Hochschule für
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Term paper

ANALYZING THE SUPPLY CHAIN NETWORK OF A DOOR CONSULTING COMPANY

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1. Introduction

In the highly competitive door construction industry, efficient supply chain management is crucial for maintaining market leadership and ensuring customer satisfaction. Door Consulting, a company with operations in Italy and Switzerland, is facing several operational and strategic challenges. To address this, Doors has employed a group of consultants to help them create a digital twin of their supply chain and analyze possible changes that would help Door's future operations. The consulting group has employed AnyLogistix software, known for its state-of-the-art supply chain design capabilities. AnyLogistix provides solutions to various decision-making problems in real-world logistics systems through its optimization and simulation capabilities (Ivanov, 2020). The software aids in facility location planning, capacity planning of distribution centers, inventory control policies and ordering rules, sourcing policies (single or multiple), transportation policies (less than truckload LCL, and full truckload FCL), and Bullwhip and Ripple effect analysis in the supply chain.

This report presents an analysis of Door Consulting's supply chain, identifies key problems, and outlines data parameters and assumptions, experiment and results (GFA, NO, SIM, Comparison and Variation experiments) to guide the improvement process. The findings are listed in the Table of content and are broken down into categories based on the order of GFA, NO, SIM, Comparison and Variation, with the Managerial recommendations at the end of the report.

2. Case overview

This case study examines Door Consulting, utilizing AnyLogistix software for analysis. Door Consulting operates with a supplier based in Italy and a manufacturing facility in Switzerland. The company serves a substantial customer base of 50 clients spread across Austria, France, Belgium, Germany, and the Netherlands. Germany stands out as the primary market, driving the highest sales and characterized by strong pricing and competitive pressures.

The objective of this study is to perform Green Field Analysis (GFA), simulation, and optimization to enhance the distribution network and lower costs through better inventory management.

Currently, Door Consulting manufactures various door types, including Fancy, Metallic, and Pet Doors, in Curaglia (Medel), Switzerland. Raw materials are transported by truck from Italy. Figure 1 illustrates the existing supply chain network.

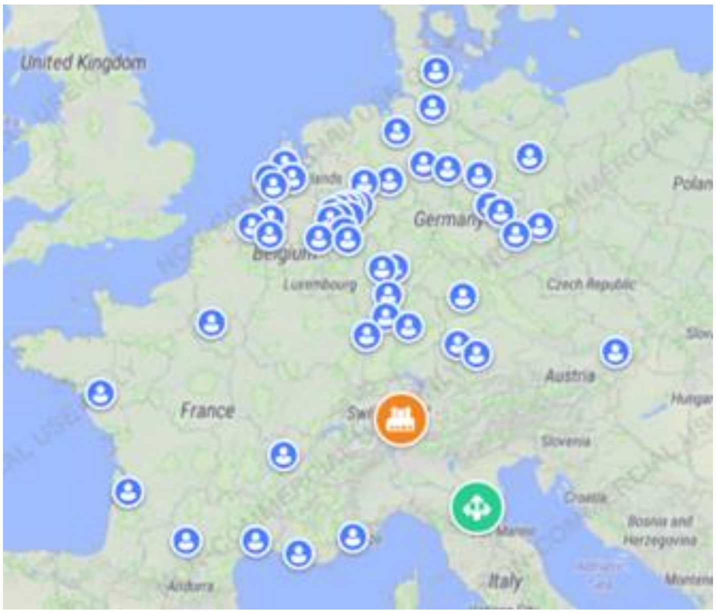

Figure 1. Current supply chain network of Door Consulting

3. Problem Statement

Door Consulting is currently facing significant operational challenges that threaten its efficiency and market competitiveness. With only one supplier and a single production facility, the company's supply chain infrastructure is limited, necessitating the establishment of new warehouses. By conducting a Green Field Analysis, Door Consulting aims to identify optimal locations for these warehouses to enhance storage capabilities and streamline logistics.

The German door market, being the company's primary revenue source, presents intense competitive pressures that have resulted in declining production rates. To counteract this, Door Consulting must develop innovative strategies to enhance product differentiation, quality, and market appeal, ensuring sustained growth and market presence.

Furthermore, the company's extended delivery routes lead to inflexibility in meeting customer demands, contributing to delays and potential customer dissatisfaction. The door construction industry's susceptibility to supply chain disruptions—stemming from raw material shortages, transportation delays, and geographical issues—compounds this problem. Therefore, building a more resilient and efficient supply chain network is imperative to mitigate these risks and maintain reliable product delivery.

Addressing these challenges through strategic infrastructure development, competitive differentiation, and supply chain resilience is crucial for Door Consulting's continued success and market leadership.

4. Data parameters and Assumptions

To facilitate the analysis and streamline the complexity of the problem, several assumptions and data parameters have been established:

- **Currency and Unit Measures**:

All costs and profits are calculated in USD.

The unit of product status is measured in pieces (pcs).

- **Transportation Specifications**:

The capacity of a single truck load is 50 pieces.

The type of shipment is exclusively by truck, with an average speed of 50 km per hour.

- **Transportation costs are defined as follows:**

From supplier to factory: 0.05 USD per pcs.

From factory to distribution center (DC): 1 USD (fixed delivery cost).

From DC to customer: 0.02 USD per pcs.

- **Production Costs:**

Fancy door model: 50 USD per pcs.

Metallic door model: 25 USD per pcs.

Pet door model: 5 USD per pcs.

- **Product Data:**

The bill of materials (BOM) and product data are detailed in Table 1.

- **Seasonal Demand Periods:**

Two seasonal periods are considered:

Summer: From January 1, 2024, to August 31, 2024.

Winter: From September 1, 2024, to April 9, 2025.

- **Demand coefficients are:**

Summer: 1.35

Winter: 1.0

The demand coefficient indicates here the relative increase or stability in demand for door products during different seasons. A coefficient of 1.35 during summer means that demand is 35% higher compared to the base level. In contrast, a coefficient of 1.0 during winter signifies stable demand, with no increase or decrease from the base level.

