

On-shelf Availability Strategies in Coffee Industry

By: Masoud Khakdaman

Thesis Advisor: Dr. Ioannis N. Lagoudis



Masoud holds a Master of Engineering degree in Industrial Engineering from Technology University of Malaysia (UTM). Prior to that, he worked in automotive industry contributing on various business process improvement projects. His bachelor's degree is also in Industrial Engineering from Yazd University of Iran. Masoud worked in textile industry as well and initiated several effective solutions for enhancing business systems.

KEY INSIGHTS

1. Considering the opportunity cost also among actual supply chain costs is a critical viewpoint in the current retail industry. It can result in making different decisions on improving customer's demand fulfillment as well as total long term profits of the companies.
2. Different uncertainties in different stages of the supply chain can be taken simultaneously into consideration using simulation-based approaches. Using sophisticated supply chain analytics can reveal the impact of different decisions and strategies on total value generation and potential achievable profits by assisting managers to make right decisions at the right time with lowest possible risks.

performance indicator for the retail industry, significantly impacting profit and customer loyalty. OOS is critical in reaching high levels of availability at the final point of sale in the supply chain, where OSA has the greatest impact on consumer behaviour.

This research focuses on the retailing activities of the coffee industry. The company under investigation is one of the premium coffee leaders in China which operates in an extensive distribution network seven days a week. However, in high-density locations, stores often run out of food items before by midday (Average daily 40% OOS). This will result in a high frustration for the whole chain that try to provide customer satisfaction all the time, but got disappointed at the last point of sale due to OOS occasion. The aim of the project is to look into options to assure availability of key items, especially food related, in Beijing stores throughout the day. Here, the main factor contributing to the problem is the current distribution and transportation system. Thus, developing the best possible logistic model to improve the OOS problem is the main contribution of this study.

INTRODUCTION

One of the key challenges of the retailers is on-shelf availability (OSA), since going out of stock (OOS) directly results in customer dissatisfaction. In fact, OSA is a key

CURRENT SUPPLY CHAIN SYSTEM

There are 55 SKUs from four food types which are being served in 122 stores. Using the collected data and analyzing them, current transportation-distribution system of the company is simulated using AnyLogic Simulation software (Figure 1). All required verification and validation processes are conducted as well.

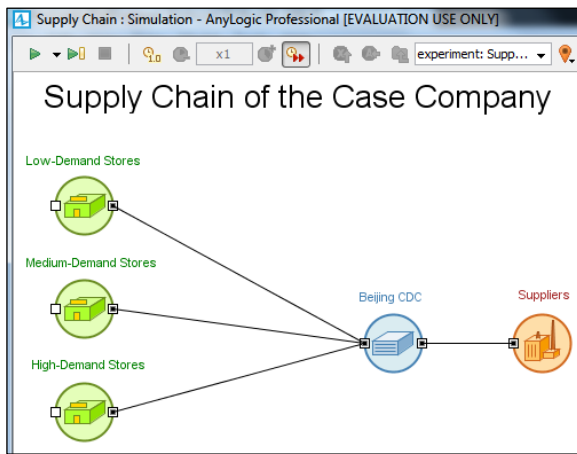


Figure 1: Simulation Model of the supply chain system (source: author)

ALTERNATIVE STRATEGIES FOR INCREASING ON-SHELF AVAILABILITY IN STORES

Four alternative transportation-distribution strategies for improving current stock-out levels of the case company are developed, simulated and explained. As Table 1 shows, in the distribution network of each alternative strategy, there are a number of entities such as quantity of CDCs in Beijing, quantity of RDCs in Beijing etc. It should be noted that there is no change in configuration or number of suppliers since they are out of scope of this study and there is no information available on them. Furthermore, there are two more columns for each entity, “Delivery to” and “Delivery times”. “Delivery to” highlights the destination of the entity e.g.,

from “Beijing CDC” to “stores”. “Delivery times” shows the number of deliveries from each entity to each destination. As an example, consider the first alternative strategy, in which, suppliers send orders to CDC once a day, Beijing CDC sends orders to stores two times a day and there is not any Regional DC in Beijing in this alternative strategy.

