Case Sport Obermeyer

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q.1 Calculation for Optimum Order Quantity

- Known Factors
  - Average demand of style
  - SD of demand for each style
  - Probability density distribution of demand
  - Cu = 24%
  - Co= 8%

- Given: Q*= optimum order quantity
  - μ_i=mean of demand of each style
  - σ_i=standard deviation of demand of each style

Based on Newsvendor Model

- Calculation
  - $F(Q^*)= Cu/(Co+Cu)$
  - $F(Q^*)= 24\%/(8\%+24\%)$
  - $F(Q^*)= 0.75$
  - $\phi((Q^*-\mu i)/\sigma i)=0.75$
  - $(Q^*-\mu i)/\sigma i=0.6745$
  - $Q^*=\mu i+0.6745\sigma i$

Table 1. The Newsvendor model parameters and order quantity as fractile of demand.

profit = unit cost of underage $=c_u$	24 %
loss = unit cost of overage $= c_o$	8 %
$F(Q^*)= c_u / (c_u + c_o) =$	**0,75**

Table 4. Optimal order quantities per style, and their scaling to 11 000 units.

	Individual Forecasts										
Style	Laura	Carolyn	Greg	Wendy	Tom	Wally	Average Forecast	Standard Deviation	Std. Dev of Demand	Q*= optimum order quantity	Scaled to 11 000
Gail	900	1 000	900	1 300	800	1 200	1 017	194	388	1 278	534
Isis	800	700	1 000	1 600	950	1 200	1 042	323	646	1 478	617
Entice	1 200	1 600	1 500	1 550	950	1 350	1 358	248	496	1 693	706
Assault	2 500	1 900	2 700	2 450	2 800	2 800	2 525	340	680	2 984	1 245
Teri	800	900	1 000	1 100	950	1 850	1 100	381	762	1 614	673
Electra	2 500	1 900	1 900	2 800	1 800	2 000	2 150	404	807	2 695	1 125
Stephanie	600	900	1 000	1 100	950	2 125	1 113	524	1 048	1 819	759
Seduced	4 600	4 300	3 900	4 000	4 300	3 000	4 017	556	1 113	4 767	1 989
Anita	4 400	3 300	3 500	1 500	4 200	2 875	3 296	1 047	2 094	4 708	1 965
Daphne	1 700	3 500	2 600	2 600	2 300	1 600	2 383	697	1 394	3 323	1 387
Total	20 000	20 000	20 000	20 000	20 000	20 000	20 000	4 714	9 428	26 359	11 000

Operational Performance

- Main issues related to long lead times
- Complex supply chain
- Limited supplier capacity
- Forecasting accuracy
  - Risk of stock-out
  - Risk of unsold items
- High product variety
  - Variety in materials and components
  - Lead time

Component	Variety	Procurement Lead Time	Average % of Total Parka Material Cost
Zippers	400 standard tape colors 4 teeth gauges 4-5 teeth colors 2-3 teeth materials 5-6 slider types	standard: 60 days custom: 90 days	12 %
Thread	80 colors	30 days	2 %
Snaps (undyed)	10	1-2 months	3 %
Dyeing of Snaps	50	15-30 days	1 %

Production Allocation

- Issues to consider:
    - Production costs
    - Labour Efficiency
    - Process Efficiency
    - Order Quantity
    - Conflict of Interest

	Hong Kong	China
Pros	• smaller lot sizes • flexible • efficient • high-skilled workers • high quality • high realiability	• very low labour costs • provides more capacity
Cons	• expensive	• larger lot sizes • less flexible • less efficient • possible quality issues • possible reliability issues • possible ethical issues

Recommendations for Operational Performance

- IT system incorporating sales data
    - Accurate response -> decrease risk
- Decrease variation in styles, components and materials
    - Decrease in procurement lead times
    - Inventories for high volume, low cost products
- Booking volume from facilities and suppliers instead of specific orders/styles
    - Later specifying what to produce -> flexibility
- Seattle distribution center

Recommendations for Production Allocation

- Short-Term: Hong Kong
  - Reliable, flexible and efficient processes
  - High skill levels
  - China too risky, with mere cost estimates
  - Test-run China with less critical, high-volume styles
- Long-Term: Increasingly China, alongside Hong Kong
  - Identify critical areas of development in China
  - Improve processes, Train workers
  - Get minimum order quantities down
  - End Goal: Have two equally efficient production plants at hand

Case Sport Obermeyer

PRODUCT AND INVENTORY MANAGEMENT

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Contents

1. Introduction

Sport Obermeyer Ltd. was founded in 1947 by Klaus Obermeyer, a German engineer. The company offered a plethora of fashionable yet functional ski apparel, ranging from parkas to skiing accessories. The company aimed at offering the best price-to-value ski apparel and targeted the mid-high end of the skiwear market. Sport Obermeyer offered a great variety of skiwear items with the parka as its most critical model. Other products were designed to match the parka in terms of colour and design. The products were offered in five different genders and within each gender various styles were offered in several colours and sizes. The firm's strategy relied on delivering products to retailers early in the selling season. Matching collection of products were delivered at the same time to enable consumers to purchase matching products. Early delivery of new collections gave Sport Obermeyer a competitive advantage where they were able to maximize the sales period from September to January and provide products to consumers before their competitors. Production orders were divided into two separate orders, both representing half of the annual production. The 1st orders are based on the demand forecasts of a buying committee which reflected their 'gut feel'. This led to inaccurate forecasts and deep discounts and lost sales towards the end of the season. The 2nd orders are placed after a Las Vegas fashion show, after receiving the first feedback from retailers, and represent the demand rather accurately.