Table 1. Product data

Name of the products	Unit	Selling price	Cost	Currency
Components (raw materials)	pcs	2	1	USD
Metallic Door Model	pcs	25	20	USD
Fancy Door Model	pcs	70	60	USD
Pet Door Model	pcs	7	6	USD

5. Experiments and Results

5.1.Green Field Analysis (GFA)

One of the numerous analytical possibilities of Anylogistix is establishing the optimal location for the installation of distribution centers (DCs) through Greenfield Analysis (GFA), also known as Center of Gravity Analysis. GFA aims to identify the best locations for new DCs or facilities by considering the locations of current or potential customers, the distances between DCs and customers, and the demand for the company's products. The objective is to find locations that meet customer demand at the lowest possible cost. To determine the ideal location for a DC, customer distances from the warehouse are calculated and weighted according to their respective demands (Ivanov et al., 2017).

Understanding where DCs should be located is a crucial first step in designing supply chain networks, as it generates optimal location options. In this project, we are focusing on optimizing the product range for a major European construction company. Our goal is to enhance the efficiency and competitiveness of the company's product range by identifying the best standards for new DCs.

Accurate data entry is essential as it provides the model with the necessary information to make precise calculations and predictions. The next step involves performing the GFA experiment and analyzing the results over a specified period. Several critical aspects need to be considered when conducting a GFA experiment.

Through the GFA experiment, we can answer important questions and determine the best options for our company.

After running the GFA experiment, we gain a comprehensive understanding of the optimal coordinates for the new DC. By accurately determining these coordinates, the GFA experiment identifies the most strategic location for the new DC, thereby minimizing transportation costs and improving the overall efficiency of the supply chain.

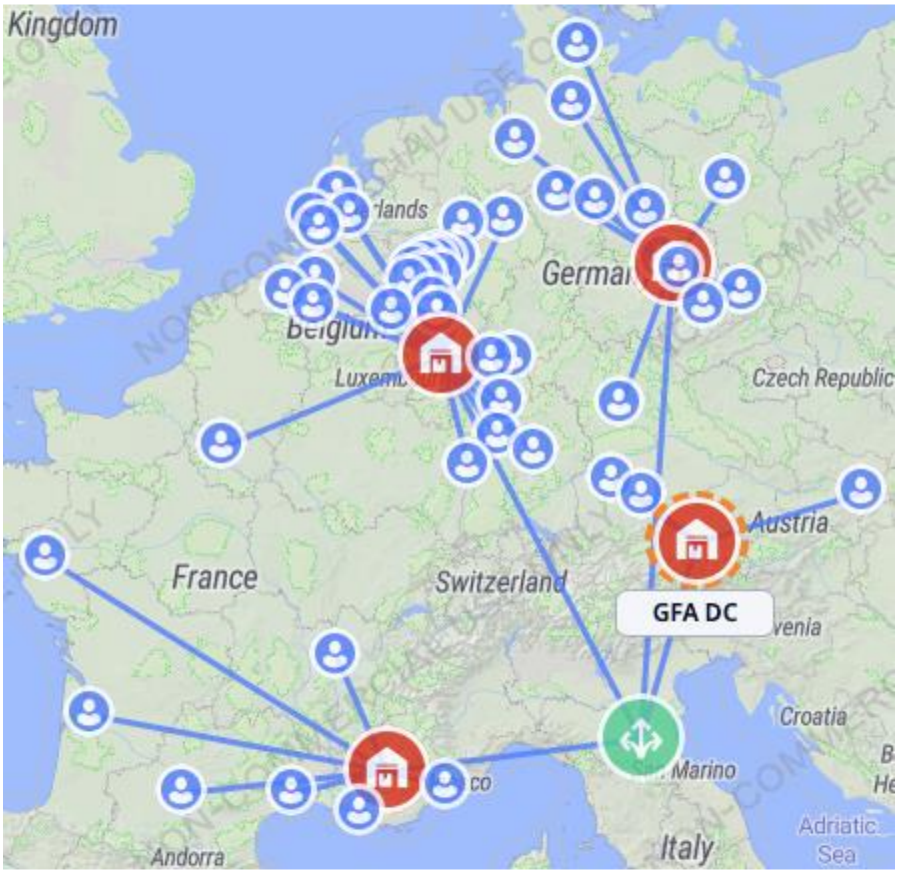

Figure 2. Recommended location for distribution centers by Anylogisitx.

By accurately determining these coordinates, the GFA experiment identifies the most strategic location for the new distribution center. For our model, we conducted the GFA for various potential sites to determine the optimal number of locations that would minimize our costs. Table 2 below presents the results of our model for different numbers of locations (sites). After aggregating all the costs and analyzing the data from the statistics flow in the Excel file, it is evident that having four locations results in the minimum total cost.

Table 2. Comparison of the total cost associated with the number of sites

Number Of Site	Total cost
GFA DC 1	$ 75,001,851,364
GFA DC 2	$ 69,014,120,094
GFA DC 3	$ 65,452,476,908
GFA DC 4	$ 59,656,866,677
GFA DC 5	$ 93,784,423,135

AnyLogistix's Greenfield Analysis (GFA) helps us determine the optimal coordinates for the new distribution center (DC). To achieve this, we utilize the statistical data of potential new locations. In this project, the optimal coordinates for the new DC are a latitude of 47.445 and a longitude of 12.749 which is in Austria. This implementation is expected to be more effective in minimizing transportation costs, optimizing supply chain performance, and analyzing new placements in AnyLogistix.

Table 3. Results of gravity analysis for one, two, three and four optimal distribution centers.

