

UE 4 - Logistique et Gestion de la Supply Chain

UE 4 - Logistics and Supply Chain Management

Module 4.3 - Modélisation & optimisation de la Supply Chain
Module 4.3 - Supply chain modelling and optimization

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Case study 1

Polarbear Bicycle has been newly founded as an e-commerce start-up selling bicycles. Polarbear's portfolio includes four different types of bicycles: x-cross, urban, all terrain, and tour bicycles. Polarbear needs to find a good location for a new distribution center (DC). First, they estimate customer demand. Polarbear distributes their bicycles to four locations throughout Germany: Cologne, Bremen, Frankfurt am Main, and Stuttgart.

Customer	Bicycle Type	Demand per day
Cologne	x-cross	2
Cologne	urban	50
Cologne	all terrain	15
Cologne	tour	10
Bremen	x-cross	7
Bremen	urban	30
Bremen	all terrain	20
Bremen	tour	20
Frankfurt am Main	x-cross	6
Frankfurt am Main	urban	5
Frankfurt am Main	all terrain	4
Frankfurt am Main	tour	5
Stuttgart	x-cross	15
Stuttgart	urban	15
Stuttgart	all terrain	1
Stuttgart	tour	40

Polarbear Bicycle has hired a consulting firm to analyze supply and distribution network alternatives and to develop a best-case scenario for Polarbear Bicycle. They are charged with conducting a GFA to determine the possible location of a new DC in Germany, as well as a network optimization to compare several options for network paths. The consulting firm was also asked to run a simulation to validate several KPIs and plan inventory, and to conduct a sensitivity analysis to verify all results as well.

Task 1 - Greenfield Analysis (GFA) for Facility Location Planning: Selecting the Best Warehouse Location for Polarbear Bicycle

The aim of this GFA is to determine the optimal location of one new DC in Germany subject to total minimum transportation costs.

Creating an ALX model:

Step 1. Open scenario PB GFA Level 1.

Step 2. Check the tables Customers, Demand, and Products.

Performing experiments:

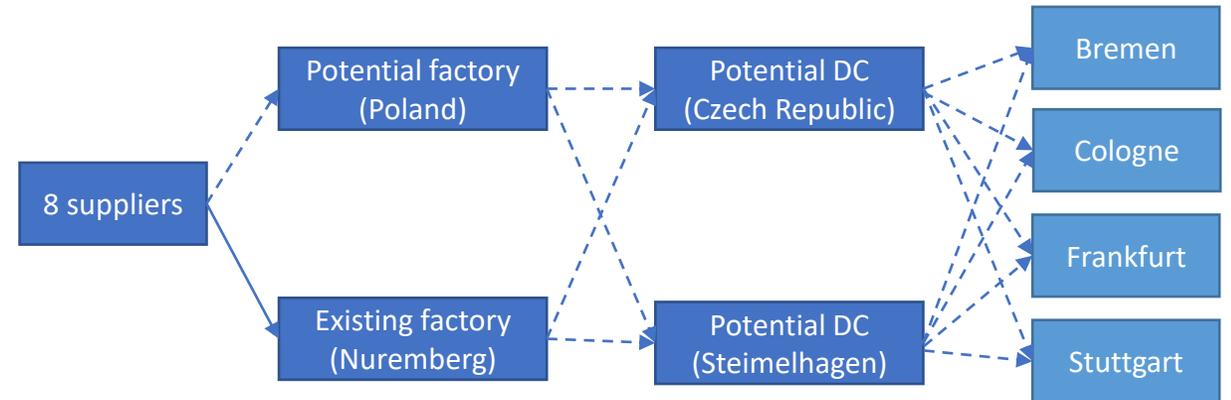
Step 1. Go to GFA Experiment and run it for “Number of sites = 1” and the period of two months.