Sport Obermeyer is currently producing its garments in two locations, Hong Kong and China. The previous year two thirds of Obermeyer's sourced materials were cut and sewn in their current facilities in Hong Kong and one third of the production was allocated to independent subcontractors in China. This year, the company has decided to move at least half of its production to China, using both independent subcontractors and their new plant in Lo Village. The firm is struggling with operational issues such as long lead times and the long waiting period before hearing any feedback from the market. Additionally, the company founder and his son, Wally Obermeyer, the Vice President of the company, have different management approaches with Klaus relying on intuition and industry experience, and Wally relying on formal data gathering and analytical techniques. Wally is struggling with two main questions, how to measure demand uncertainty from disparate forecasts, and how to allocate production between the factories in Hong Kong and China.

This report will discuss the operations and inventory management of Sport Obermeyer Ltd. and examine the allocation of production between the two factories divided in two main sections, analysis and recommendations. Firstly, the operations of Sport Obermeyer are analysed critically, identifying the main issues the company is struggling with. Secondly, all the factors affecting the sourcing decision between Hong Kong and China are discussed. The report then moves onto giving recommendations on each issue, starting with providing a recommendation on how many units of each style Wally Obermeyer should order during the initial phase of production. Following, recommendations on operational changes to improve performance, and recommendations on sourcing location, in both short-term and long-term, are given. Finally, the report ends with a concluding chapter.

2.Analysis

2.1 Order Quantities for First Phase of Production

Sport Obermeyer divides their production orders into two separate orders, both which represent half of the annual production. The first order was based on the demand forecast of a buying committee with lower accuracy levels. The first production order was the riskiest since the demand forecast was based on the intuition and experience of the buying committee, consisting of the managers of the company. The second order was placed after Las Vegas fashion show, representing the demand rather accurately. To get more accurate forecasts already for the first production order, Sport Obermeyer should incorporate risk on their calculations.

The appropriate model for incorporating risk would be the Newsvendor model where the approach is based on a probability density function, and the demand is a random variable. (Kuula 2017) For Sport Obermeyer, the expected profit on each parka was 24% and the loss of an unsold parka was 8%. These figures correspond the unit costs of underage and overage. The optimal order quantity is the fractile of demand distribution given in Table 1. This equation results in the probability of 0.75. The recommendation on allocating production quantities for the initial phase of production is presented later in the report.

Table 1. The Newsvendor model parameters and order quantity as fractile of demand.

profit = unit cost of underage = c_u	24 %
loss = unit cost of overage = c_o	8 %
$F(Q^*) = c_u / (c_u + c_o) =$	**0,75**

2.2 Operational Performance

2.2.1 Lead Times and Forecasting

The main issues at Sport Obermeyer are long lead times in a complex supply chain, limited supplier capacity and demand forecasting inaccuracy. The main operational issues in order to improve performance are primarily related to lead time. All the secondary factors are a consequence of long lead times. In total the planning and production cycle takes nearly two years and is presented in exhibit 4.

Due to long lead times and limited supplier and manufacturing capacity, Sport Obermeyer needs to start production of new collections before they have accurate forecast from retailer demand. To avoid unsold items and stock outs, the company uses accurate response to minimize forecasting errors. Accurate response is an approach where planning process is redesigned at the same time when forecasts becomes more accurate (Fisher et al. 1994). Similarly, Sport Obermeyer's demand forecasts become more accurate for the second production order, which was based on the retailer feedback received at the Las Vegas fashion show.

Sport Obermeyer strategy relied on delivering products to retailers early in the selling season, in early September. The matching collection of products were delivered at the same time enabling the consumers to buy matching products. Early delivery of new collections gave Sport Obermeyer competitive advantage when they could maximize the sales period lasting from September to January and bring products available to consumers before their competitors.

The long lead time in transportation is one of the factors that affects the supply chain. Before retailer selling period in June and July, the finished products are transported by ship from Hong Kong to Seattle . Subsequently, the materials are transported by truck to the Denver distribution centre. Total transportation took approximately 6 weeks, revealing lost time due to transportation inefficiencies.

The products produced in China for U.S import are limited due to quota restrictions imposed on the total amount of all products. Because of this quota restriction, every company is in a hurry to import their goods before the quota limit is exceeded. From Exhibit 9, the cost of sea freight is \$1.4 and cost of air freight is \$5.

