Executive Summary

Sport Obermeyer creates mountain-inspired ski wear that embraces the spirit of skiing with style. Klaus Obermeyer founded this company in 1947 with a pure focus on innovative, high performance ski wear. By 1990, Sport Obermeyer was selling over $32 million dollars of ski apparel annually; and held 45% of the children's ski wear market and 11% of the adult ski wear market.

As demand had grown, sufficient production capacity was scarce; and manufacturing had moved overseas, significantly increasing the supply chain. Lead times now were so long that production orders had to be placed several months before any actual demand was received. Greater product variety and intense competition had made estimating market response especially difficult. Additionally, the supply chain costs and performance varied drastically between Hong Kong and China, which added complexity. Making significant production allocation decisions based on inaccurate forecasts had resulted in painful losses to Obermeyer.

This paper provides an overview of these challenges with supporting detail; and analyses the effect of changing the cost structure, forecast uncertainties, and ordering policy on expected profits. The key recommendations provided are: reduce variety in small components, obtain actual demand earlier in the year from retailers and plan to spread demand throughout the season, and to send orders for styles with lower forecast uncertainty to the Hong Kong plants. When implemented, these recommendations can cut the costs of overproduction and underproduction with better product availability, which will dramatically improve profits.

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Section 1: Introduction

Klaus Obermeyer was born in a small mountain village in Germany in 1919; and grew to love skiing from an early age. By the time he came to Aspen, Colorado in 1947, he had a passion to share that love of skiing with the world. He started out as a ski instructor for this relatively new sport in the US; but quickly noticed many of his students dropped out of his classes because they were miserably cold and unprepared for the elements (Hammond, 1994, p. 3). He was determined to keep his students on the slopes; and he knew the only way to do this was to keep them warm and comfortable. He believed that by designing high performance ski wear that was also stylish, he could attract and delight skiers of all ages. So he founded Sport Obermeyer in his attic and began inventing designs that quickly became industry standards.

Over the next 40 years, Sport Obermeyer grew from of his small attic to a top competitor in the US ski wear market supplied from all around the world. Drawing on his intuitive style and summer trips to Germany, Klaus produced many innovations such as: the first high alpine sunscreen, dual-construction ski boots with a soft inner lining and stiff outer boot, the widely popular two-pronged ski brakes, turtle necks, nylon wind-shirts, mirrored sunglasses, and double lensed ski goggles (Sport Obermeyer, 2017). These products were designed for the upper end of the ski wear market, strategically offering an excellent price/value relationship for ski apparel with excellent technical performance and stunning style (de Treville, 2014, p. 3). By 1990, Sport Obermeyer was selling over $32 million dollars of ski apparel annually; and held 45% of the children's ski wear market and 11% of the adult ski wear market. But several difficult problems were developing as Klaus brought his son Wally, a Harvard MBA, on as his vice president.

The 1st challenge was finding enough production capacity. As demand had grown, production capacity also needed to increase; but by the 1980's Obermeyer was beginning production earlier and earlier in the year due to a lack of sufficient production capacity. In 1985, Klaus and Raymond Tse established a joint venture called Obersport Ltd. to coordinate production in the Far East as orders were being placed 10 months ahead of the season. This had led to the US$1 million investment for a brand-new factory in Lo Village, Guangdong, China.

The 2nd challenge was to accurately predict market response to avoid the added costs of lost sales or inventory liquidation from too little or too much supply. Pressure was mounting on sales and costs because Columbia was taking market share with a lower price strategy, up to 23% of the adult ski-jacket market in 1992. Even the optimistic Klaus Obermeyer characterized the ski wear market as extremely fickle (Fisher, 1994, p. 90). Adding to this challenge was their decision to increase product variety – "expanding the number of stock keeping units from less than 200 in 1980 to around 700 in 1994, with 15 styles, 4–6 colors per style, and 9 sizes per color–style combination, up from 4 in 1980 (Fisher, 1994, p. 91)."