- a) What are the optimal coordinates of the DC?
- b) What is the maximum distance from the optimal DC location to a customer?
- c) What is the minimum distance from the optimal DC location to a customer?
- d) What are the total costs of the SC? (Note: to compute the sum of costs or flows in GFA Results, just slightly drag the heading of the column “Period” or “From” in table “Product flows” in the space over the table).
- e) Compare the data in statistics “Flows” and Table “Demand”. Do we satisfy all customer demand from the optimal DC location?
- f) What other costs were not considered in selecting the optimal facility location in the GFA?

Task 2- Network Optimization (NO) for Facility Location Planning: Comparing Polarbear's Supply Chain Design Alternatives

After selling the bicycles from the newly established DC according to the GFA results, Polarbear decided to produce their own bicycles. Their production facility has now been established in Nuremberg and 250 bikes are produced each day. Recently, they have received an offer from a Polish production factory to rent a DC in the Czech Republic at a reasonable price. The same company also wants to offer them rental of a factory in Warsaw, Poland, even though they already have one factory in Germany. Polarbear must now decide which SC design is more profitable:

- Option 1: DC in Germany and Factory in Germany
- Option 2: DC in Germany and Factory in Poland
- Option 3: DC in Czech Republic and Factory in Poland
- Option 4: DC in Czech Republic and Factory in Germany



The aim of the NO is to determine which network design is optimal based on Polarbear's selected KPIs, e.g., profit.

Therefore, the factory in Warsaw, Poland, the DC in the Czech Republic, and the DC in Steimelhagen were added as inputs to the model along with the Nuremburg factory. To enable the model's calculation, the reality of the case must be simplified: all demand is assumed to be deterministic without any uncertain fluctuations. To define the two-stage NO problem (transport between factories and DCs and between DCs and customers) from a mathematical perspective, several parameters must be input as data.

Cost	Value in USD
Factory Nuremberg: fixed (other) costs, per day	15,000
Factory Poland: fixed (other) costs, per day	5,000
DC Germany: fixed (other) costs, per day	15,000
DC Germany: carrying costs (per bicycle)	3.00
DC Czech Republic: fixed (other) costs, per day	5,000
DC Czech Republic: carrying costs	2.00
DC Germany: processing costs (inbound and outbound shipping per pcs)	2.00
DC Czech Republic: processing costs (inbound and outbound shipping per pcs)	1.00
Factory Nuremberg: production costs (per bicycle)	250
Factory Poland: production (per bicycle)	150
All bicycles: product purchasing costs	30
Transportation costs; Paths: from factory - to DCs	$0.01 * \text{product}(\text{pcs}) * \text{distance}$
Transportation costs; Paths: from DCs - to customers	$0.01 * \text{product}(\text{pcs}) * \text{distance}$
Unit revenue	499

The costs of the rent for the factory in Poland and the DC in Czech Republic are included in “other costs”. For transport, it is always assumed that each truckload fits 80 bicycles, and trucks travel at a speed of 80 km/h.

Creating an ALX model:

Step 1. Open scenario PB NO Level 1.

Step 2. Check data in tables “DCs and Factories”, “Facility Expenses”, “Paths”, “Processing Costs”, “Product Flows”, “Product Storages”, “Production”, “Products”, and “Vehicle Types”.

Performing experiments:

Step 1. Go to NO Experiment and run it with the Demand variation type “95-100%”.

Step 2. Analyze the results using statistics “Optimization Results”, “Flow Details”, “Production Flows”, “Demand”, and “Overall Stats”:

- a) What is the most profitable SC design?
- b) Is demand for all customers satisfied?
- c) What is the total revenue of the most profitable SC?
- d) What is total profit of the most profitable SC?
- e) Compare the data in statistics “Production Flows” and Table “Demand”. Does the production quantity correspond to the total demand?
- f) Compare the optimal SC design as computed in the NO and the initial SC design (factory and DC in Germany) in terms of profit.
- g) What other costs should be considered when redesigning the SC according to NO results?
- h) What other factors, apart from costs, should be considered when re-designing the
- i) SC according to the results of the NO?