2.2.2 Product Variety

It can be extrapolated that the total number of stock keeping units has varied significantly over time. The lowest SKU (Stock Keeping Unit) of 200 was in 1978-1979 and the highest at SKUs of 700 in 1993/1994. Conversely, the number of styles from 1989/1990 to 1993/1994 has been relatively constant at 15 to 17 styles. Additionally, the average number of colours per style has decreased to 4 or 5 while the average number of sizes per style-colour combination has increased to 9 in 1993/1994. Overall, it can be seen that the firm produces a large variety of products.

Due to the variety in end-products, a great variety of additional components is also required. *Exhibit 6* presents the procurement information for Obermeyer's parka components.

As seen from *Table 2*, the lead time for low-cost items are high. A simple product such as a snap can be easily manufactured. This component comes in a variety of 10 to 50 colours despite its simplicity, and the lead time to procure an undyed snap is between 1 to 2 months. The snaps then need to be coloured with a lead time of 15 to 30 days. Despite all this effort, the cost of procuring and dying snaps contributes only 3% and 1% of the average percentage of total parka material cost.

Table 2. Component variation and lead times. (Modified from Hammond & Raman, 1994)

Component	**Variety**	**Procurement Lead Time**	**Average % of Total Parka Material Cost**
Greige Shell Fabric	10	45-90 days	30 %
Finishing of Shell Fabric	8-12	45-60 days	13 %
Finished Lining Fabric	6	45-60 days	13 %
Insulation	3-4	2-3 weeks	16 %
Zippers	400 standard tape colours 4 teeth gauges 4-5 teeth colours 2-3 teeth materials 5-6 slider types	standard: 60 days custom: 90 days	12 %
Thread	80 colours	30 days	2 %
Logo Patches, Drawcords, Hang Tags, etc.	various	15-30 days	10 %
Snaps (undyed)	10	1-2 months	3 %
Dyeing of Snaps	50	15-30 days	1 %

2.3 Product Allocation

2.3.1 Production Costs

Examining the overall production costs of both plant locations, the major differing component is labour costs. The labour costs in Hong Kong are significantly more expensive than in China as the hourly wage is $3,85 in Hong Kong and $0,16 in China. Consequently, despite the higher efficiency levels of workers in Hong Kong, the labour cost per garment is about 12 times more expensive in Hong Kong ($9,69) than in China ($0,78). Hence, looking merely at the labour costs and putting ethical issues aside, the decision would be easy as the numbers are clearly in favour of China.

However, looking at the overall landed costs of a garment for Obermeyer, there are no huge differences in the numbers except for the above-mentioned labour costs. Overall, producing a parka coat is 15,7% cheaper in China ($51,92) than in Hong Kong ($60,08). The biggest contributor to this difference in the costs is the difference in FOB costs, which again results from the differing labour costs. Other than that, there are only slight differences in the FOB cost related agent’s fees, and the duty, insurance and miscellaneous costs. The latter cost component is 8% more expensive in Hong Kong but the difference only accounts for $0,39.

Examining the FOB cost paid for freight and owned products more closely, the material, and the quota, Obersport profit and overhead cost components are the same for both locations. Hence, while materials are the single largest cost component in producing a garment, the costs of sourcing them seem to be independent on the location as the cost of materials is set at $30 for both Hong Kong and China. Otherwise, the small cost of $2 that is needed for transporting the goods within China does not affect the bigger picture. The sole factor that contributes in making production in China significantly cheaper is thus labour costs.

2.3.2 Labour Efficiency

One of the factors that could only be estimated so far for China is the skill levels of the workers. While the newly hired 200 workers were now in training at the facility, it was expected that their skills would not correspond the skills of Hong Kong workers. The workers in Hong Kong were trained in a broader range of tasks, were more highly skilled and could work up to 50% faster than their Chinese colleagues. While a single parka line required 40 workers in China, it only required 10-12 workers in Hong Kong mainly due to their cross-training and ability to work with diverse tasks. The workers in China would thus need extensive training, which again would come at a price. Even then, the repair rate in China was estimated to be around 10%, 5-10 times more than in Hong Kong (1-2%), and this was only an estimate. To sum up, there is a prevailing concern over the quality of production in China. Possible issues with quality and reliability are not ones to overlook as they may have far-reaching effects not only on the production and training costs but also on indirect costs such as decreased customer satisfaction and brand image. Moving production to the new plant in China too rapidly could prove a risky decision when no proof of sufficient quality and training is yet available.

2.3.3 Process Efficiency

Another closely related factor is the process efficiency of the two locations. As mentioned, a work line in China required up to 4 times more people than in Hong Kong and the workers in Hong Kong could work 50% faster than the workers in China. In addition, the production lines tended to be longer in China.

Although these differences were somewhat considered in the labour costs through working hours, the cost of the lacked efficiency had not been otherwise estimated. Surely, the fact that a sewer in Hong Kong could produce a two times greater output during a given period of time than a Chinese sewer could be seen in cost savings through faster, more efficient production quantities. On a weekly basis, whereas a worker in China could produce 12 parkas, a worker in Hong Kong could produce 19 parkas, 58% more. Thanks to their cross-trained skills and higher process efficiency, the workers in Hong Kong were also able to ramp up production faster.