Name	Latitude	Longitude
DC Austria	47.445	12.749
DC Germany	51.428	12.22
DC Belgium	50.155	7.139
DC France	43.965	5.915

To determine the maximum and minimum distances between the optimal distribution center (DC) location and a customer, we analyzed the distances by demand statistics. This analysis provided insights into the varying distances between the new DC location and customers. By examining these distances, we identified both the maximum and minimum distances, ensuring that the selected location is optimized for efficient service.

The analysis revealed that the maximum distance between the DC France optimal location and Nantes customer is 684.756 km. Conversely, the minimum distance to reach a customer from the location DC Germany is the Leipzig Costumer with 14.39 km.

Table 4. The maximum and minimum distance to a Costumer from the optimal DC's

GFA DC to Costumer	Max. Distance	Min. Distance
DC Germany to Leipzig Costumer		14.39
DC France to Nantes Costumer	684.756	

By comparing the data from AnyLogistix, we gained a comprehensive understanding of the situation. To ensure that we are meeting all customer needs from the optimal distribution center (DC) location, we compared data from the "Flow" statistics and the "Demand" table. This comparison confirmed that total flows is not equal total demand. Indicating that all customer demands are not met.

Table 5. Comparison Statistica between the “Product Flow” and “Distance coverage by Demand”.

Total Product Flow	Total Demand
222.411.546	611.631.752

However, while selecting the optimal location in the GFA, we identified that several important costs were not considered. These include fixed facility costs, inventory holding costs, and processing costs. These costs were not included in the GFA analysis and should be considered for a more comprehensive cost assessment.

5.2. Network Optimization

5.2.1. Introduction about Network optimization

Supply chain network optimization aims to determine the most efficient combination of factories, distribution centers and their connections within the supply chain [(1)]. This process involves not only balancing supply and demand but also configuring the network by positioning facilities and optimizing transportation flows to minimize costs. Network Optimization will provide a detailed analysis of various supply chain designs - encompassing different possible flows and facilities - so that the company can assess and compare them to choose the best one that maximizes profitability (Ivanov, 2020). This solution is invaluable for managers making decisions related to supply chain network configuration.

This phase leverages a wide range of information, including demand, supplier locations, customer locations, existing and potential facilities, transportation flow, fixed or variable costs of distribution centers, transportation costs, time periods, and inventory storage. To produce insights. The output of the network optimization includes the values of transportation flows, production, and storage at each time period, along with the associated costs so that company can achieve a better inventory management, route planning, improved transportation time, leading to the increased efficiency as well as enhanced customer satisfaction.

5.2.2. Configuration of Network optimization

In order to ensure a comprehensive analysis, various factors are taken into account, including product storages, different type of costs. that are displayed in the Table 6:

Table 6, Configuration of Network optimization

Type	Value (USD)	Time unit	Product unit
DC (Site): Other costs	10000	day	
DC (Site): Carrying cost	1	day	pcs

DC (Site): Processing cost for all products (Inbound shipment)	8		pcs
DC (Site 2): Other costs	11000	day	
DC (Site 2): Carrying cost	1.5	day	pcs
DC (Site 2): Processing cost for all products (Inbound shipment)	8		pcs
DC (Site 3): Other costs	12000	day	
DC (Site 3): Carrying cost	0.5	day	pcs
DC (Site 3): Processing cost for all products (Inbound shipment)	8		pcs
DC (Site 4): Other costs	13000	day	
DC (Site 4): Carrying cost	1	day	pcs
DC (Site 4): Processing cost for all products (Inbound shipment)	8		pcs
Factory: Other costs	9000	day	
Factory: Carrying cost	1.5	day	pcs
Factory: Processing Cost for all products (Outbound shipment)	6		pcs
Factory: (per door: Fancy Door Model 1)	50		pcs
Factory: (per door: Metallic Door Model 1)	25		pcs
Factory: (per door: Pet Door Model 1)	5		pcs
Supplier 1: Processing cost for component (Outbound shipment)	5		pcs
Path: From supplier to factory	0.05 x product (pcs) x distance		
Path: From factory to DC	1		vehicle
Path: From DC to customer	0.02 x product (pcs) x distance		

The rental costs for facilities of DCs and factory are also included in “Other costs”, and it is calculated per day [9]. About transportation, only the route from factory to DC accepts FTL, other routes still accept LTL. The reason for this is that there is always inventory stored in the DC, so waiting until the goods accumulate to a full truckload before moving them to the DC will help to achieve cost efficiency and faster transit times. Besides, for deliveries from DC to customers, because orders are often not sufficient to fill full one vehicle, using LTL allows company to consolidate different customers' orders into a single truckload, optimizing delivery routes and reducing costs.

5.2.3. Running Network optimization (NO)

The supply chain manager at Door Consulting decided to conduct network optimization experiments to identify the most profitable supply chain design, incorporating the solutions from the Green Field Analysis (GFA). Some supply chain locations suggested by the GFA were reevaluated, considering additional factors such as the availability of warehouses for rent, construction costs for new warehouses, fixed costs, infrastructure, and future demand forecasts.

After inputting all the required data related to costs, paths, and other relevant factors, the network optimization yielded four possible path network combinations/iterations, as shown in Table 7:

Table 7. Possible path network combinations/iterations

Description	Flow amount	Profit ((NetOpt)
Iteration 1: Site, Site 2, Site 3, Site 4, Site 5	199,415,009.25	2,193,483,550.443
Iteration 2: Site, Site 2, Site 3, Site 5	199,415,009.25	2,186,982,955.616
Iteration 3: Site, Site 2, Site 4, Site 5	199,415,009.25	2,178,719,683.582
Iteration 4: Site, Site 2, Site 5	199,415,009.25	2,172,219,087.755

In this result, the flow amounts are consistent across all iterations because of the stable and fixed demands of all customers. In other words, each iteration requires the same quantity of goods. However, the profitability of each iteration differs significantly. The reason for this variability belongs to different routes and costs among all iterations, such as transportation cost, costs relating to objective members that are also the costs that have the greatest impact on profit fluctuations.