Transportation-Distribution Strategy	Suppliers			Beijing CDC			Beijing RDC		
	Quantity	Delivery to	Delivery times	Quantity	Delivery to	Delivery times	Quantity	Delivery to	Delivery times
Current	1	CDC	1	1	Stores	1	0	0	0
Alternative 1	1	CDC	1	1	Stores	2	0	0	0
Alternative 2	1	CDC	1	1	Stores, RDC	1,1	1	Stores	1
Alternative 3	1	CDC, RDC	1,1	1	Stores	1	1	Stores	1
Alternative 4	1	RDCs	1	0	0	0	2	Stores	1

Table 1: Alternative strategies for improving stock-out levels in stores (source: author)

First alternative strategy: Adding one more delivery from Beijing CDC to stores before the peak demand time (lunch time)

According to the current operations of the case company, there is one time delivery to the stores every day very early in the morning, while many stores go out of stock before the noon. An alternative transportation-distribution strategy is developed and simulated in order to add one more delivery run to the stores before the everyday noon. Referring to Figure 2, it is clear that applying this strategy can decrease the current stock-out levels from approximately 40% to a figure around 24%, however, there is a noticeable increase in total supply chain cost as well. In addition, this strategy is capable of improving the opportunity cost from current value of approximately 528,000 USD to 312,000

USD (Table 2), which is a significant improvement amount as well.

In this scenario, the main advantage is that there is no need to change the configuration of the supply chain network. However, its disadvantage is increasing the total supply chain cost.

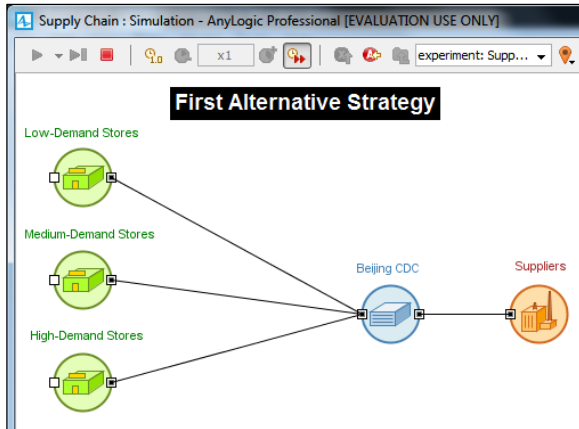


Figure 2: Simulation model of the First alternative strategy (source: author)

Second alternative strategy: Adding one Regional Distribution Center (supplied by CDC) to the current supply chain network

The second alternative strategy is built based on developing a Regional distribution center (Beijing RDC) between Beijing CDC and stores. Beijing RDC should be located inside the Beijing city to be able to deliver orders of stores in quickly. In addition, Beijing RDC is supplied only by Beijing CDC. This configuration is easier to manage since the case company is the only entity that supply and manage orders' handling from Beijing CDC to Beijing RDC. Furthermore, more consistency in average delivery time to Beijing RDC can be achieved in comparison to the third alternative strategy since there is just one source of supply for Beijing RDC.

The delivery time from Beijing RDC to stores is almost half of that figure for Beijing CDC. Referring to Figure 3, it is clear that applying this strategy can decrease the current stock-out levels significantly from approximately 40% to about 18% (Table 2), however, there is a dramatic increase in total supply chain cost as well. Regarding shortage costs, this strategy is capable of reducing opportunity costs even more than the first alternative strategy (from approximately 528000 USD to 235000 USD).

This scenario is the most effective one in terms of improving stock-out levels. However, the disadvantage is that it requires some investment capital for acquiring or renting the Beijing RDC.

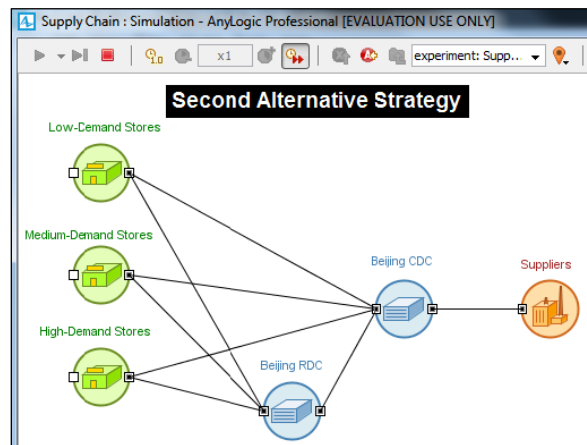


Figure 3: Simulation model of the Second alternative strategy (source: author)

Third alternative strategy: Adding one Regional Distribution Center (supplied by CDC and suppliers) to the current supply chain network

The third alternative strategy is similar to the second one in terms of configuration; however Beijing RDC can put orders directly to suppliers as well as Beijing CDC. Although this flexibility will empower the Beijing RDC to secure enough quantity of SKUs, it increases the average variability in delivery time since delivery from

suppliers take more time. In addition, since two entities (Beijing CDC and Suppliers) handle the orders, more variability in delivery time and cost are expected.