2.3.4 Order Quantity

Consequently, Hong Kong was able to produce up to two times smaller order quantities compared with China, having the minimum order quantities at 600 and 1200 in consecutive order. Smaller order quantities naturally provide Obermeyer with more flexibility and enabled more agile production planning. Such flexibility is crucial in the fashion industry where production must start before receiving first orders from the retailers, and especially at Obermeyer where forecasts and production planning were subject to continuous changes when gaining more information on the market response to their collection. Hence, moving more and more production to China would be risky as it might constrain the company’s ability to manage production in terms of the range of products offered, and to manage its inventory risks. Conversely, what could give production in China more flexibility and compensate some of the lacked efficiency, is the larger amount of working hours and maximum overtime available. Workers in China work 1 hour more per day and 0,5 a day more per week than their colleagues from Hong Kong which compensates a bit on their slower working pace. Additionally, the peak production periods are addressed by workers working 13 hours a day in China whereas the plant in Hong Kong has a maximum of 200 hours of overtime allowed per year. To sum up, the China’s working hour arrangements provide additional flexibility but do not make up for all the deficiencies in their production processes and operations.

2.3.5 Conflict of Interest

Finally, the firm should consider the possibility of Raymond Tse's conflict of interest in moving Obersport's sourcing to China. Raymond is the managing director of Obersport Ltd and responsible for sourcing the fabric and components in the Far East for Sport Obermeyer's production. He is also the owner of the Alpine factories of which production capacity 80% is filled by Sport Obermeyer's orders. The decision to invest in a new Alpine factory in Lo Village, the home village of Raymond's parents, was inspired by Raymond's visit to his childhood village and by the local community persuading him to invest in the area. Consequently, Raymond had decided to invest over $1 million in the facility complex that could provide jobs and wealth for over 300 workers. The level of critical analysis on the investment decision is thus unclear. It would naturally be in Raymond's best interest to move as much of Obersport's sourcing and hence Obermeyer's production as possible to the costly new facility in China, as Obermeyer represented the largest client of Alpine factories. Furthermore, the company founder, Klaus Obermeyer had always trusted his joint venture partner, relying on Raymond's judgement on production and investment decisions. This combined with Raymond's possible exterior interests on providing wealth to the place of his origins give reason for further scrutiny over the decision of moving production to China. The sourcing decision must be analysed critically from Sport Obermeyer's perspective instead of anyone else's, considering all of the factors discussed earlier. To sum up, the pros and cons of producing in Hong Kong versus China are presented in Table 3

	Hong Kong	**China**
Pros	• smaller lot sizes • flexible • efficient • high-skilled workers • high quality • high realiability	• very low labour costs • provides more capacity
Cons	• expensive	• larger lot sizes • less flexible • less efficient • possible quality issues • possible reliability issues • possible ethical issues

Table 3: The pros and cons of producing in Hong Kong versus China

3. Recommendations

3.1 Order Quantities for First Phase of Production

Wally Obermeyer had found that the standard deviation of demand for a style was twice the standard deviation of the average forecast. When the probability, the average forecast of each style and the standard deviation of demand were known, the optimal order quantity could be calculated. The optimal order quantities per style are presented in Table 4. The minimum order quantity was scaled to 11 000 for the initial phase of production. The detailed calculations for optimum order quantities can be found from Appendix I.
To reduce the risk of quota restrictions, the management should plan to produce most of their products in China and to deliver the finished garments by air freight to the U.S. Although air freight is more costly than sea freight by $3.6/unit, it still made more financial sense if the products were to be unsold. The company would lose at least $5.84/unit (*Exhibit 10*, the cheapest product is $73 while expected loss if left unsold is 8% of wholesale price equivalent to $5.84). Therefore, it is worth importing products to US by air freight. In addition, management should negotiate the retailer to place his products earlier than rivals to increase opportunity for more sales

	Individual Forecasts										
Style	Laura	Carolyn	Greg	Wendy	Tom	Wally	Average Forecast	Standard Deviation	Std. Dev of Demand	Q*= optimum order quantity	Scaled to 11 000
Gail	900	1 000	900	1 300	800	1 200	1 017	194	388	1 278	534
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Electra	2 500	1 900	1 900	2 800	1 800	2 000	2 150	404	807	2 695	1 125
Stephanie	600	900	1 000	1 100	950	2 125	1 113	524	1 048	1 819	759
Seduced	4 600	4 300	3 900	4 000	4 300	3 000	4 017	556	1 113	4 767	1 989
Anita	4 400	3 300	3 500	1 500	4 200	2 875	3 296	1 047	2 094	4 708	1 965
Daphne	1 700	3 500	2 600	2 600	2 300	1 600	2 383	697	1 394	3 323	1 387
Total	20 000	20 000	20 000	20 000	20 000	20 000	20 000	4 714	9 428	26 359	11 000

Table 4. Optimal order quantities per style, and their scaling to 11 000 units.

3.2 Operational Performance

Firstly, in order to improve their operations and decrease procurement lead time, Sport Obermeyer should decrease the variety in their products. There may not be a need for different colours and components for each style. They could redesign their products to use the same standard components and materials. This results to decrease in procurement prices since higher order quantities can be made for lesser products compared to lower order quantities for higher amount of product variety. For example the lead time for a standard zipper is 30 days compared to 90 days of lead time for a custom zipper. If the styles variation is insisted to be kept, the safest standard styles should be produced first and the more risky fashion styles after sales response and more information on demand.