Table 8. Cost of all possible supply chain designs in Network Optimization

Iteration	Transportation cost	Objective
1	-1,680,612,741.557	2,193,483,550.443
2	-1,689,986,336.384	2,186,982,955.616
3	-1,698,028,608.418	2,178,719,683.582
4	-1,707,402,204.245	2,172,219,087.755

a. Analysis of the Current Supply Chain Design

As shown in Table 8, the current design (Iteration 4) yields the least profit, amounting to $2,193,483,550.443, among all iterations. This indicates that the existing supply chain (SC) design is not optimized, leading to significant inefficiencies that negatively impact profitability.

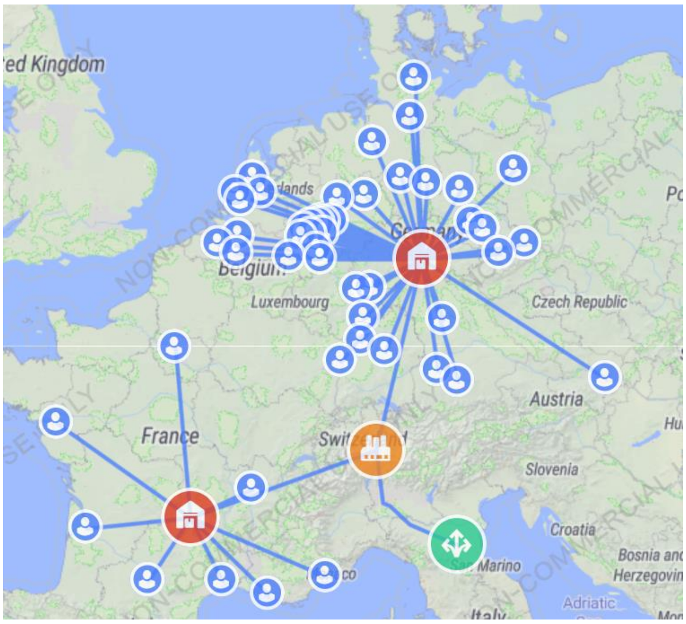

Figure 3. Current supply chain design

It is clearly seen from the Figure 3 that the current scenario, the distribution center (DC) in Germany (Site) handles a large number of customers, primarily concentrated in Germany and surrounding countries. Meanwhile, the DC in France (Site 2) serves customers mainly in France and some neighboring areas. This setup results in each DC, especially the one in Germany, managing a very high volume of goods. This can lead to overutilization issues or capacity constraints, such as higher transportation costs from the DC to customers, longer lead times, and other inefficiencies. These factors are likely the main reasons why the current scenario is becoming ineffective.

b. Analysis of a More Optimized Supply Chain Design

Given the challenges faced by the current scenario, running network optimization can help determine if a better scenario exists. According to Table 1, the design with the highest profit is seen in Iteration 1, where all distribution centers (Site, Site 2, Site 3, Site 4) are utilized.

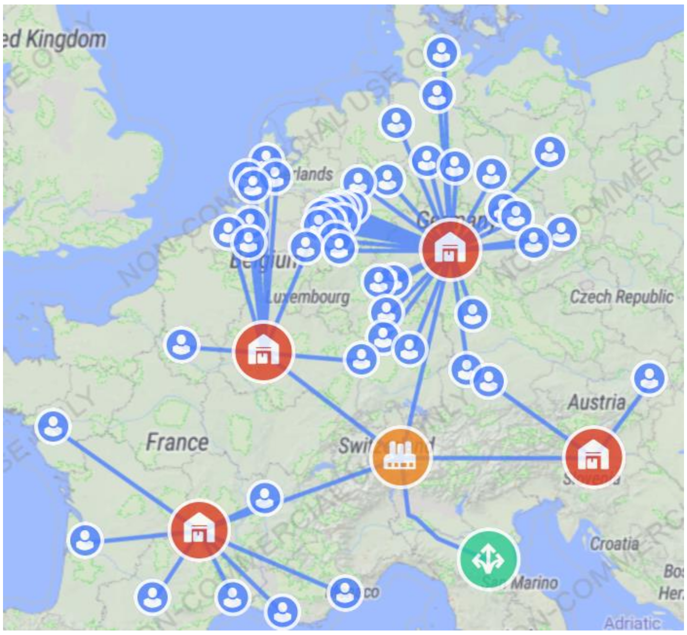

Figure 4. Optimized supply chain design

Adopting Iteration 1 means the company will open two additional DCs as Figure 4 (Site 3, Site 4) while maintaining the operations of the existing DCs (Site, Site 2). Although this iteration will incur increased operational costs for the additional DCs, the company can save significantly on transportation expenses as shown clearly in table 8, which constitute a larger portion of the total costs. Moreover, the addition of two more DCs will alleviate the workload of the existing DCs, leading to a more even distribution of goods across all DCs. This improvement can provide customers with faster delivery services and better inventory management.

By achieving a more balanced distribution, the demand for all customers will be fully satisfied, reaching 100% demand fulfillment. This means every customer's order will be completed without any shortages, ensuring maximum profitability and customer satisfaction.

5.3. Simulation

In the case of Door consulting as a result of GFA and NO we can establish that we have a Singular supplier (Supplier1) in Italy and a manufacturing facility (Factory) in Switzerland, and four different DCs (Site, Site 2, Site 3 and Site 4) in France, Germany, Belgium and Austria, respectively.

According to the sourcing policy, the distribution of customers among the DC's is as follows also shown in the figure 5:

Site 1 (France): 7 customers

Site 2 (Germany): 31 customers

Site 3 (Belgium): 10 customers

Site 4 (Austria): 2 customers

In the following Figures and Tables, we will compare results of the Comparative simulation where the company is experimenting to see if the change in KPI's when one or more DCs are removed.