The Polish factory would only consider annual quantities of each bicycle type within the range of 10,000 units (minimum capacity utilization) and 25,000 units (maximum capacity utilization). Polarbear must now conduct another NO to include this additional capacity constraint.

Creating an ALX model:

Step 1. Open scenario PB NO Level 1 Constrained.

Step 2. Check data in table “Production” in the columns “Min Throughput” and “Max Throughput”.

Performing experiments:

Step 1. Go to NO Experiment and run it.

Step 2. Analyze the results using statistics “Optimization Results”, “Flow Details”, “Production Flows”, “Demand”, and “Overall Stats”:

- a) What is the most profitable SC design considering the capacity constraint of the factory in Poland?
- b) What is the total profit of the most profitable SC?
- c) Compare the optimal SC design with the capacity constraint, as computed in the second NO, and the optimal SC design without the capacity constraint, as computed in the first NO experiment, in terms of profit.
- d) Which differences between solutions in incapacitated and capacitated scenarios can be observed? Explain.

Task 3 - Simulation: Dynamic analysis of the Polarbear's supply chain design

Analysis are extended by adding the following features:

- transit from flows (as in NO) to orders, i.e., the customer demand is no longer considered an aggregated flow during a period, but it is now generated as orders at certain intervals, e.g., 10 bicycles every day.
- introduce inventory control to manage ordering processes.
- introduce sourcing policies (e.g., single vs. multiple sourcing) to manage replenishment processes.
- introduce shipment control (LTL/FTL) to manage shipment processes.

First, simulate the SC with two factories in Poland and Germany and a DC in the Czech Republic subject to customer demand from the GFA exercise and the following data.

Object	Inventory Policy		Expected Lead Time (ELT), days	Transportation Time, days	Production Time per Unit, days	Sourcing Policy	Transportation Policy
	Min	Max					
Factory Ger many	50	100		2	0.1		LTL
Factory Poland	50	100		2	0.07		LTL
DC Czech Re public	50	100		2		Closest dynamic	LTL
Customers			5				

For the DC and the factory, three inventory policies have to be developed. Assign the DC and factories a “min-max policy” for all products, where the minimum stock is 50, the maximum stock is 100, and the initial stock is 50 bicycles.

To evaluate the simulation results, consider six KPIs according to the needs of Polarbear:

- Financial KPIs, such as profit, revenue and costs
- ELT service level by product, which is the ratio of products delivered within the expected lead time to the total ordered quantity
- Demand fulfillment (product backlog)
- Available inventory
- Production capacity utilization and Lead time.

With all of the parameters described, run the simulation for a period of one year.

Creating an ALX model:

Step 1. Open scenario PB SIM Level 1.

Step 2. Check data in tables “DCs and Factories”, “Inventory”, “Production”, “Sourcing”, and “Unit Conversions”.

Performing experiments

Step 1. Go to Simulation Experiment and run it.

Step 2. Analyze the results using the KPI Dashboard “Revenue, Profit, Costs”, “Lead Time”, “ELT Service Level”, “Production Utilization”, “Demand (Product Backlog)”, and “Average Available Inventory”:

- a) What are the profit, revenue, and costs of the SC?
- b) Is demand for all customers satisfied? Explain.
- c) What is the production utilization of factories in Poland and Germany? Explain why the German factory is utilized to 100% and the factory in Poland is utilized only to 75% even if we clearly see insufficient production quantities and the backlog?
- d) What is your judgment on the inventory dynamics in the SC?
- e) What is your judgment on the lead time?
- f) What suggestions for improvement do you have which could increase profit and customer satisfaction?