Secondly, delivering products from Seattle warehouse to the Denver distribution centre is redundant and time consuming. Our analyses recommend setting up the Seattle warehouse as another distribution centre for sea freight, to be able to distribute goods immediately and hence prevent wastage of resources.

Thirdly, Sport Obermeyer should consider establishing inventories for material components that have high volume and low price but long lead times. The effect is even higher with standardized components. Items such as threads and snaps should be suitable for inventories. As a result these components would be ready to use in manufacturing as soon as the order would be placed and hence decrease the lead time.

Following, Sport Obermeyer could use their purchasing power and only book production capacity from facilities, and material volume from suppliers in advance, instead of placing style-specific orders. Later, having more market information, the company could specify the styles to be produced. This approach would provide them more flexibility on production planning decisions, especially in case of demand fluctuations. However, this approach would also require the implementation of the previous recommendations since the approach would be more effective with less styles, and standard components that could be rapidly harnessed from the inventories.

In terms of its operations, Sport Obermeyer should make efforts to prevent inaccurate forecasts of retailer demand. They should move their forecasting strategy to formal data gathering in order to have historical data and use analytical techniques to improve forecasting in the first phase. In the fashion industry, the business' suitable method of analysis should be a combination of statistical forecasting and judgemental input of future events. The statistical forecasting consists of a mathematical model affected by historical data while the qualitative aspect consists of human input that weigh in on marketing judgements or competitor reactions.

Forecasting error should also have a feedback system affecting both judgemental input and statistical forecast (*Silver et al., 1998*). This framework is also presented in Figure 1. Furthermore, Sport Obermeyer should introduce IT systems that could function reactively according to the framework. The system should react to products that are in danger to be sold out and to products that have a risk of not being sold, or in other words incorporate sales data in the system. Introducing this approach leads to reduction of costs resulting from insufficient inventories and forecasts.

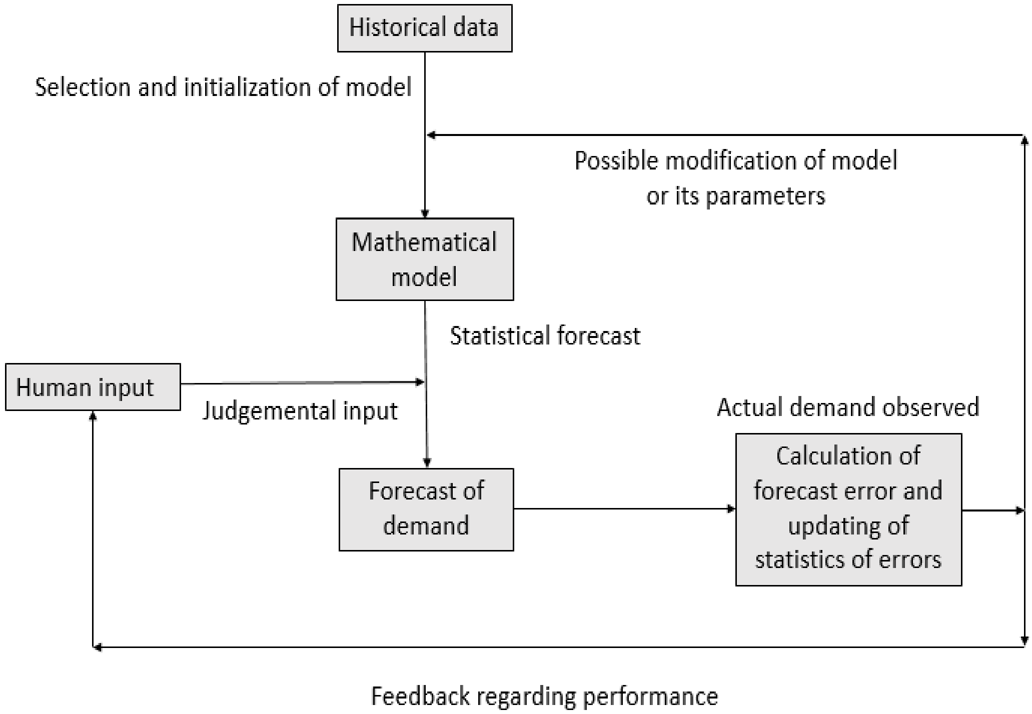

Figure 1. A Suggested Forecasting Framework (Silver et al. 1998).