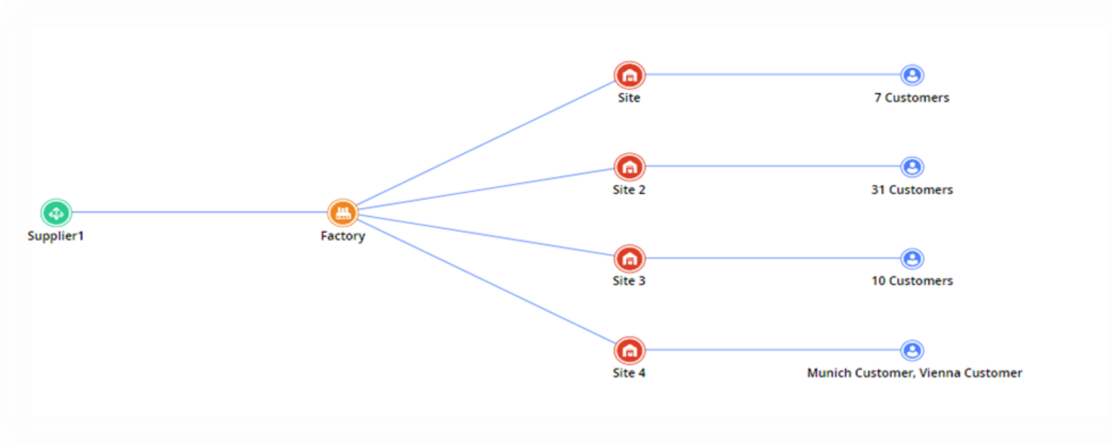

Figure 5. SCM flow hierarchy

From the analysis, it is evident that Site 2 in Germany is the most critical DC due to its large customer base. It should receive the highest level of attention regarding resources and logistical support. Sites 1 and 3 in France and Belgium, respectively, have moderate customer bases and require balanced logistical strategies. Site 4 in Austria, with the smallest customer base (2 customers), needs the least resource allocation but should not be neglected to ensure all customers are satisfied.

KPIs of Profit: Revenue – Total Cost. (Simulation Cost Original) – Case 1

Table 9. KPI of COST (profit = revenue – total cost)

Statistics	Value	Unit
Revenue	6,647,166,975	USD
Total Cost	6,251,708,818	USD
Profit	395,457,156	USD

Table 9 presents the profit KPI for Door Consulting, showing that the company generated nearly 6.65 billion USD in revenue, demonstrating a strong ability to generate sales. The company incurred approximately 6.25 billion USD in costs, highlighting substantial operational and production expenditures. We can also identify the biggest components of total cost in the table below. In this table we can see that the biggest expenses are Inventory Carrying Cost, Transportation Cost, & Production Cost. All three together make up roughly 78% of Total

Cost (4,898,680,662). Consequently, the company achieved a profit of around 395 million USD, indicating successful financial performance after covering all costs. It is important to note that at the end of the section apart from the profit and total cost we will also be comparing Service Level, with the basic configuration of the Doors Consulting Supply Chain, i.e. including all four Distribution Centers the service level by orders is at 0.99.

Table 10. Total cost breakdown (biggest expenses)

Statistics	Value	Unit
Inventory Carrying Cost	1,461,718,526	USD
Transportation Cost	1,672,689,930	USD
Production Cost	1,764,272,206	USD

KPI of Available Inventory Including Backlog (case 1 – Simulation original)

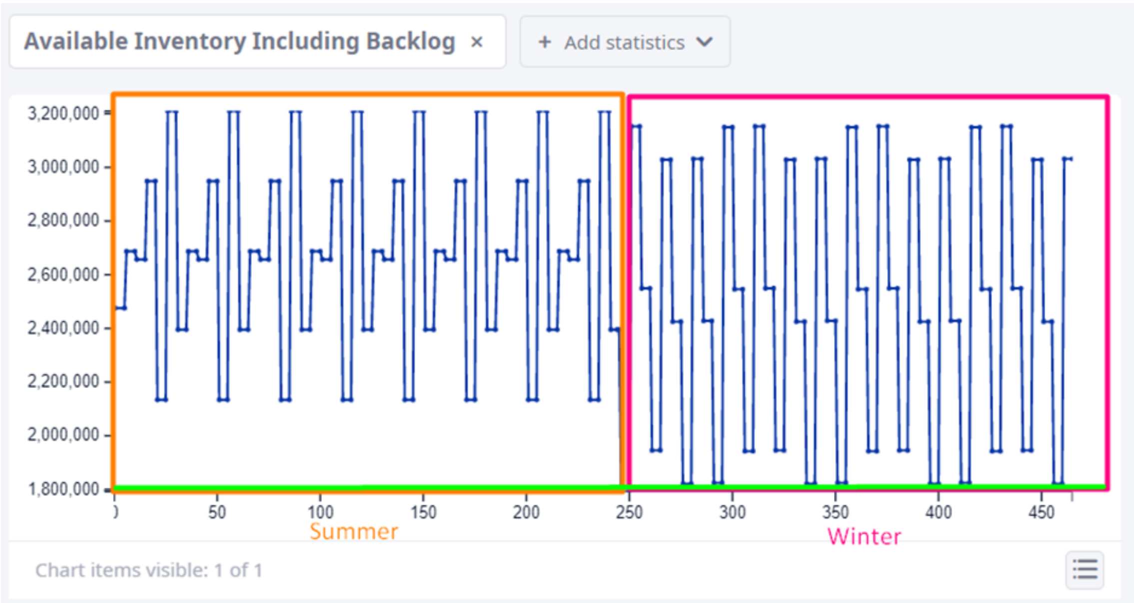

Figure 6. Available Inventory Backlog – Simulation original

The above graph illustrates the available inventory backlog for all four sites DCs, the inventory policy followed is a Min-Max policy where the minimum value as shown in a green line is 1600 and the maximum value of inventory is 3200. We can observe two different patterns that can be broken down into summer and winter; the demand in Summer is more consistent having symmetrical peaks and valleys in the Backlog. The peak demand during summer is 2450 pieces, and a low of 2150.