Polarbear’s SC managers suggest the following changes to the input parameters

Object	Inventory Policy		Expected Lead Time (ELT), days	Transportation Time, days	Production Time per Unit, days	Sourcing Policy	Transportation Policy
	Min	Max					
Factory Germany			5	2			LTL
x-cross	30	60			0.05		
urban	100	200			0.015		
all terrain	40	80			0.04		
tour	75	150			0.02		
Factory Poland			5	2			LTL
x-cross	30	60			0.05		
urban	100	200			0.015		
all terrain	40	80			0.04		
tour	75	150			0.02		
DC Czech Republic				2		Closest dynamic	LTL
x-cross	60	120					
urban	200	400					
all terrain	80	160					
tour	150	300					
Customers			5			Closest dynamic	

Creating an ALX model:

Step 1. Open scenario PB SIM Level 1_Improved.

Step 2. Check data in tables “Inventory” and “Production”.

Performing experiments:

Step 1. Go to Simulation Experiment and run it.

Step 2. Analyze the results using the KPI Dashboard “Revenue, Profit, Costs”, “Lead Time”, “ELT Service Level”, “Production Utilization”, “Demand (Product Backlog)”, and “Average Available Inventory”.

- a) What are the profit, revenue, and costs of the SC? Did we improve?
- b) Is demand for all customers satisfied? Explain.
- c) What is the production utilization of factories in Poland and Germany? Explain.
- d) What is your judgment on the inventory dynamics in the SC?
- e) Explain how MIN (reorder point) and MAX (target inventory) values have been computed.
- f) What is your judgment on the lead time?
- g) Explain why the changes made improved SC performance.
- h) How can you validate the simulation modelling results using the previous network optimization experiments?

Creating a Comparison Experiment:

Step 1. Open scenario PB SIM Level 1 and go to Comparison Experiment.

Step 2. Select scenarios PB SIM Level 1_Improved and PB SIM Level 1 to compare.

Step 3. Check KPI dashboard. The KPIs for a comparative analysis of two scenarios should be “Demand (backlog)”, “Profit”, and “ELT Service Level”.

Performing experiments:

Step 1. Run Comparison experiment.

Step 2. Analyze the results using the KPI “Demand (backlog)”, “Profit”, and “ELT service level”.

- a) What are the profit, ELT service level, and order backlog for the two scenarios? Did we improve in the second scenario?
- b) How can you explain the relationship between the Simulation and Comparison experiments?

A variation analysis must be performed to check Polarbear's simulation model and the results. The daily demand for "urban" bicycles in Cologne can be varied with a minimum demand of 50 and a maximum demand of 170 in steps of 40. The variation should be performed for a period of one year.

Creating a Variation Experiment:

Step 1. Open scenario PB SIM Level 1_Improved and go to Variation Experiment.

Step 2. Check the parameter to vary (i.e., Demand Data: bicycle "urban", Cologne; quantity).

Step 3. Check KPI dashboard. The KPIs for a variation analysis should be "Demand (back-log)", "Profit", and "ELT Service Level".

Performing experiments

Step 1. Run Variation experiment.

Step 2. Analyze the results using the KPIs "Demand (backlog)", "Profit", and "ELT Service Level".

- a) What is the profit, ELT service level, and order backlog for different demands?
- b) Why and how do the KPIs change as demand changes?
- c) Is the simulation model sensitive?

Develop recommendations for Polarbear Bicycle's management. Consider GFA, NO, SIM, Comparison and Variation results. What SC design would you recommend? Consider the impact of inventory control and production capacities. Are there any other factors that should be taken besides the results of the experiments performed?

Case study 2

BERLIN BREWERY is a Berlin beer brand well-known for its small, traditional, handmade beer. Currently, they have one brewery (factory) and one DC in Berlin. Although they have been in business a short time, they already have 50 customers in eight countries. Nevertheless, they face several problems which need to be solved. To expand their distribution network and reduce costs by inventory management improvements, a simulation and optimization analysis must be performed to evaluate their current SC performance and develop suggestions for its improvement.