As Figure 4 depicts, although using this strategy is improving stock-out levels, according to Table 2, the impact is not significant (only around 7%). Similar to the previous alternative strategies, this strategy also increase total supply chain daily cost.

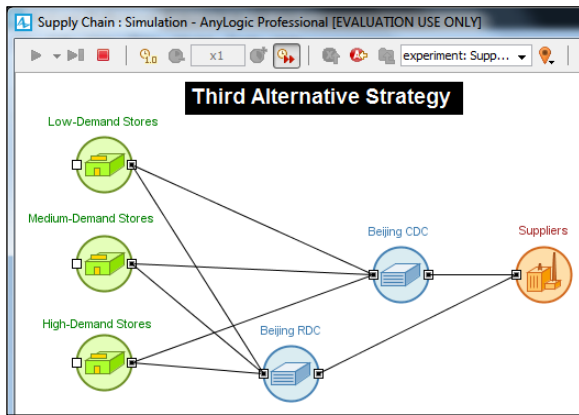


Figure 4: Simulation model of the Third alternative strategy (source: author)

Forth alternative strategy: Shutting the current Beijing CDC down and adding two Regional Distribution centers to the current supply chain network

The last strategy requires a fundamental re-configuration in the current supply chain network. Two RDCs are considered inside the city instead of the current Beijing CDC to supply all of the stores. They put orders independently to suppliers and get the shipments done through 3PLs. They have the longest transportation lead time which affected their fulfillment rate negatively. The forth alternative strategy (Figure 5) is the only one which raised under-fulfillments of demand as well as total opportunity cost (Table 2).

DISCUSSION

The impact of choosing different alternative strategies on demand fulfillment, total supply chain cost and total shortage cost is discussed. Table 2 compares each strategy in several aspects.

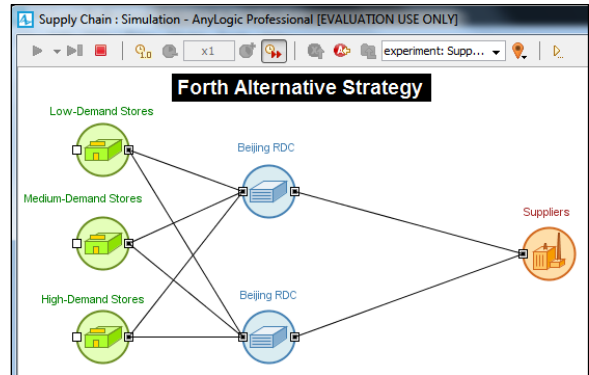


Figure 5: Simulation model of the Forth alternative strategy (source: author)

The main comparison is in terms of improving stock-out rate, which is the main objective of this study. As clearly shown in Table 2, the second alternative strategy (Adding one Regional Distribution Center (supplied by CDC) to the current supply chain network) has the best positive impact on reducing under-fulfillment of customers' demand where it increases the demand fill rate from 60% to almost 82%. This significant improvement comes with the highest transportation and total supply chain cost. However, since there is a good profit margin for sold products, the absorbed revenue from increasing sales not only covers the total supply chain costs, also increase the supply chain profitability about 37%. This means that, investing on transportation could result in higher profits for the case company. After the second alternative strategy, the first one takes priority (Adding one more delivery from Beijing CDC to stores before the peak demand time (lunch time)). Since the first alternative strategy requires no new investment, it may be more

favorable for the case company to implement. It is clear that the worst case in improving stock-out levels is the last alternative strategy which has the highest lost sales and lowest revenue and profit.

Another aspect of the supply chain of the case company is the total supply chain cost. Based on Table 2, although second and first alternative strategies have the highest supply chain costs, they both have the lowest shortage cost. This means that if we consider the total supply chain cost as the whole amount of actual (transportation, purchasing) costs and virtual (shortage) costs, the second and first alternative strategies incur the least total supply chain cost.