Additionally, to reduce the risk incurred by the quota restrictions, the management should plan to produce more of their products in China and to deliver the finished garments by air freight to the U.S. Although air freight is more costly than sea freight by $3.6/unit, it still would a good alternative opportunity if there is a rush in the order since if the products were to be unsold, the company would lose at least $5.84/unit (*Exhibit 10*, the cheapest product is $73 while expected loss if left unsold is 8% of wholesale price equivalent to $5.84). Therefore, it may be worth importing products to US by air freight. Otherwise, if there is no hurry, sea freight would still be the main form of transport. In addition, management could negotiate the retailer to place their products earlier than rival products, to increase the opportunity for more sales

3.3 Production Allocation (short-term and long-term)

Sport Obermeyer should opt for a hybrid solution when it comes to their sourcing strategy. Short-term, they should keep most of their production in Hong Kong, where reliable, flexible and proven efficient processes and high skill levels already exist. Although allocating production rapidly to the new plant in China may seem compelling thanks to the very low labour costs, the possible deficiencies in the production quality, the inferior skills levels and required training make China too risky of an option in the short-term. The figures on China's labour costs, repair rates and required work forces are still mere estimates.

As the demand for workforce and the figures discussed earlier are based on estimates of possible production levels allocated to the plant by Obermeyer, the final demand for workforce, as well as worker skill and productivity levels are hard to predict precisely. Thus, in order to avoid the risk of surprising additional costs and hidden costs, as well as of being tied to larger order quantities with possible quality issues, Obermeyer should wait for some actual data on the new plant's operations. To do that, they should allocate small "test runs" of production to the plant, including the minimum order quantities of a few well-selected, less critical and less complex high demand garment styles. Simultaneously, while developing and testing the operations in China, Obermeyer should keep most of its production including the more critical and complex pieces and pieces with smaller demands, at Hong Kong. This way, they maintain their ability to run production in an agile way and to react to the changes in production planning, and don't commit to unnecessary, larger order quantities.

In the long-term, however, Obermeyer should aim at allocating their sourcing and hence production more to China, at least for products with large planned production quantities. After testing the plant in Lo Village in action and being able to confirm the relevant figures on labour requirements, skill levels and efficiency, Obermeyer management should be able to pinpoint the possible weaknesses and critical areas of development in their new facility. Following, they should use the necessary time in improving their processes at the plant, giving the necessary cross-training for the Chinese workers, and ensuring that the required skill and quality levels are met. Once the essential improvements were achieved, Obermeyer could start moving production more and more to China over time, as the labour costs are significantly lower there. Investing in these improvements over time would also result in achieving smaller minimum order quantities at China too. This approach allows Obermeyer to not only safeguard their operations and minimise the risk related to sourcing their fabric and components but also to eventually have two, equally high-level production plants at their use in the long-term. Such situation would provide the company with further production capacity and flexibility in production planning as well as enable them to develop the plants further in more specialised, innovative directions.

To sum up, moving to China gradually does seem like the alternative in the long-term but in order to maintain the ability to manage production and inventory risks and to avoid costs incurred by committing to larger order quantities, a too hasty decision in the short-term would not yield the best results. Thus, Sport Obermeyer should stick with Hong Kong while developing the operations in China until they reach proven, satisfactory levels, or in other words secure the quality and reliability of their operations while developing a financially and operationally ideal solution of two equally efficient plants.

It should also be noted that the cost calculations for the plant in China are merely estimates for now. Should the efficiency level or repair rates of a worker prove to actualise in a negative trend, the difference in the labour costs could get smaller. Furthermore, the costs are now based on a per garment model, and the output per worker and other efficiency measures have not been accounted for, meaning the yearly cost figures could look different. In other words, relying too much on these cost estimates and the perceived savings in moving to China could be deceiving as hidden costs linked to the reliability and quality of the work done are not factored in. Overall, these are factors to examine separately.

Lastly, there may be other considerations that can influence the decision in the long-term. While the workers in both locations are paid on a basis consistent with competitive wage rates in the respective communities, some ethical concerns may arise when moving production to low-cost countries such as China. Brand management wise, it might be beneficial for the firm to market itself as an ethically sustainable company. Recently, a growing number of consumers have aligned themselves in the sustainable business movement. Due to China's blemished reputation for human rights violations, allowing production to remain in Hong Kong, with partnerships or without, where worker rights are upheld, the firm would be able to position itself as a market leader in a booming sector. However, this is a strategic decision for Sport Obermeyer to determine for their brand positioning in the long-term.

4. Conclusion

The aim of this report was to analyse and improve Sport Obermeyer's production allocation between different styles, operational efficiency and sourcing strategy. The risks of stock-outs and unsold items were associated to production orders utilizing the Newsvendor model. The model provided the result for optimal order quantity for each style.

In the analysis of operational efficiency, several issues were identified. Primarily these issues were connected to long lead times, which is crucial in fashion business. It was recommended that Sport Obermeyer would introduce an IT system that would incorporate sales data, and thus improve forecasting accuracy. Additionally, the company should make changes in the supply chain accordingly.

In addition, in order to reduce their lead time in procurement, the company should decrease the variation in their styles. They should redesign the styles to use fewer standard colours and components. Furthermore, they should establish inventories for materials and components that have high volumes and low prices but long lead times. This way these components could be rapidly deployed to production. Sport Obermeyer should also consider if they could only book production capacity in advance and later specify the type of produced items. This approach would provide them with more flexibility and reduce the risk of inaccurate forecasts.

Sport Obermeyer should also consider decreasing distribution lead time by transforming the Seattle warehouse into a distribution centre. This way time wouldn't be wasted on transportation of items from Seattle to Denver.