Currently, the BERLIN BREWERY's Brewhouse consists of 5 tanks which have a total capacity of 20hl. Assuming that demand for its beer is rising, the BERLIN BREWERY has the option to expand its Brewhouse with more tanks. The whole process from the original brewing to the finished product requires between four to six weeks depending on how long each type of beer must be stored. As the location of production in Berlin is small, all beer produced is stored in the only DC in Berlin. An external service provider takes care of all logistical requirements. Currently, most of the beer BERLIN BREWERY sells is sold in Berlin, though the craft beer is also sold to wholesalers all over Germany. Since 2018, customer locations include Switzerland, Austria, Sweden, Norway, France, Italy, and Spain. BERLIN BREWERY collaborates with three suppliers in Germany who deliver empty beer bottles in crates, as well as the hops and malt. Empty bottles in crates are delivered from a location close to Nuremberg, the hops come from Koblenz, and malt is delivered by a supplier from a location close to Dresden. One-off acquisition costs for the brewing equipment is \$300,000. Moreover, maintenance costs (including energy and electricity) for the location of the factory are \$80,000 per month or \$2,630 per day.

Assuming that one beer crate consists of 20 bottles, the whole cost for one crate is \$10. Note that in the anyLogistix model, a product "Beer" which is considered equivalent to one beer crate. The costs of the product "Beer" can be broken down as follows.

BOM	Usage per beer crate	Measure used in anyLogistix	Costs per beer crate, \$
Hops	7.92 gr.	1 piece	0.32
Malt	1390 gr.	1 piece	2.22
Crate	20 bottles	1 piece	6.00
Production processing costs			1.46
Total	20 bottles		10.00

Carrying costs, which include warehousing costs, handling inside inventory, and inventory costs, are estimated to be \$0.005 per beer crate (\$0.2 per pallet) per day. The transportation from the BERLIN BREWERY factory to the DCs are calculated as volume-distance based transport and costs are \$0.00175 per km/beer crate (\$0.07 per pallet). The transport from the three suppliers to the BERLIN BREWERY factory is paid by suppliers. Inbound and outbound costs are shipment processing costs. Outbound costs are assumed to be \$0.66 per beer crate (\$26.40 per pallet) and inbound costs are \$1 per crate (\$40 per pallet). Hops and malt are delivered in a one-kilogram packaging unit: one pallet of malt or hops equals 40 packaging units. BERLIN BREWERY wishes to expand its sales and work as efficiently as possible to increase profit. To reach these goals, several problems must be overcome: beer consumption in Germany, BERLIN BREWERY's main market, is decreasing and the market as a whole is highly competitive. The German beer market is a mature, nearly saturated market. Two potential solutions exist: expansion into other countries or increased sales to existing customers. These options instigate further challenges as BERLIN BREWERY has only one DC in Berlin. Long routes and long delivery times to individual customers are the main problems. Because of the long routes, BERLIN BREWERY can respond only relatively inflexible to spontaneous requests and a high number of unnecessary routes might be taken. There is also the risk of manmade or natural disruptions which can influence service quality (e.g. a storm destroys DC).

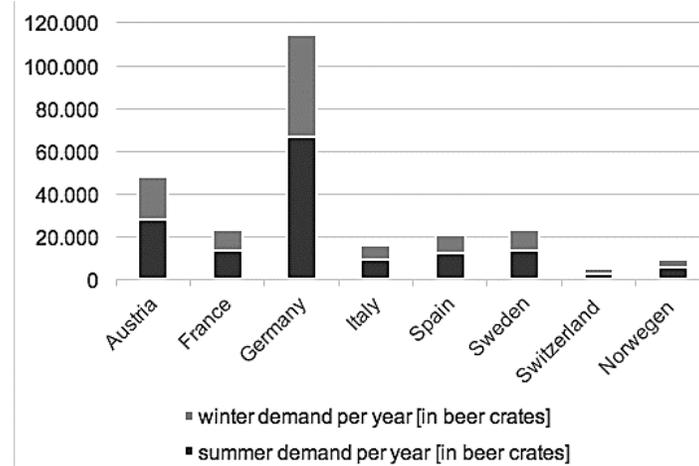
In sum, the goal of BERLIN BREWERY is to expand their distribution network, serve their customers as efficiently and satisfyingly as possible, raise their sales numbers, and increase profit. This is possible by optimizing their SC: an optimal number of DCs as well as good locations for these DCs must be found to save as much logistics costs as possible. Loss of quality and delivery problems should be avoided.