Case 2 without site 2 Germany

During our comparative simulation we decided to compare what would happen to the company's productivity and profitability when one or more Distribution center where to be closed, due to a disruption or company action. As stated previously the most important KPIs are Profit, Revenue, Total Cost & Service level by order, with this configuration the table and figures below show what would happen when the company would continue to operate without Site 2 (Germany).

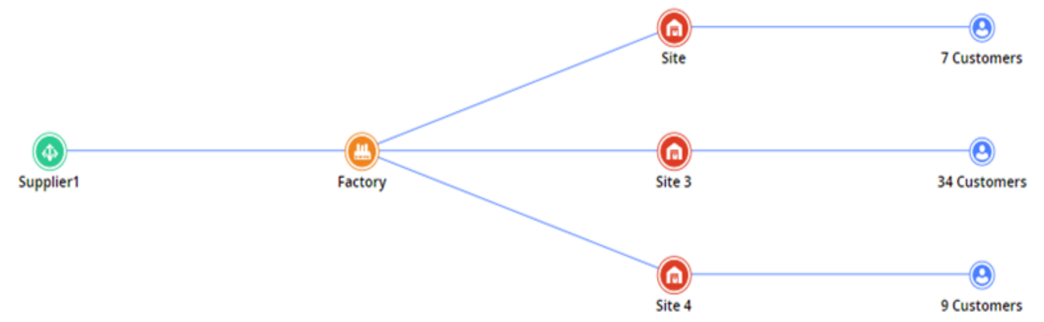

Figure 7. SCM flow hierarchy (Case 2 without site 2 Germany)

In the figure above we can see how the removal of Site 2 (Germany) has affected Doors Consulting's Supply Chain: The customers have been re-distributed making site 1 now have 7 customers, Site 3 now has 34 customers making it the most important distribution center, and finally site 4 now has 9 customers.

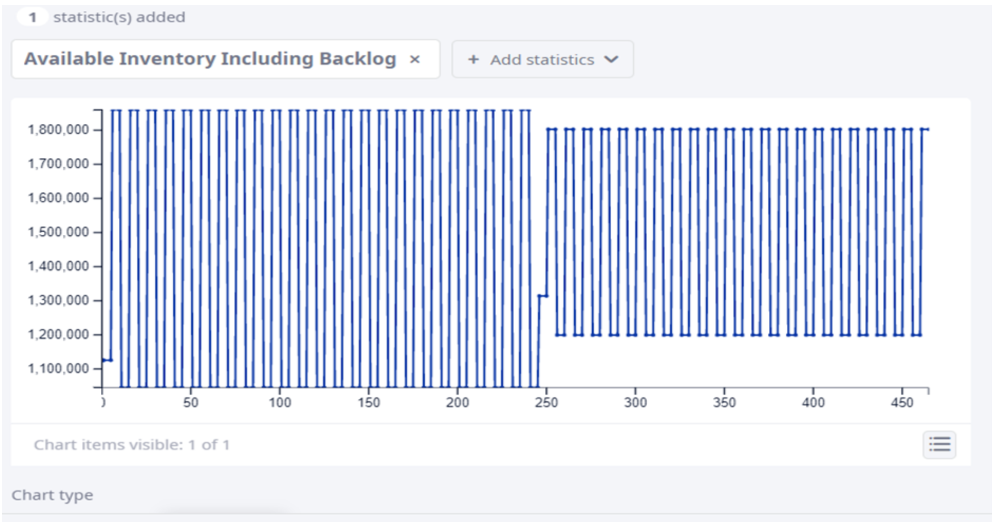

Figure 8. Available Inventory Backlog – Case 2 (Without Germany)

The graph above illustrates the available inventory backlog for the remaining Sites, here we can see how sporadic the fluctuation of Inventory is without Site 2 (Germany). The division is the same as before with the first half of the graph showing summer and the second half showing winter. We can see how the summer portion of the graph now a much higher peak and valley has than the Winter portion: In Summer the peak is 1,900,000 and a valley of 1,000,000 while in winter the peak is 1,800,000 and the valley is 1,200,000.

Table 11. KPI of COST (profit = revenue – total cost) of Case 2

Statistics	Value	Unit
Revenue	6,647,166,975	USD
Total Cost	5,679,425,608	USD
Profit	967,741,361	USD

In the table above we see the Profit breakdown after the removal of Site 2, when compared to the previous Profit breakdown, we can see that the biggest difference is the huge decrease in Total cost, 5,679 million dollars is the new total cost, almost 600 million differences. By subtracting Total cost from Revenue, we get the new Profit (Profit = Revenue – Total cost), calculating with this formula the new profit is 967,741,361, almost a billion dollars in profit. However, even with this huge increase in profit there is a considerable downside, the lowering of Service level by order: With the original configuration Doors consulting had 0.99 however with this new configuration the service level is lowered to 0.84 as shown table

Case 3 without site 3 Belgium

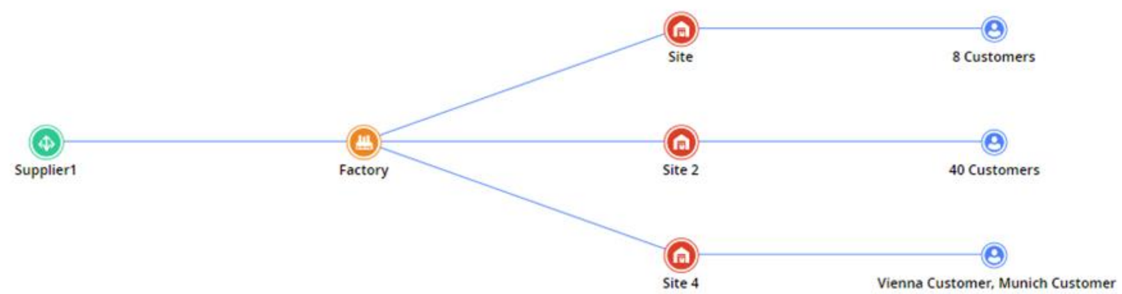

Figure 9. SCM flow hierarchy (Case 3 without site 3 Belgium)

In the figure above we can see how the removal of Site 3 (Belgium) has affected the Doors Consulting's Supply Chain: The new distribution of customers shows a significant increase in the customers that are catered to by Site 2 (now 40 customers). As compared to the last example where Site 2 was removed Site 1 has gained a single new customer, with Site 4 remaining with the same 4 customers.

