evident that Tableau can identify

areas where companies can address to improve their stocking strategies on the inbound and

transfer side of their supply chains.

Figure 5. Company X Stock Transfer Findings Visualization
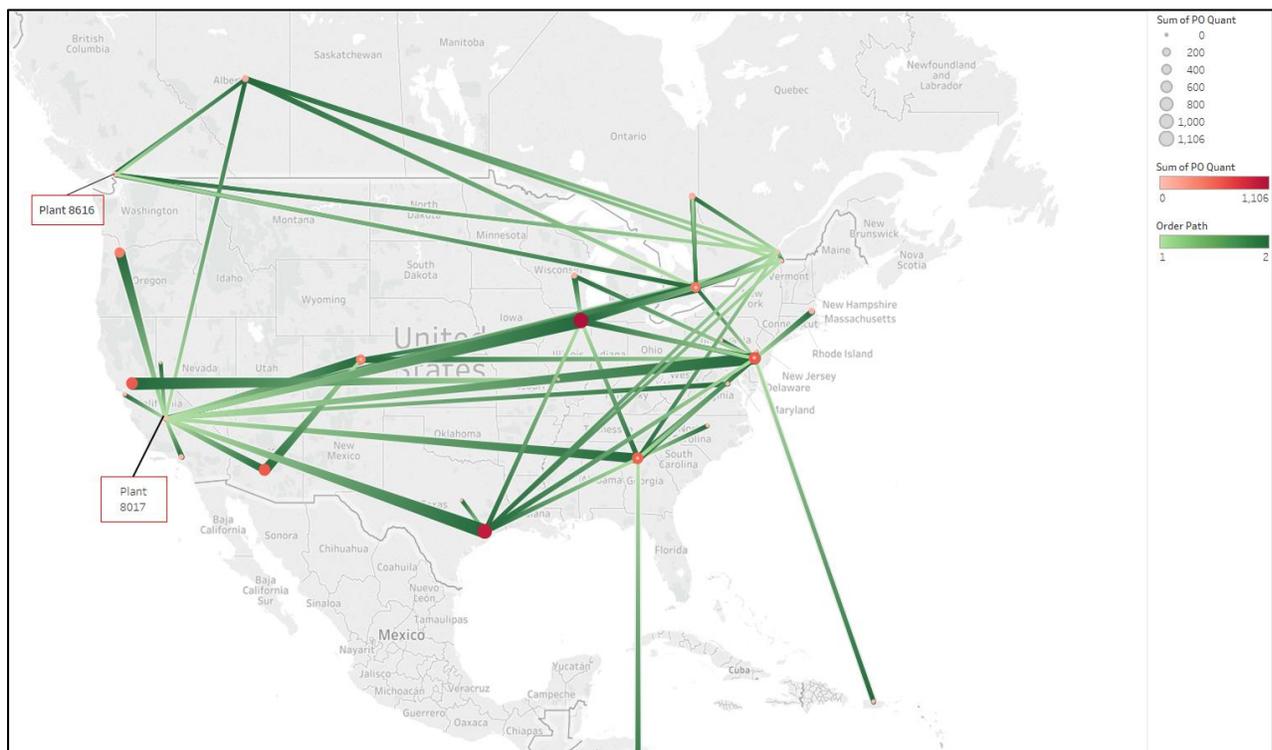
Company X Demand Findings

      The next set of findings for this thesis were on the demand side for Company X. Specifically, a review of the company's largest customers and their locations in relation to Company X's plants was undertaken. However, like the Purchase Order Findings, it was necessary to understand the illustrations of Figure 6. Figure 6, like Figure 5, includes green lines that indicated shipments between Company X's plants and customers. The green lines in the demand visualization had the same representation as the green lines in Figure 5; however, the data being depicted is the "Demand" data. To this point, the thickness of the green line indicated the quantity a customer ordered for the month of January. In addition, the light green color of the line indicated the origin of an order and the darker green section of the line indicated the order's destination. The major difference between Figure 5 and Figure 6 is Figure 6's circle colors represent different customers of Company X. The size of the circle still indicated the volume of orders.

      With a baseline knowledge of what Figure 6 showcased, it was important to fully understand the findings it was capable of providing. For Company X, Figure 6 highlights a main issue, as it displays numerous shipments that were sent across the entire U.S. Specifically, there are four different customers on the West Coast that received large quantities of product from Company X's plants located on the East Coast. This finding was alarming because Company X has several plants that are in the central part of the U.S. and are under-utilized in terms of capacity. To this point, Company X could look to change their stocking methodology by stocking the items that are being shipped from the east to the west of the U.S. and shift the stock to the central part of the country. The change of stocking products from the East Coast to the

central part of the U.S. would eliminate the long shipments that Company X executed. This stocking issue that Company X faced usually meant either Company X's customers were dealing with long lead-times after their orders were placed or Company X was spending large amounts of money to expedite shipments to satisfy on-time delivery goals.