As a supplier in the fashion market, Obermeyer must deal with highly uncertain demand, which needs a more responsive supply chain. (Fisher, 1997, p. 113) Their product mix is supplied components globally and manufactured overseas. When forecast estimates are highly inaccurate, Obermeyer is at a disadvantage due to long lead times or steep discounting at the end of the season. The main advantage of Obermeyer's product mix is its purity of focus. The brand is strongly unified around fashionable high performance ski apparel. Klaus said "I think the reason for the success of this business is that we're not a money-hungry company. We never tried to do it all. We concentrated on alpine ski clothing. We are one of the few clothing companies that is not also doing tennis clothes, biking clothes, etc." (Lukens, 1991, p. 33)

Section 2: Analysis and Recommendations

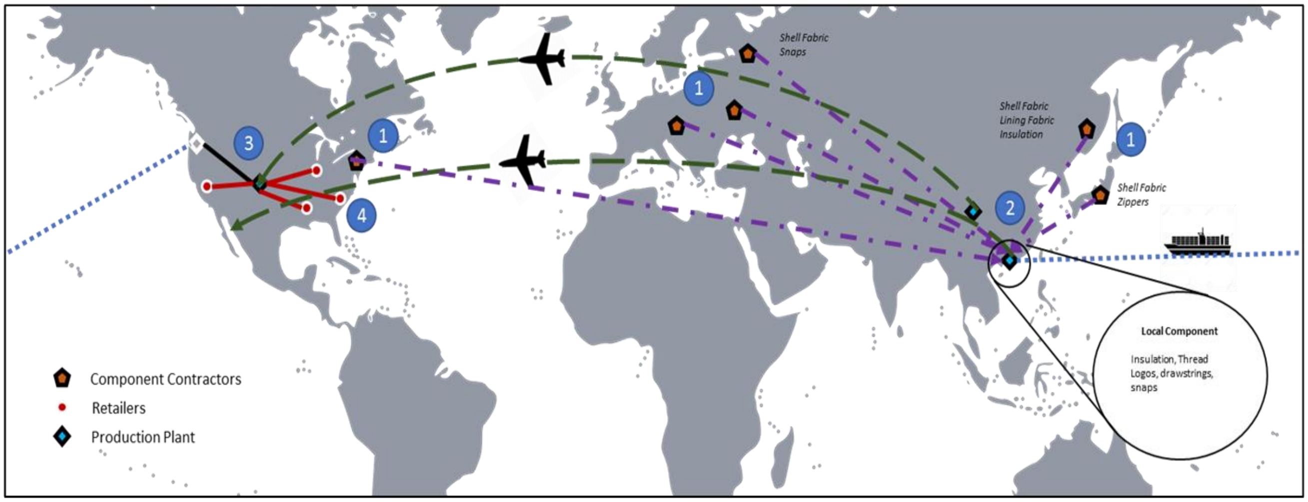
Section 2.1: Order Cycle

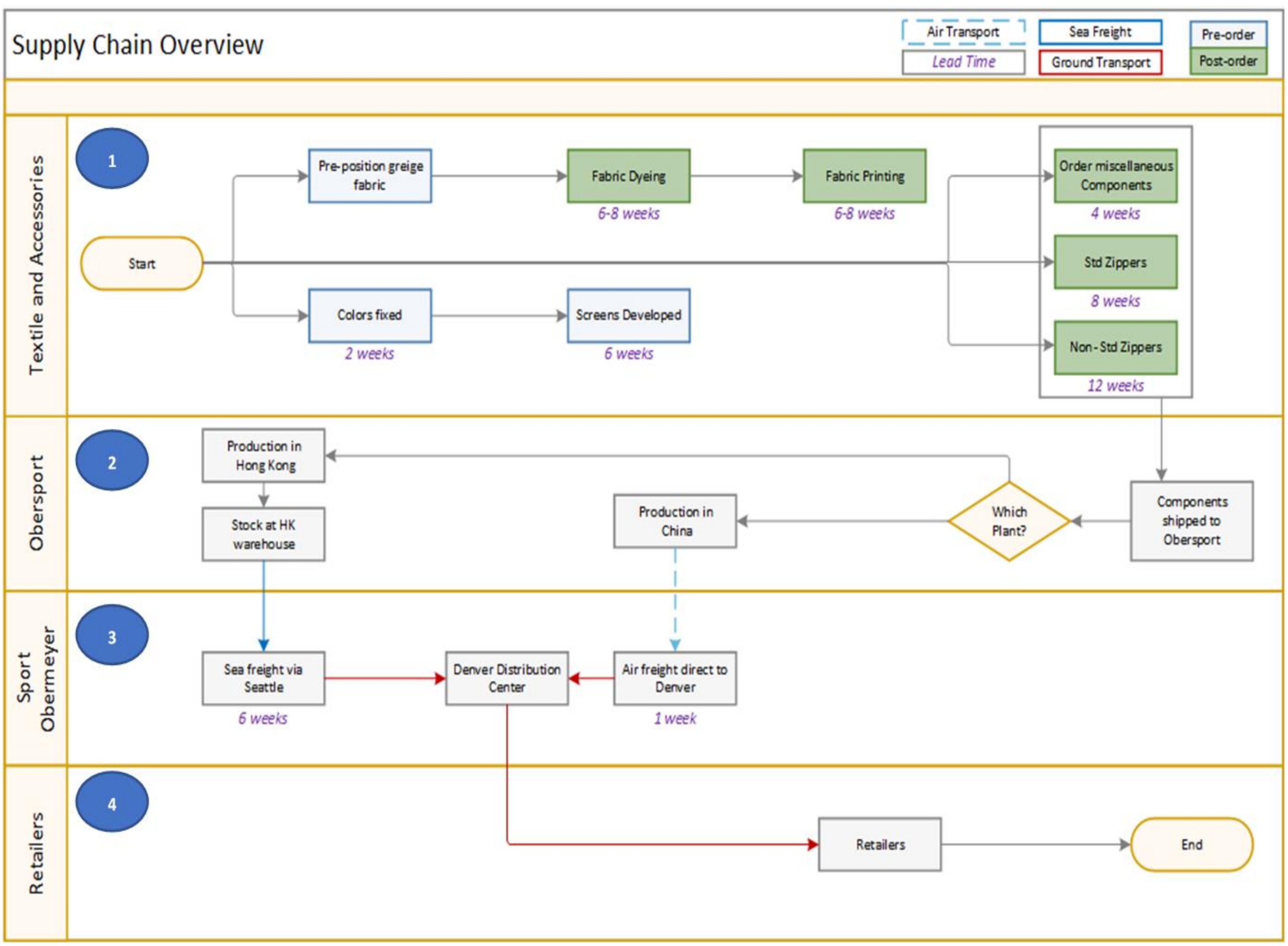
Obermeyer’s strong brand lines and pure alpine inspiration attracted many consumers; but the fundamental success of each year’s line was at the mercy of how accurately they could predict market response to the new styles and colors. Feedback from retailers was not available until 4 months after production had begun. Since most retailers requested full delivery of that season’s orders by September, this meant nearly two years of planning and production activities had taken place prior to the first sale, shown in the timeline below.

	1991				1992				1993				1994			
	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec
92-93 Line	Design			1st Order produced		2nd Order produced		Replenishment		Clearance						
						Orders	Shipping									
93-94 Line					Design			1st Order produced		2nd Order produced		Replenishment		Clearance		
										Orders	Shipping					