Figure 10. Available Inventory Backlog – Case 3 (Without Belgium)

The graph above shows the available inventory backlog for the new DC customer configuration. With this configuration there is a now a much stabler push and pull when it comes to the summer period, with the Peaks of 2,600,000 and a valley of 1,700,000. However, the winter period is now much more volatile with the same peaks however valleys of 1,200,000.

Table 12. KPI of COST (profit = revenue-total cost)

Statistics	Value	Unit
Revenue	6,647,166,975	USD
Total Cost	6,097,393,659	USD
Profit	549,773,315	USD

As we can see with the removal of Site 3 (Belgium) there was a slight reduction in Total Cost approximately 200 million, meaning that this money will be directly moved down to our Profit line and the company will earn 549,773,315 in Profit. Although the Profit increase is not as large as the previous configuration without Site 2 the service level is much higher; with this configuration the Service level by order reaches 0.97.

Case 4 without site 4 Austria

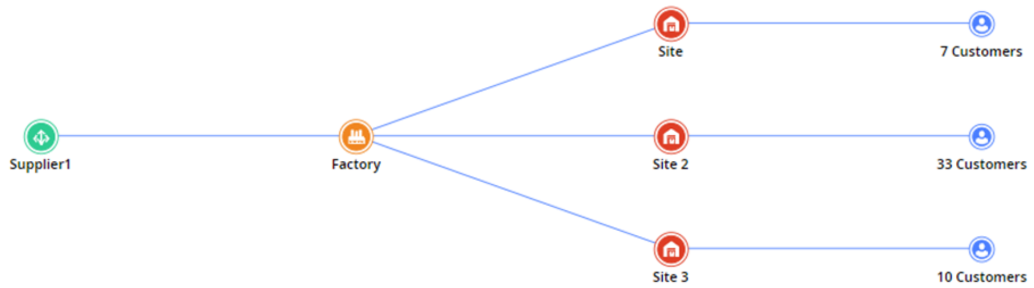

Figure 11. SCM flow hierarchy (Case 4 without site 4 Austria)

In the figure above we can see how the removal of site 4 (Austria) has affected the Doors Consulting's Supply Chain: the new customer configuration shows a much more even distribution as compared to previous models where another site was removed. Here the facility with the lowest number of customers is Site 1 with 7 customers, Site 3 following with 10 Customers and finally Site 2 our largest with 33 customers.

Figure 12. Available Inventory Backlog – Case 4 (Without Austria)

The figure above shows the available inventory backlog for DCs with this configuration, compared to previous configurations this is the one that resembles the original model. The same division between the summer period and winter period is evident in the graph.

Table 13. KPI of COST (profit = revenue – total cost)

Statistics	Value	Unit
Revenue	6,647,166,975	USD
Total Cost	6,106,727,636	USD
Profit	540,439,338	USD

In the table above, we can see the Revenue, Total Cost & Profit for the configuration without Site 4 (Austria) shows that there is very little change when it comes to the bottom line as compared to the previous configuration (just 9-million-dollar difference). However, the difference in Profit is not only difference between these two configurations: although there is 9 million dollars difference in between these configurations has the coveted 0.99 Service level by order.

Case 5 without site 2 and 4 Germany and Austria

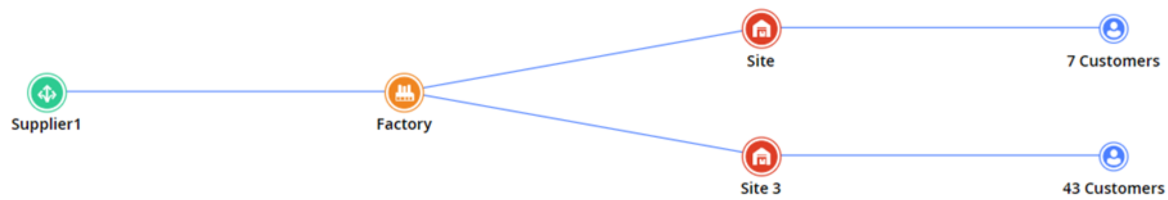

Figure 13. SCM flow hierarchy (Case 5 without site 2 and 4 Germany and Austria)

In the Figure above we can see a hypothetical configuration where Door’s consulting has decided to close both Site 2 & 4. Here we can see how dependent the company is on Site 2, without it, Site 3 must take all the customers and becomes bloated with 43 customers, with the remaining 7 going to Site 1.

Figure 14. Available Inventory Backlog – Case 5 (Without Germany & Austria)

The graph above illustrates the available inventory backlog based on the configuration, as compared to previously available inventory graphs this one has the most uniform look with regards to the change between Summer and Winter period having the same shape even when they have different peaks and valleys. With this configuration Doors consulting has an Available inventory backlog peak of 1,600,000 across both Summer and Winter periods; however, the valley during Summer is as low as 800,000 and in winter it rises to 1,000,000.

Table 14. KPI of COST (profit = revenue – total cost)

Statistics	Value	Unit
Revenue	6,647,166,975	USD
Total Cost	5,581,173,565	USD
Profit	1,065,993,409	USD

With the elimination of Site 2 and Site 4 we can see a dramatic decrease in Total Cost, which inversely correlates to Profit. The new profit is the highest calculated of all previous configurations, however it has the lowest service level for orders with a score of 0.73, far below what Doors Consulting would accept as an acceptable level.