Lastly, the sourcing strategy of Sport Obermeyer was evaluated for both short-term and long-term allocation decisions. Short-term, they should keep most of their production in Hong Kong, where reliable, flexible and proven efficient processes and high skill levels already exist. In long term, Sport Obermeyer should increase allocating their production to China where production costs are lower. In time, they could improve the overall quality and reliability of production with effective training, and finally have two equally efficient facilities at their hand.

In the end, the possibilities for the firm's short-term and long-term sourcing strategy depend on a variety of factors ranging from foreseen and unforeseen costs to branding equity, all of which depends on what the firm's management deems as crucial.

5. References

Fisher, M., Hammond, J., Obermeyer, W. & Raman, A. 1994. Making Supply Meet Demand in an Uncertain World. Harvard Business Review 72, no. 3, spp. 83–92.

Hammond, J. & Raman, A. 1994. Sport Obermeyer, Ltd. Rev. 2006. Boston, USA: Harvard Business School. 19 p.

Kuula, M. 2017. Inventory 2. [Lecture] 35E00300 - Product and Inventory Management. 25.9.2017

Silver, E. A., Pyke, D. F. & Peterson, R. 1998. Inventory management and production planning and scheduling. 3rd ed. New York: Wiley.

6. Appendix I. Calculation of Optimum Order Quantity

Known:

- Average demand of each style
- Standard deviation of demand for each style (2 standard deviation of forecast)
- Probability density distribution of demand is normal distribution, $F(x)$
- $Cu = 24\%$
- $Co = 8\%$

Solution: Find optimum order quantity

Given: Q^*=optimum order quantity

μi=mean of demand of each style

σi=standard deviation of demand of each style

From newsvendor model, we get

$$F(Q^*) = Cu/(Co+Cu) \tag{1}$$

$$F(Q^*) = 24\%/(8\%+24\%) \tag{2}$$

$$F(Q^*)=0.75 \tag{3}$$

$$\varphi((Q^*-\mu i)/\sigma i)=0.75 \tag{4}$$

$$(Q^*-\mu i)/\sigma i=0.6745 \tag{5}$$

$$Q^*=\mu i+0.6745\sigma i \tag{6}$$

Then, for each style, we use this equation $Q^*=\mu i+0.6745\sigma i$ to calculated optimum order quantity. The result show in table 4.

Sum up optimum order quantity and scale to 11,000 units for ordering during initial phase of production. The result show in table 4.