In the case of the 93-94 winter season, design activities had started in February of 1992 when the senior management and the design team attended the annual international outdoor-wear show in Munich, Germany. The European fashion trends were strong indicators of what would soon be popular in the US. Then it was off to Las Vegas for a major trade show for ski equipment and apparel in March. These two events provided the key inputs to for the following year’s design concepts. The design and management teams used prototypes made from the previous year’s leftover fabric to improve the design until a final style was agreed on. The final design had to be ready for sample production to begin by September 1992. Samples were produced in small batches for the next 3 months with the actual fabric to be used in the 93-94 products for the March 1993 trade show in Las Vegas. Based on these showcased samples, Obermeyer usually received orders for about 80% of its annual volume from retailers soon after.

Section 2.2: Supply Chain Overview





Section 2.3: Supply Chain Structure

Manufacturing of ski jackets takes place overseas and is coordinated by Obersport. The ski jackets are then shipped to US and sold primarily through specialty ski stores and some outdoor gear stores like REI. Obersport handles component and manufacturing logistics, while Sport Obermeyer handles the retail logistics.

Section 2.3.1: Pre – order activities

To bring the erratic manufacturing lead times under control, Obersport has started using "pre-positioning" of shell fabric, used as both outer and lining fabric. There are around 10 types of shell fabric which are sourced globally from Europe and East Asia. Obersport contracts the suppliers to manufacture and stock the greige fabric; and Obersport agrees to purchase the fabric irrespective of the downstream demand. When Sport Obermeyer sends the 1st order quantities, the greige fabric is dyed and printed at their respective plants. This process has a 12 to 15-week lead time.