Transportation-Distribution Strategy	Simulation results				Analysis of results					
	Under-fulfillment rate (%)	Total SC cost (\$k)	Transportation Cost (\$k)	lost sales (shortage cost) (\$k)	Purchase Cost(\$k)	total actual & opportunity cost (\$k)	Average Demand (#k)	Revenue (\$k)	Profit (\$k)	Potential increase (decrease) in profit (%)
Current	40	467	58	528	409	995	48	783	315	0
Alternative 1	24	588	73	312	515	900	48	992	403	28
Alternative 2	18	636	79	235	557	871	48	1,070	433	37
Alternative 3	33	517	64	429	452	946	48	874	357	13
Alternative 4	50	387	49	651	338	1,039	48	652	264	-16

Table 2: Analysis of different alternative strategies (source: author)

CONCLUSION

Aiming at enhancing the service level of one of the global coffee companies in China, this research is conducted to ensure availability of key food and coffee items in stores. A simulation-based approach is applied in order to simulate the current supply chain system of the

company. Initially, required data such as stores' demand data, product types, procurement and transportation costs, delivery capacity of trucks, working procedure of the stores and Beijing CDC, current configuration of the distribution network and etc is collected. Then, data is analyzed and categorized appropriately with the simulation software requirements and limitations. Using the analyzed data, the current distribution network of the case company is conceptually designed and simulated using AnyLogic simulation software and a series of runs take place to validate the model.

To improve the current order fulfillment level and to reach to the lowest level of stock-outs, four different alternative transportation-distribution network configurations are designed. First alternative strategy is adding one more delivery run from Beijing CDC to the stores before the midday. Second option is adding one Regional Distribution Center inside the Beijing city (Beijing RDC) to the current supply chain network, in which, only Beijing CDC supports the Beijing RDC. The third alternative transportation-distribution network is the same with the second one, but Beijing RDC is allowed to place orders directly to suppliers as well as Beijing CDC. The last choice is removing current Beijing CDC and adding two RDCs inside the Beijing city which both place orders to suppliers. Using the developed simulation model of the current supply chain network of the company, all four alternative strategies are simulated as well and equipped with the required data as well. Then each alternative transportation-distribution network configuration is tested against current supply chain system of the case company to assess its influence on the stock-out levels and total supply chain cost.

The second alternative strategy, which is adding one Regional Distribution Center (RDC) to the current transportation-distribution network, appears to provide the best results. It increases the on-shelf availability of the stores by approximately 22%, while it improves the total supply chain profit by 37%. These significant improvements come from the role of the added RDC in serving stores' orders in a responsive way and just before the midday peak time demand. The only disadvantage of this alternative strategy is the requirement of extra investment in buying or renting a RDC facility, which increases the payback period of the whole supply chain network.

Another key finding of this study is recommending the first alternative strategy, which is adding one more delivery run to the stores before noon. The main advantage of this alternative strategy is that no changes are required in the current distribution network of the company. Furthermore, its effectiveness in terms of demand fulfillment (increased 16%) and profit generation (improved 28%) is remarkable, although it is not as big as the second alternative transportation-distribution network.

As a final remark, a mindset change in the management viewpoint of the case company is recommended to consider lost sale as one of the critical components of the actual total supply chain costs as well as other costs.

FUTURE RESEARCH DIRECTIONS

A future potential research would be incorporating stores, distribution centers, manufacturers and suppliers as independent decision making entities in the simulation model using Agent-based simulation. Since in the real world circumstances, each stage of the supply chain including, stores, distribution centers,

factories and suppliers, have different interests for their business, they make their business decisions independently. This fact will impact the whole supply chain profit and service level in the long term. Using agent-based simulation, one can define each entity in the whole distribution network as an independent decision-maker (independent agent) who will not pay much attention to the total supply chain profitability and responsiveness. Evaluating the supply chain KPIs in this way can provide a more realistic picture of the real-world supply chain performance. AnyLogic simulation software can be applied for this purpose since it has both agent-based and discrete-event simulation capabilities simultaneously.

Another research recommendation would be incorporating more uncertainties in developing transportation-distribution networks. Demand is the most common uncertainty type in the literature while supply uncertainty also should be considered as an important risk especially with the nowadays frequently-reported shortages and disruptions in the supply side. In terms of financial uncertainty, exchange rate changes can be considered. In production and manufacturing, production lead time is the major uncertainty that can be incorporated into the model as well.