5.4. Comparison Experiment

Table 15. Comparison of all cases of simulation

Iteration	Description	Profit	Total Cost	Service level by orders
Case 1	Simulation Costs (1)	395,457,156	6,251,708,818	0,99
Case 2	Simulation Costs No Site 2	967,741,361	5,679,425,608	0,84
Case 3	Simulation Costs No Site 3	549,773,315	6,097,393,659	0,97
Case 4	Simulation Costs No Site 4	540,439,338	6,106,727,636	0,99
Case 5	Simulation Costs No Site 2 and 4	1,065,993,409	5,581,173,565	0,73

In the comparison experiment a study has been performed using AnyLogistic to understand the impact of distributions and change in network of the supply chain scenario to the key KPI parameters like total cost, profit and service level by orders. The ideal case of the five cases can be considered as case 4 (simulation cost without Site 4 DC in Austria) because in the initial case Site 4 has only 2 customer which can add additional expenses such as operating cost, operating cost & transportation cost; and although its service level by order is at a desirable level (0.99) the profit is significantly lower than any other experiment. When it comes to Case 2 there is a significant increase in profit, however there is also a significant decrease in service level by order (0.84). In Case 3 there is a higher balance between profit and Service level: 549 million in profit and 0.97 in Service level by profit, however Door's consulting doesn't want to decrease its service level by orders from its original configuration in Case 1. In Case 4 Doors finds a balance between the increase in profitability and Service level by order: as compared to Case 3 it has a decrease in Profit of 9 million, however it increases the service level by the remaining 0.02 reaching the desired level (0.99). When it comes to Case 5, the removal of two DCs (Site 2 & Site 4) has by far the highest profit out of all the other Comparison experiment Cases however its service level by orders is the lowest (0.73)

5.5 Variation experiment

Variation experiments involve a series of simulations where a single scenario is run by iterating one or more parameters. This process helps in understanding the performance of indices.

Use Cases for Variation Experiments:

1. Parameter Impact Verification:

- To verify how changing a certain parameter value in a scenario can affect the supply chain.
- Variation experiments automatically adjust the required parameter, run the simulation for each variation, and provide easily comparable results. This is more efficient than comparing results from multiple scenarios with different settings.

2. Stochastic Parameter Impact:

- To verify how a stochastic parameter in a scenario will affect the supply chain.

In simulations conducted with Door Consulting, the MIN parameter for Distribution Centers (DCs) is varied. Specifically, the minimum reorder point is set at 100,000 and the maximum reorder point at 200,000 with steps of 5,000. This variation is performed over a period of one year.

The Table below shows the variation experiment results. It can be observed that the performance of the supply chain varies with change in minimum inventory or reorder point. We can see that Iteration 1 and 2: Both iterations have a minimum order quantity of 100,000 and 105,000, respectively, with identical total costs of 6,141,653,718 and a service level by order of 0.94. Iteration 8: This iteration considers a higher minimum order quantity of 135,000, resulting in a higher total cost of 6,251,709,768 and an improved service level by order of 0.99. Iteration 21: This iteration has the highest minimum order quantity of 200,000, with a total cost of 6,240,433,768 and the highest service level by order of 1.0.

Table 16. Variation Experiment result

Iteration	Description	Total cost	Service Level by Order
1	Min 100,000	6,141,653,718	0,94
2	Min 105,000	6,141,653,718	0,94
8	Min 135,000	6,251,709,768	0,99
21	**Min 200,000**	**6,240,433,768**	**1**

6. Managerial recommendations

6.1.Recommendation based Supply Chain Design

Green Field Analysis (GFA) Results:

The analysis confirmed that establishing four distribution centers (Germany, Austria, France and Belgium) results in the lowest total cost. Implementing these optimal coordinates is crucial for achieving significant cost efficiencies and improving service delivery times. It is also important to consider the biggest flaw in Door's Supply chain:

being reliant on a single supplier, for further improvement in resilience it would be wise to investigate other possible suppliers.

Network Optimization:

From our network optimization process, Iteration 1, comprising sites 2, 3, 4, and 5, has been identified as the most profitable configuration with a net profit of $2,193,483,550.44 Adopting this configuration will maximize our profitability. The detailed cost analysis highlighted the critical impact of transportation and processing costs on overall profitability. By selecting the most cost-effective routes and optimizing the number of DCs, we can substantially reduce operational expenses.

Simulation Results:

Simulations across various scenarios have demonstrated that Case 4, which excludes the site in Austria, shows improved inventory management and reduced backlogs. This indicates that consolidating operations and minimizing the number of sites can lead to better inventory control and lower holding costs. Case 4 also has the highest profit when compared to the 0.99 service level by order. Our simulations underscore the importance of building a resilient supply chain. We should reduce dependence on single points of failure, such as a single production facility and supplier, to mitigate risks associated with supply chain disruptions.

Additional Recommendations for Supply Chain Improvement

Diversification of Suppliers:

We must mitigate risks by diversifying our supplier base, reducing our reliance on a single supplier, and ensuring a more resilient supply chain. This strategy will help us avoid raw material shortages and transportation delays.

Technology Integration:

AnyLogistix Software: Continual use of AnyLogistix will enable us to optimize and simulate various supply chain scenarios, facilitating data-driven decisions for ongoing improvements.
Digital Twin Technology: Implementing digital twin technology will create a virtual model of our supply chain, aiding in real-time monitoring, predictive analysis, and proactive decision-making to enhance performance. (8)
Improved Transportation Management:
Optimizing transportation routes with advanced logistics software will ensure the selection of the most efficient paths, reducing fuel costs and delivery times. GPS tracking and route optimization tools will further enhance transportation efficiency.

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