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Risk Analysis and Supply Chain Management for Companies' Short-Life-Cycle Products

Yuanhao Li[1,a,*]

[1]*School of Computer Science, Fudan University, Shanghai, 200433, China*
a. 20307130062@fudan.edu.cn
**corresponding author*

Abstract: When the supply chain operates in an uncertain environment, especially for fashion products with fast changing trends and short life cycles, matching supply and demand is the main task. This requires enterprises to have the ability to analyze risks and manage the supply chain. This paper is mainly about a case analysis of Sport Obermeyer who is confronting two core issues, "Greater products variety and more intense competition have made accurate predictions increasingly difficult" and "How to allocate production between two suppliers". The key tool to solve these two problems is the Newsvendor Model. Following the principles of the model, the article first calculates the expected quantity and profits of each product. Afterwards, based on the comparison of the mismatch cost of each product, the article provides a preliminary decision. After analyzing the advantages and disadvantages of the suppliers, the article obtains the final result. This process demonstrates some ways on risk analysis and supply chain management and provides some new perspectives for the development of the enterprise and related research in the future.

Keywords: Business analysis, newsvendor model, risk analysis, supply chain management

1. Introduction

Product life-cycle becomes increasing short nowadays due to the rapidly changing demand in the market. This drives enterprises to adopt more effective supply chain management dealing with the short-life-cycle products. Furthermore, information and data analysis technology changes the way of doing business, assisting to lower the risk as well as improving the profits [1]. The definition of risk in business is the likelihood of future changes deviating from expectations and the degree of their impact on goals. Supply chain is a concept that includes a regulatory system related to the flow of product, information and financial [2]. A supply chain is a set of activities that involved in the process of transformation and distribution of products from the earliest raw materials in nature to the finished product to the end consumer [3]. This paper aims to study the case of Sport Obermeyer to illustrate how risk analysis and supply chain management could be applied to practical problems.

Sport Obermeyer, Ltd is a fashion ski-wear manufacturer that specifically produces ski-wear for middle to high class end user. As a manufacturer company, the ultimate success of Sport Obermeyer will largely depend on the company's ability to predict market reactions to products of different styles and colors. Inaccurate forecast of the demand will cause a great deal of loss for Obermeyer: styles left at the end will have to be sold at deep discounted price, often below their manufacturer cost. On the other hand, some popular style often run out of stock pretty quickly, thus the company will lose a

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significant amount of income due to the shortage of those popular products. Moreover, there is another constrain that Sport Obermeyer has to face is how to allocated its production in factories in Hong Kong and China mainland. The labor costs in the mainland are much lower, but at the same time, workers in Hong Kong complete their jobs faster than the Chinese counterpart. Also Hong Kong workers are typically trained in a broader range of task and could use much less worker to finish a task. The company also has to consider the large minimum order sizes of China and the risk of the trade relationship between China and the United States.

According to the introduction of the case, the key point is to use the forecast of products' demand to calculate the production quantity and predict the expected profits, which could assist to make the decision on the amount and suppliers of each stage of production. The paper choose to use the Newsvendor Model to calculate the preliminary data and then set my criteria of identifying risks based on that in order to make the production management.

The Newsvendor model is a model that used to determine optimal inventory levels [4]. It is targeted at short-term products with fixed prices and uncertain demand. If the inventory level is q, each unit of demand above q is lost. This model can be traced back to the situation where newspaper vendors must determine the daily inventory of newspapers when facing uncertain demand, and know that unsold newspapers will be worthless at the end of the day [5]. Based on this model, this paper firstly compute the best order quantity which matches the forecast of the demand. Based on the data, the paper further calculates the expected profits, lost sales, leftover inventory and maximum profit. Then it uses the ratio of mismatch cost and quantity to assess the risks of each products to make the final decision [6].