In the current situation production is in the centre of Berlin and the raw ingredients are shipped by truck directly from Dresden, Nuremberg, and Koblenz. To store as little as possible, raw materials are delivered on demand and used directly (JIT- just-in-time) for the production. The beer is delivered to 50 customers all over Europe.

To provide a better understanding of the circumstances, a few assumptions are made:

- All prices and costs are shown and calculated in \$.
- All processes are considered in terms of (beer) crates or pallet specifications, rather than bottles. This is because BERLIN BREWERY sells their beer only in whole crates, and these terms help to simplify the model. In one beer crate there are always 20 bottles of beer, which have 0.33 liters of content per bottle (6.6 liters per crate).
- 1 pallet = 40 beer crates = 800 beer bottles
- The recycling deposit on bottles is not considered.
- Transportation costs from the factory to all DCs are the same.
- Transportation-/ handling costs from the DCs to the customers are adapted to the price level of the actual country.
- One year consists of two periods:
 - Summer period: 01.05.2021 - 31.10.2021
Demand coefficient: 1.2 (meaning 1.2 times higher demand as in winter due to higher demand during warm months)
 - Winter period: 01.11.2021 - 30.04.2022
Demand coefficient: 1.
- Orders are received every seven days (static demand).
- Transportation speed is 80km/h, the capacity of a truck is 1,320 crates, which equals 33 pallets which are single stocked.
- Price per crate for customer: \$60.00.

We assume that BERLIN BREWERY will sell 260,405 beer crates within the coming summer period (151,035 crates) and winter period (109,370 crates).



The main customers are beverage retailers, which purvey to smaller retailers or restaurants. Therefore, it is considered that only one wholesaler is supplied per city. This wholesaler makes resales independently. As a result, no further storage costs are incurred as no further DC is required. Transportation to the wholesalers and handling is currently being handled entirely by a logistics service provider as BERLIN BREWERY does not yet have the necessary capacity and occupancy rate for profitable shipment. This service provider picks up the goods in the brewery, stores them in their own warehouse, and launches directly to the distributor as needed.

Financial KPIs	\$
Transportation cost	346,991
Other cost	996,450
Inbound processing cost	905,117
Outbound processing cost	348,895
Inventory purchases	2,282,011
Production	390,133
Revenue	15,684,866
Profit	10,407,351

Task 1 - Greenfield Analysis (GFA)

The aim of this GFA is to determine optimal DC locations in the SC subject to minimum total transportation costs.

Creating an ALX model:

Step 1. Open scenario BR GFA Level 1.

Step 2. Check the tables Customers, DCs and Factories, Demand, Unit Conversions, and Products.

Performing experiments:

Step 1. Go to GFA Experiment and run it for “Number of sites = 7”.

Step 2. Analyze the results using statistics “Flows” and “New Sites”:

- a) What are the optimal coordinates of the new DCs?
- b) What is the maximum distance from an optimal DC location to a customer?
- c) What are the total costs of the SC?
- d) Compare the data in statistics “Flows” and table “Demand”. Do we satisfy all customer demand from the optimal DC locations?
- e) Which costs, relevant for choosing an optimal DC location, were not considered in this GFA analysis?

Task 2 - Network Optimization (NO)

The solutions of the GFA will be taken into account to optimize the SC. Having checked the suggested GFA sites for DCs, the SC manager of BERLIN BREWERY analysed those locations further regarding additional factors such as availability of warehouses to rent, construction costs for building new warehouses, fixed costs, infrastructure, future demand forecasts, etc. As a result, some of the GFA suggested locations are moved.