The other benefit from potentially moving certain products would be determined based on additional analyses performed by Company X. Since the plants on the East Coast were near capacity, stock allocated to other plants would reduce the strain on the East Coast plants. If this was the direction Company X pursued in the future, it would enable Company X to handle their projected growth in demand without having to invest their capital immediately to build new plants. Refer to Figure 6 below to reference for the Demand Findings Visualization for Company X.

Figure 6. Company X Top Customer Demand Findings Visualization
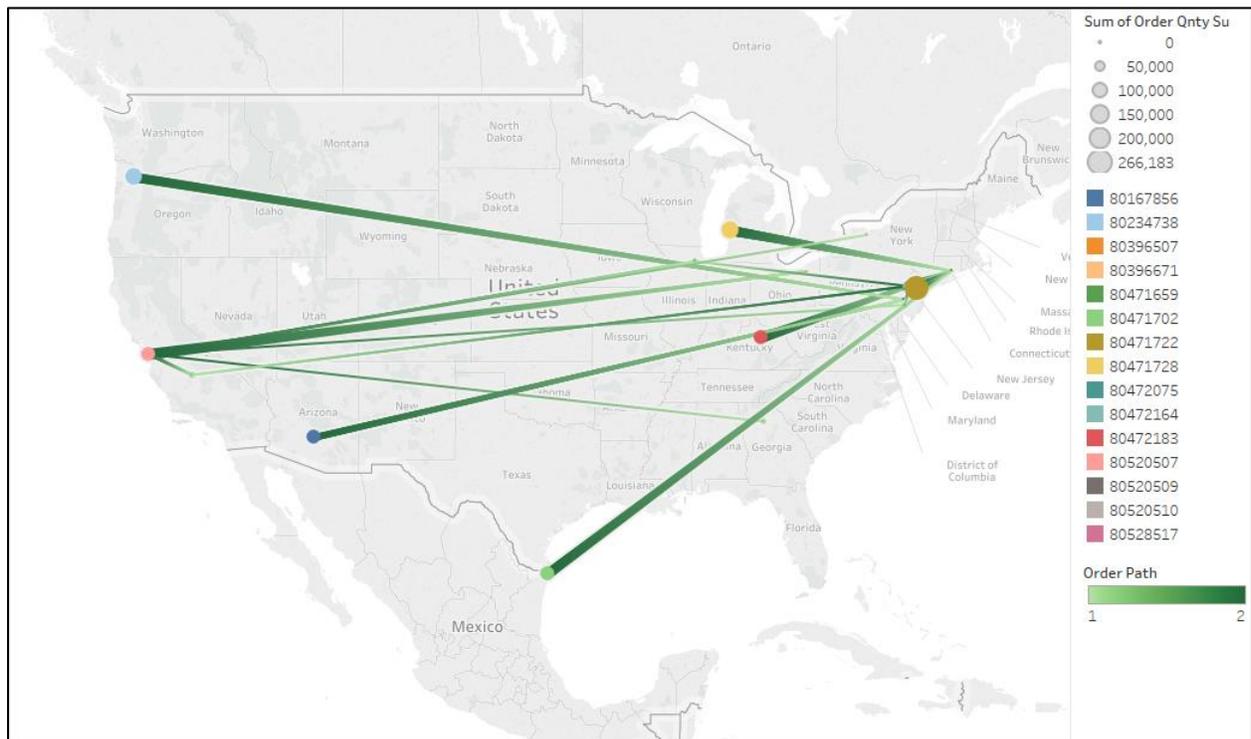
Chapter 5

Conclusion

It should be evident throughout the data cleansing steps as well as the creation of the distribution visualization in Tableau, that this software program enables flexibility and customization. This was the main reason why Tableau, for Company X, was the premier network design platform for the company to utilize for identifying issues among its current supply chain operations.

The visualizations used in the Findings section of this thesis clearly showcased how Tableau had the capability to highlight bottleneck areas within a supply chain network, as the software was able to display the volume of specific shipping routes. Also, Tableau was able to highlight inefficient transfers, such as the transfers being sent across the entire U.S. In the immediate future, Tableau's distribution visualizations that had been created for Company X in this thesis provides specific areas where the company needs to analyze further since there were clearly issues on how products were being shipped throughout the company's supply chain network. Specifically, there are tremendous opportunities for Company X to change their stocking strategy to utilize their plants in the central part of the U.S. to free up capacity in their plants on the East Coast as well as decrease lead-times to their customers. To this point, Tableau may not solve problems instantly for a company; however, the software highlights areas of concern or inefficiencies in a company's network to further analyze.