This study of the case provides other ideas on improving risk analysis and management of production for companies. These include reducing the lead times by focusing the raw materials on specific countries to get the most available quota. Also, standardizing the production process of components, such as zippers, is a point that could be developed [7]. Besides, e-commerce is increasingly playing an irreplaceable role in today's development. Whether models meet the market demand and whether the risk assessment is accurate becomes key points. Selecting appropriate supply chain models for short- life-cycle products will be a critical issue [8, 9]. At present, the research on the short-life-cycle products supply chain in many fields is still at the early stage [10]. This study may explore the characteristics of the short-life-cycle products and how to establish an accurate model for the supply chain that the enterprises need to handle short-life-cycle products in the market economy.

2. Methods

2.1. Data Sources

The data for this paper is collected from the report of Sport Obermeyer, Ltd which was created by Janice H. Hammond and Ananth Raman from Harvard Business School in 2006.

2.2. Variable Selection

The problem to be solved in this case is to determine the allocation of 20,000 orders. Before the Las Vegas show, the company has a total of three months of production time, producing a total of 10000 products. After the show, from which the company get more information of the requirements of the market and retail orders, it completes the remaining half of the production. This paper uses the forecast of the Sample Buying Committee that Table 1 shows below which consists of 10 styles of women's parkas the company needs to produce.

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Table 1: Sample Buying Committee forecasts

		Individual forecasts of committee members						Ave.	S.D.
Parkas	Price	Laura	Carolyn	Greg	Wendy	Tom	Wally	Forecast	
Gail	$110	900	1000	900	1300	800	1200	1017	194
Isis	$99	800	700	1000	1600	950	1200	1042	323
Entice	$80	1200	1600	1500	1550	950	1350	1358	248
Assault	$90	2500	1900	2700	2450	2800	2800	2525	340
Teri	$123	800	900	1000	1100	950	1850	1100	381
Electra	$173	2500	1900	1900	2800	1800	2000	2150	404
Stephanie	$133	600	900	1000	1100	950	2125	1113	524
Seduced	$73	4600	4300	3900	4000	4300	3000	4017	556
Anita	$93	4400	3300	3500	1500	4200	2875	3296	1047
Daphne	$148	1700	3500	2600	2600	2300	1600	2383	697

The expected profit on each parka sold is approximately 24% while the expected loss on each parka left unsold is 8%. As for suppliers, the minimum order quantity of Hong Kong factories is 600 while the number of China Guangdong factories is 1200.

2.3. Model Principle

Inventory management is a cautious balancing act between stock availability and the cost of inventory. The company needs to find the optimal order quantity at the critical point. This point could be calculated in the Newsvendor Model by this formula:

$$\text{Prob}\,(D \leq Q) \geq \frac{Cu}{Cu+Co} \tag{1}$$

In this formula, Cu represents the unit inventory cost while Co represents unit out of stock cost. The left side represents the probability of no stock out and the right side is the critical ratio. By keeping the benefit of increasing batch size larger than the cost of increasing batch size, the formula could yield the smallest value of Q, the order quantity.

As shown in the table 2 above, the forecast overall distribution follows a normal distribution, with the standard deviation twice the predicted standard deviation. Therefore, the paper uses z-scale and the principle of normal demand distribution fitting the continuous demand distribution to calculate the order size. After getting the Q, the paper can preliminary get the expected profit of each products which includes expected sales and expected leftover inventory.

The next steps are comparing the expected profits and maximum profits to get the mismatch cost. Then, the paper uses the ratio of mismatch-quantity as the decisive factor to determine the risks of production so that the company could make the decision with limited reactive capacity.

As for the selection of the suppliers, the paper also gives some recommendation based on the calculation of production and revenue, as well as some analysis of the two producers. The results section will conclude with a short-term plan consisting of two production decisions and the total profits based on the analysis above. After summarizing the whole process of making the production decisions, the article will propose some expectations for long-term solutions.

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3. Results and Discussion

Table 2 shows the order quantity calculated based on the Newsvendor model for different product prices. The paper treats the two order decision as the company's whole output of 20,000 amount to analysis. The total quantity calculated exceeds the restriction, which needs further analysis to be conducted. As the case has stated, the higher the degree of committee consensus, the higher the accuracy of predictions will be, and the accuracy could be demonstrated through the coefficient of variance of each products. This list can serve as a basis for the initial decision-making risk assessment of the article, that is for the styles with low coefficient of variance, the article believes that the risk is lower.