The NO goal is to find the SC design with the highest possible profit. To define the NO problem from a mathematical perspective, several parameters must be input as data. Each of the DCs has an inventory capacity of min. 5,800 beer crates and max. 11,600 beer crates as well as a one-week inventory range. The brewery can stock 10,000 crates at maximum and should carry an inventory of at least 5,000 crates. Customers and their demands remain the same as in the GFA. To avoid confusion, the DCs are now marked as red icons. Green icons are added to symbolize the suppliers of beer ingredients. These suppliers are located in Nuremberg, Koblenz, and Dresden.

Sites / costs in (\$)	Other costs per day	Carrying costs per day per beer pallet	Outbound shipment processing costs per beer pallet	Inbound shipment processing costs per beer pallet	Transportation costs per beer pallet, from DCs to customers and from Brewery to DCs
DC Austria	120	0.20	0.66	1.00	0.07
DC Spain	70	0.10	0.33	0.5	0.035
DC Sweden	310	0.40	1.02	1.55	0.108
DC Bochum	120	0.20	0.68	1.07	0.07
DC Switzerland	146	0.20	0.96	1.46	0.102
DC Italy	90	0.20	0.33	0.5	0.05
DC Berlin	100	0.20	0.66	1.00	0.07
Factory Berlin (beer)	2,630	0.005	0.66 (beer)	40.00 (ingredients)	0.07

Production costs at the brewery are \$1.46. Revenue is \$60.00.

Creating an ALX model:

Step 1. Open scenario BR NO Level 1.

Step 2. Check data in tables “DCs and Factories”, “Facility Expenses”, “Paths”, “Processing Costs”, “Product Flows”, “Product Storages”, “Production”, “Products”, and “Vehicle Types”.

Performing experiments:

Step 1. Go to NO Experiment and run it.

Step 2. Analyze the results using statistics “Optimization Results”, “Flow Details”, “Production Flows”, “Demand”, and “Overall Stats”:

- a) What is the most profitable SC design?
- b) Is demand for all customers satisfied?
- c) What is total profit of the most profitable SC?
- d) Compare the optimal SC design as computed in the NO and the initial SC design (factory and DC in Germany) in terms of profit.
- e) What other costs should be considered when redesigning the SC according to NO results?
- f) What other factors, apart from costs, should be considered when redesigning the SC
- g) according to the results of the NO?

Task 3 – Simulation

For the simulation, assumptions must be made to make the model more realistic. The previous assumptions remain unchanged, and a lead time of three days is added. The sourcing policies are defined as follow: for the DCs, the program should choose the closest dynamic source. In this case, there is only one factory and the customers should choose the fastest dynamic source to receive orders as soon as possible.

In simulation, the following features are considered:

- transit from flows (as in NO) to orders. i.e., the customer demand is no more considered as an aggregated flow during a period but it is now generated as orders in certain intervals, e.g., 10 crates per day.
- introduce inventory control to manage ordering processes.
- introduce sourcing policy (e.g., single vs. multiple sourcing) to manage replenishment processes
- introduce shipment control (LTL/FTL) to manage shipment processes.

First, simulate the SC with two DCs in Germany and Spain subject to the following data

Object	Inventory Policy		Sourcing Policy	Transportation Policy
	Min	Max		
Factory Germany (beer)	2000	5000	Closest dynamic	LTL
Factory Germany (ingredients)	On demand			LTL
DC Germany	1800	11600	Closest dynamic	LTL
DC Spain	1800	11600	Closest dynamic	LTL
Customers			Closest dynamic	LTL

To evaluate the simulation results, consider six KPIs according to the needs of BERLIN BREWERY:

- Financial KPIs, such as profit, revenue and costs
- Service level by products, which is calculated as (number of outgoing orders / number of placed orders), where an outgoing order is an order that is not dropped
- Available inventory including backlog at DCs.

With all of the parameters described, run the simulations for a period of one year from May 1, 2021 until April 30, 2022.