Overall, Tableau is an incredibly powerful tool as the data can be customized in a way to showcase high level heat maps to spark discussions on current supply chain stocking strategies as had been done for Company X. In addition, Tableau offers the capability to perform a more in-

depth analysis to gain a better understanding of how part items for certain products flow

throughout a company's supply chain, much like Company X. Fortunately, for Company X and

other companies that pursue the use Tableau after reading this thesis, the software program does

have the capability to display the flow of individual part items for products as well as

determining distribution efficiencies.

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EDUCATION

The Pennsylvania State University │ Schreyer Honors College **University Park, PA**
Smeal College of Business │ Bachelor of Science in Supply Chain and Information Systems   Graduation: May 2019
College of Information Systems of Technology │ Minor in Integration and Application

PROFESSIONAL EXPERIENCE

The Boeing Company **Everett, WA**
Supply Chain Strategy Intern *May 2018 – Aug 2018*
- Facilitated a 20-person cross-functional workshop for hydraulic pumps by showcasing data on the current supplier landscape, generating over 10 different strategic options to capture more of the $5.5B aftermarket
- Identified a gap within the hydraulic pump strategy scope by utilizing the Part Item Database and collaborating with engineers to ensure an accurate scope as well as a 60% increase in the aftermarket opportunity
- Developed a SQL script that streamlined data collection processes by 99%, which created real-time visibility on contracts requiring strategic changes and diversification of Boeing's supply base

General Mills **Buffalo, NY**
Logistics Management Associate Intern *May 2017 – Aug 2017*
- Revitalized the detention report in RedPrairie, the warehouse management system, by manually dispatching over 150 inbound trailers to ensure data accuracy, which resulted in $60,000 in annual detention savings for the Buffalo plant
- Pioneered a new design to streamline communication across 3 shifts, resulting in over $35,000 in employee overtime cost savings by enhancing the trailer unloading procedure for production
- Conceptualized the future yard layout by utilizing Microsoft Visio, and created a training program to educate the guards on the proper process on checking-in and dispatching trailers in RedPrairie to increase the visibility and accuracy of the yard

Kimberly-Clark Corporation **Neenah, WI**
Data Visualization Analyst Co-op *Jul 2016 – Dec 2016*
- Remodeled a Python script, which reformatted over 150 Excel documents containing 1 year of sales data, resulting in quicker data manipulation and identification of sales bias in trade dollars
- Established a Tableau Category Management 301 training course by mastering features of the software and creating computer-based trainings, which allowed category management to increase sales by $500,000
- Directed monthly meetings to 8 Senior Managers to update and display the progress of constructing logistical, demographical, store, and sales workbooks in Tableau to guarantee a smooth company-wide roll out of the Tableau software

Seko Medtec **State College, PA**
Accounts Payable Intern *May 2015 – Apr 2017*
- Reviewed and processed accounts receivable from 50 different companies and generated invoices for 8 different companies by Seko's tariff agreement to ensure proper payment to agents
- Instructed new personnel on the practices of checking different companies' charges and calculating reverse invoice companies, and provided recommendations to increase productivity in Seko Medtec's department

LEADERSHIP EXPERIENCE

Alpha Kappa Psi Co-Ed Professional Business Fraternity **University Park, PA**
THON Liaison of Recruitment *Sep 2015 – Present*
- Cooperated with a recruitment class of 28 to plan professional, philanthropic, fundraising, and social events to increase the unity between the recruitment class and the brotherhood of over 100 members
- Publicized weekly announcements to the pledge class regarding what the Penn State Dance Marathon (THON) chairs of the fraternity were planning while contributing to a fundraiser that raised 10% of the fraternity's $39,740 to end pediatric cancer

Penn State IFC/Panhellenic Dance Marathon **University Park, PA**
Supply Logistics Captain Committee Member | Inventory Coordinator *Sep 2017 – May 2018*
- Communicated with 4 other captain committees on a monthly basis to provide donation requests and inventory on hand statuses, ensuring that the fundraising events such as the THON 5K and Family Carnival were efficiently supplied
- Implemented a new inventory management system with the assistance of 5 other co-captains, which used a coded numeric system to identify proper item placement within the storage facility, resulting to an increased inventory accuracy of 80%

Dancer Relations Committee Member | Recycling Chair (2015), Weekend Warrior (2016) *Oct 2014 – May 2016*
- Provided exceptional, emotional, and physical support to a fundraising dancer who stood for 46 hours without sitting or sleeping to raise money for the fight against pediatric cancer

HONORS, SKILLS, AND INTERESTS

Honors: Dean's List
Skills: Proficient in Microsoft Office products (Excel, PowerPoint, Word), SQL, Tableau
Interests: College Football, Family, FIFA, Golden Retriever puppies, Green Bay Packers, Lifting, Personal development books