Table 2: Order quantity of each product in Newsvendor model

Parkas	Average	2*Std	Variance	Q
Gail	1017	388	0.38	1278.7
Isis	1042	646	0.62	1477.7
Entice	1358	496	0.37	1692.5
Assault	2525	680	0.27	2983.7
Teri	1100	762	0.69	1614.0
Electra	2150	807	0.38	2695.0
Stephanie	1113	1048	0.94	1819.9
Seduced	4017	1113	0.28	4767.0
Anita	3296	2094	0.64	4708.4
Daphne	2383	1394	0.58	3323.2
Total	-	-	-	26360.1
Cu	Co	Critical ratio	α	-
24%	8%	0.75	0.67	-

Based on the quantity of orders obtained, the article calculates relevant performance indicators including the expected profits, the maximum profits and the mismatch cost. The expected profit is computed by the difference of expected revenues and expected cost, which needs the number of the expected sales and leftover. The sales could be computed by the difference of the expected demand, which is the average of the forecasts, and the expected lost sales, which could be calculated by the formula (in excel):

$$\text{Expected lost sales} = \theta \times \left[\text{NORMDIST}(z, 0, 1, 0) - z \times \left(1 - \text{NORMSDIST}(z)\right)\right] \quad (2)$$

And the leftover inventory is the difference of the quantity and the sales. Demand-supply mismatch cost includes the cost of leftover and the cost of lost sales. In other words, it includes the “too much” cost as well as the “too little” cost. The maximum profit is the profit that contains no mismatch costs, which means every item has been sold without any sales losses (Table 3).

Mismatch cost-quantity ratio implies the risk of each product. In actual situation, companies need to reduce mismatch costs with make-to-order, that is ordering more after some demand occurs. The order strategies depend on the availability and the cost of reactive capacity. Reactive capacity is the capacity obtained after observing market demand. In this case, after getting the information about the market demand from the Las Vegas show, the Sport Obermeyer could make the second order considering the higher unit cost and the limited capacity. So this paper obtain the final result based on this ratio (Table 4).

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Table 3: Profits of each product and the mismatch-quantity ratio

Style	Ave.	2*Std	Q	price	Expected profit	Max profit	Mismatch cost	Mismatch-Q
Gail	1017	388	1278.7	$110	22509	26849	4340	3.39
Isis	1042	646	1477.7	$99	18255	24758	6503	4.40
Entice	1358	496	1692.5	$80	22039	26074	4035	2.38
Assault	2525	680	2983.7	$90	48317	54540	6223	2.09
Teri	1100	762	1614.0	$123	22941	32472	9531	5.91
Electra	2150	807	2695.0	$173	75071	89268	14197	5.27
Stephanie	1113	1048	1819.9	$133	21353	35527	14174	7.79
Seduced	4017	1113	4767.0	$73	62116	70378	8262	1.73
Anita	3296	2094	4708.4	$93	53764	73567	19803	4.21
Daphne	2383	1394	3323.2	$148	63665	84644	20979	6.31

Table 4: Final results of two order decisions

Product	Q	Exp profit	Max profit	Mismatch cost	Mis-Q ratio	1st order	2nd order	Profit
Seduced	4768	62116	70378	8262	1.73	4768	0	62116
Assault	2984	48317	54540	6223	2.09	2984	0	48317
Entice	1693	22039	26074	4035	2.38	1693	0	22039
Gail	1279	22509	26849	4340	3.39	1279	0	22509
Anita	4708	53764	73567	19803	4.21	4708	0	53764
Isis	1478	18255	24758	6503	4.40	0	1042	24758
Electra	2694	75071	89268	14197	5.27	0	2150	89268
Teri	1614	22941	32472	9531	5.91	0	1100	32472
Daphne	3323	63665	84644	20980	6.31	0	2383	84644
Stephanie	1820	21353	35527	14174	7.79	0	1113	35527
Total	26360	410028	518076	-	-	15431	7788	475412