7. Exhibits

Exhibit 3 Product Variety, Obermeyer Women's Parkas

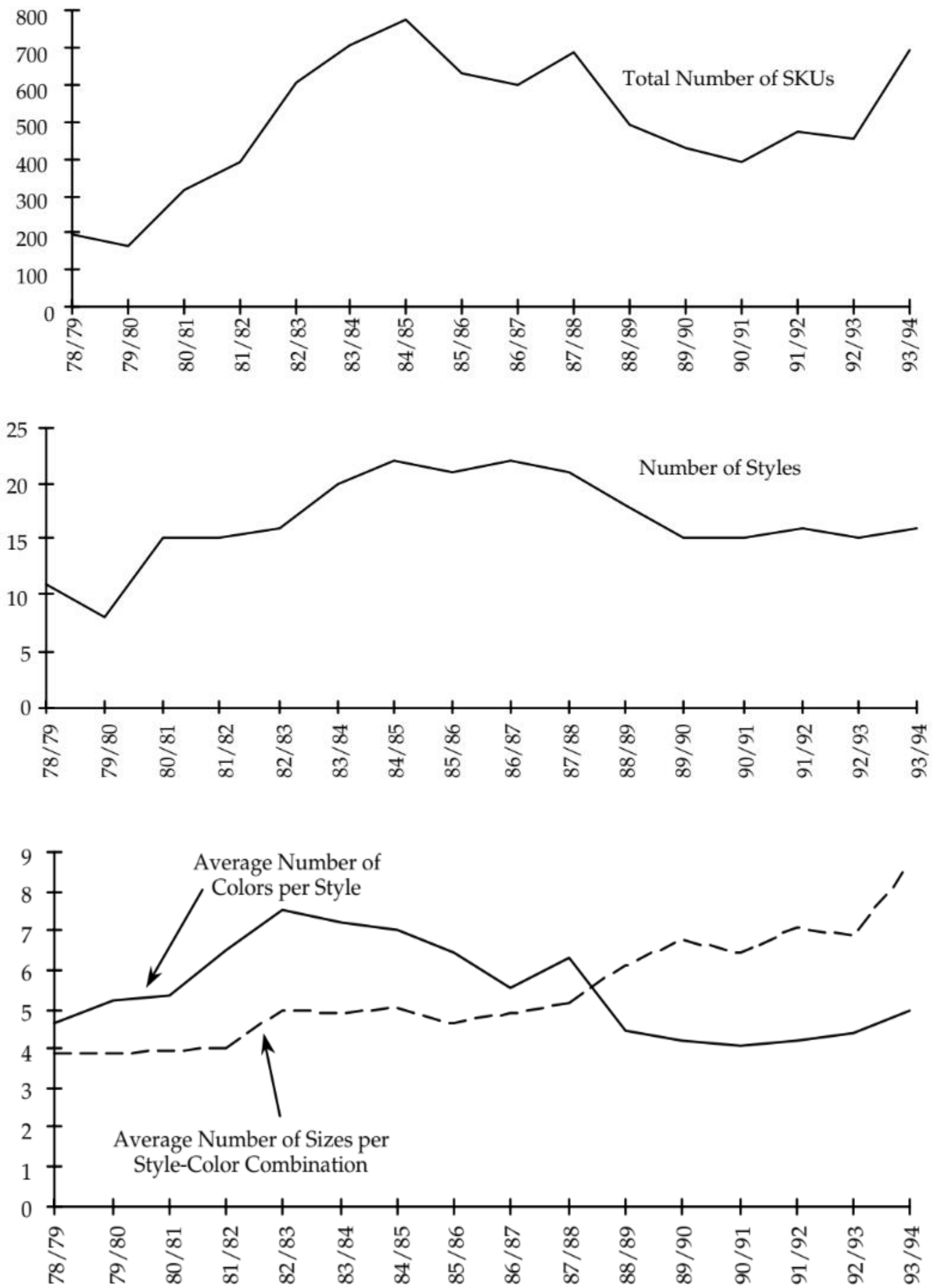

Exhibit 4 Planning and Production Cycle, Obermeyer 1993-1994 Line

Month	*Design Activities*	*Order Receipt and Production Planning*	*Materials Management*	*Production*	*Retail Activities*
Feb 92	Design process begins				
Mar 92	Las Vegas show for 92-93 line				
May 92	Concepts finalized				
Jul 92	Sketches sent to Obersport		Order greige fabric		
Aug 92				Prototype production	
Sep 92	Designs finalized			Prototype production	
Oct 92				Sample production	
Nov 92		*Place first production order with Obersport*	Receive first order • Calculate fabric and component requirements • Order components • Place print/dye orders	Sample production	
Dec 92				Sample production	
Jan 93			Chinese New Year vac.	Chinese New Year vac.	
Feb 93				Full-scale production	
Mar 93		Las Vegas Show for 93-94 line (80% of retailers' initial orders received) *Place second production order with Obersport*	Receive second order • Calculate fabric and component requirements • Order components • Place print/dye orders	Full-scale production	
Apr 93		Additional retailer orders received		Full-scale production	
May 93		Additional retailer orders received		Full-scale production	
Jun 93		Additional retailer orders received		Full-scale production Ship finished goods	
Jul 93				Full-scale production Ship finished goods	
Aug 93				Full-scale production Air freight finished goods	93-94 line delivered to retail
Sep 93					Retail selling period
Oct 93					Retail selling period
Nov 93					Retail selling period
Dec 93		Retailer replenishment orders received			Peak retail selling period
Jan 94		Retailer replenishment orders received			Peak retail selling period
Feb 94		Retailer replenishment orders received			Retail selling period
Mar 94					Retail selling period
Apr 94					Retail selling period

Exhibit 6 Procurement Information for Obermeyer's Parka Components

Component	Variety	Country of Origin	Procurement Lead Time	Minimums	Usage per Parka	Avg. % of Total Parka Material Cost
Greige Shell Fabric	10	Japan, USA, Switzerland, Germany, Austria, Korea, Taiwan	45-90 days	5,000-10,000 yards	2 .2-2.5 yards per adult parka 1.5-2 yards per child's parka	30%
Finishing of Shell Fabric	8-12 color-prints per fabric	Finishing takes place in country of origin (see above)	Dyeing or Printing: 45-60 days	Dyeing: 1,000 yards Printing: 3,000 yards per design, at least 1,000 yards per color in any design	2.25-2.5 yards per adult parka 1.5-2 yards per child's parka	13%
Finished Lining Fabric	6	Nylon: Korea, Taiwan Fleece: Korea, Taiwan, USA	45-60 days	600-1,000 yards	2-2.25 yards per adult parka 1.25-1.75 yards per child's parka	13%
Insulation	3-4 different weights used (from 80-240 grams/meter)	Hong Kong, Korea, Taiwan, China	2-3 weeks	50-100 yards	~ 2 yards per adult parka ~ 1.2-1.5 yards per child's parka	16%
Zippers	400 standard tape colors 4 teeth gauges 4-5 teeth colors 2-3 teeth materials 5-6 slider types	Hong Kong, Japan	Standard (from Hong Kong): 60 days Custom (from Japan): 90+ days	500 yards (standard colors) 1000 yards (custom colors)	~ 1 yard	12%
Thread	80 colors	Hong Kong	30 days	5,000 yards	2,000-3,000 yards	2%
Logo Patches, Drawcords, Hang Tags, etc.	various	Mostly from Hong Kong	15-30 days	various	various	10%
Snaps (undyed)	10	Germany, Italy, Hong Kong	1-2 months	1,000 pieces	5-10 pieces	3%
Dyeing of Snaps	50 colors	Hong Kong	15-30 days	1000 pieces per color	5-10 pieces	1%
						100%