Creating an ALX model:

Step 1. Open scenario BR SIM Level 1.

Step 2. Check data in tables “DCs and Factories”, “Inventory”, “Sourcing”, and “Paths”.

Performing experiments:

Step 1. Go to Simulation Experiment and run it.

Step 2. Analyze the results using the KPI Dashboard “Revenue, Profit, Costs”, “Service Level”, “Average Inventory including Backlog”:

- a) What are the profit, revenue, and costs of the SC? Does this result match with the NO results? Explain.
- b) Is demand for all customers satisfied? Explain.
- c) What is your judgment on the inventory dynamics in the SC? Explain the change in inventory dynamics in the second part of the simulation period.

Task 4 - Risk analysis: Two-month disruption at one of the DCs

This analysis simulates a two-month disruption of the DC in Berlin from August 1st to September 30th for two different network design scenarios, i.e., with two DCs and with a single DC in Berlin.

Creating an ALX model:

Step 1. Open scenarios BR SIM Level 1 Disruption Risk 2 DC and BR SIM Level 1 Disruption Risk 1 DC.

Step 2. Check data about the disruption in table “Events”.

Performing experiments:

Step 1. Go to Simulation Experiment and run it.

Step 2. Analyze the results using the KPI Dashboard “Revenue, Profit, Costs”, “Service Level”, “Average Inventory including Backlog”:

- a) What are the profit, revenue, and costs of the SC for the two different network design scenarios?
- b) Is demand for all customers satisfied? Explain.
- c) What is your judgment on the inventory dynamics in the SC? Explain the change in inventory dynamics in the disruption period.

Task 5 - Comparison experiment

In order to simplify comparison of the two simulation scenarios subject to disruption with each other and with the “ideal” scenario (no disruption), run a Comparison experiment.

Creating a Comparison Experiment:

Step 1. Open scenario BR SIM Level 1 and go to Comparison Experiment.

Step 2. Select scenarios BR SIM Level 1, BR SIM Level 1 Disruption Risk 1 DC and BR Level 1 Disruption Risk 2 DC.

Step 3. Check KPI dashboard. The KPIs for a comparative analysis of the three scenarios should be “Available Inventory”, “Profit”, “Total Costs” and “Service Level”.

Performing experiments:

Step 1. Run Comparison experiment.

Step 2. Analyze the results using the KPIs “Available Inventory”, “Profit”, “Total Costs” and “Service Level”.

- a) What are the profit, service level, average inventory and total costs in each of the three scenarios? Explain.
- b) What’s the relationship between the Simulation and Comparison experiments?

Task 6 - Validation using Variation

Perform a variation analysis. The MIN parameter for the DCs will be varied with a minimum reorder point of 900 and a maximum reorder point of 2300 in steps of 200. The variation should be performed for a period of one year.

Creating a Variation Experiment:

Step 1. Open scenario BR SIM Level 1 and go to Variation Experiment.

Step 2. Check the parameter we will vary (i.e., Inventory Policy: DC for product beer: MIN).

Step 3. Check KPI dashboard. The KPIs for a variation analysis should be “Available inventory including Backlog”, “Profit”, and “Service Level”.

Performing experiments:

Step 1. Run Variation experiment.

Step 2. Analyze the results using the KPIs “Available Inventory including Backlog”, “Profit”, and “Service Level”:

- a) What are the profit, service levels and inventory for different reorder points?
- b) Why do the KPIs change as the reorder point changes?
- c) Is the simulation model sensitive?

Task 7 – Recommendations

Develop recommendations for BERLIN BREWERY management. Consider GFA, NO, Simulation, Comparison, and Variation results. Which SC design would you recommend? Consider the impact of inventory control and disruptions. Are there any other relevant factors that should be taken into account besides the experiments performed?

Reference

Ivanov D. (2021). Exercises in Supply Chain Optimization and Simulation using anyLogistix, Berlin School of Economics and Law, 3rd Edition