The paper chooses to place the five products with the lowest ratio in the first production. The quantity of each product is the calculated quantity Q. For the remaining five products, which has higher ratio, the paper places them in the second round and their quantity is the mean value of the committee's predictions. Under such allocation, the company's sales risk will be greatly reduced. The Newsvendor profit is the sum of the expected profit while the reactive capacity profit is the total actual profit after allocation. From this, it can be concluded that the reduction in mismatch cost is 61%.

The second issue that the company faces is the allocation of production in Hong Kong and mainland China. The company's original plan is to produce half of the products in mainland China. The minimum order quantity of factories in mainland China is greater than that of Hong Kong factories. Combining these conditions with the assessment of the product risks above, the paper decides to put the first order production in China mainland since the first batch of clothing is relatively stable and profitable. And the second order production is put in Hong Kong since the time is relatively tight and the production per order is relatively low.

In the short term, the order decision and the supplier selection the paper makes for this case has fully reduced the risk for the company. In the long term, there are many details in the case to be improved by the enterprise. Since the continuous growth of China's foreign trade in the 21st century,

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export quota restrictions have been lifted, and the quality of goods has also continued to increase. Supplier selection can be transferred to Chinese Mainland which has lower production costs. For material suppliers, they should also gain more access to production information, optimize design, and increase safety inventory to shorten lead times, such as the production and

delivery of parkas' buttons. Besides, the enterprise should select subcontractors who can adopt more flexible production lines to reduce the minimum order quantity. They could design the process for small unit production or they may have more flexible cutting machine. These measures can prepare in advance for situations of insufficient production capacity.

In this case, there are already some effective methods that the Sport Obermeyer applied to manage uncertainty and risk. The company provides a method of committee forecast to reduce risks. This approach can now be improved and expanded in multiple directions. By conducting market research and collecting feedback from grassroots sources, predictions can be made more democratic. There is also a method called Delphi Method that is hiding the identity of the members participating in the study, with each person having the same importance, and summarizing the opinions of each participant through a questionnaire survey, and then anonymously share them with a new round of questionnaires before providing feedback to each member. On the other hand, forecasting requires an effective process. Based on this process, the enterprise selects appropriate models and software. By incorporating continuous evaluation and correction into the process, enterprises can improve the accuracy of predictions and align them with their development plans. The process of modeling and calculating predictions requires accurate business analysis methods, such as the Newsvendor model, linear regression. The Sport Obermeyer also uses the reactive capacity that reduces risks in production. This method enables production to have a certain degree of reactivity, that is enterprises can obtain more market feedback information to adjust production. According to its principles, low risk products need to be produced in advance based on long-term predictions with the goal of minimizing costs. The decision on the production of high-risk products should be postponed until there is accurate information of demand for each style.

4. Conclusion

Business analysis plays a crucial role in the development of modern enterprises. This paper uses some methods in this field to solve two core issues confronting the Sport Obermeyer, order decisions and suppliers selection. After modelling and calculating the data and evaluating the risks, the article provides the results.

From the perspective of long-term development of the enterprise, the article optimizes its existing strategies. Its decision-making needs to have clearer processes and cover more content. By analyzing the market, it can understand the positioning in the market and develop reasonable marketing strategies. Through cost analysis, it can control costs and improve profitability. Besides, by analyzing customers, it can understand their needs and preferences, refine operations, and improve customer satisfaction.

Nowadays, analyzing risks and managing supply chains through business analysis requires more about digital technology. Based on data, enterprises can quantify the current situation and eliminate ambiguity. Further processing of data through the internet can generate more valuable information. Business judgment also requires data as a standard to reduce the risk of prediction and sometimes as a clue to explore the causes of problems. Therefore, enterprises need to constantly follow the footsteps of business analysis to make the right decisions.

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