Section 2.3.2: Component Sourcing

Obersport has different agreements with different manufacturers based on standard practices and its priorities. Insulation is sourced from Dupont based on yearly estimates rather than forecasted data. Snaps are sourced from Germany but are not imported on per-product basis. They are sourced and then dyed locally based on the forecasted estimates. Other products such as zippers have different lead times based on the type of product ordered. Small components are sourced locally. Thus, certain components are heavily dependent on the forecast while others are bulk ordered and are not affected by the forecast.

Section 2.3.3: Apparel Manufacturing

A typical ski parka requires around 40 cutting, machining, and sewing steps. Parka production was divided 1/3 and 2/3 between the China and Hong Kong factories respectively. This was planned to shift to half of the production made in China for the 93-94 line, using its existing contracts with subcontractors, and the new plant in Lo Village, Guangdong.

Workers in Hong Kong are educated by a rigorous cross-training program resulting in significant performance differences to the Chinese plants. A parka line requires only 10 workers in Hong Kong, compared to 40 workers in China. Hong Kong plants work twice as fast and have decreased their minimum order quantities to half of the Chinese plants (600 vs 1200 parkas). This high performance output however is compensated by higher wages. The average worker in the Hong Kong factory is paid almost 24 times more per hour than a Chinese factory worker.

Section 2.3.4: Shipping and Transportation

After production of the parkas are completed in June-July, the garments from both factories are pooled at the Obersport warehouse in Hong Kong. From here, Obersport transports the garments via ship to Seattle, which takes about six weeks. Goods produced during August are shipped expensively via air freight to Denver to ensure the retailers receive their orders on time. Goods manufactured in China have to be brought into the US quickly due to strict quota restrictions on the total amount of product to be imported from China. By the end of August, most orders are shipped directly to retailers via parcel carriers such as UPS.

Section 2.3.5: Retail Season

Retail sales for skiwear improved gradually during the months of September, October and November, eventually peaking in January and December. By this time retailers had an idea of which items they expected to sell more than they currently had in stock and would request replenishment orders from Obermeyer. By mid-February, Sport Obermeyer started to offer discounts on replenishment items to retailers. At the end of the season, Obermeyer engaged in barter trade and shipped larger containers of garments to South America to liquidate inventory.

Section 2.4: Supply Chain Analysis

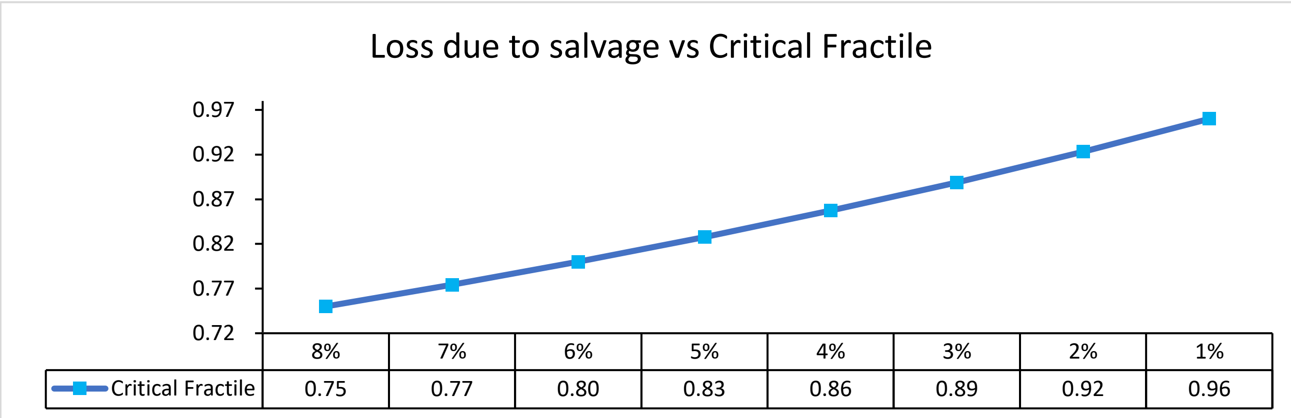
Obermeyer has two main causes of uncertainty in their supply chain: demand volatility and the complex nature of the logistics of global component sourcing and production shipping. Within some limits, Obermeyer can reduce, avoid, and plan for uncertainty to improve its competitive edge and supply chain responsiveness. Improving the forecast will have the compound effect of reducing lead times and lowering costs by giving Obersport better information to decide how and when to allocate production between the Hong Kong and China plants. For this analysis, the effects of varying costs are considered first; and then how different forecast scenarios effect production ordering and expected profits.

Section 2.4.1: Analysis of Expected Costs

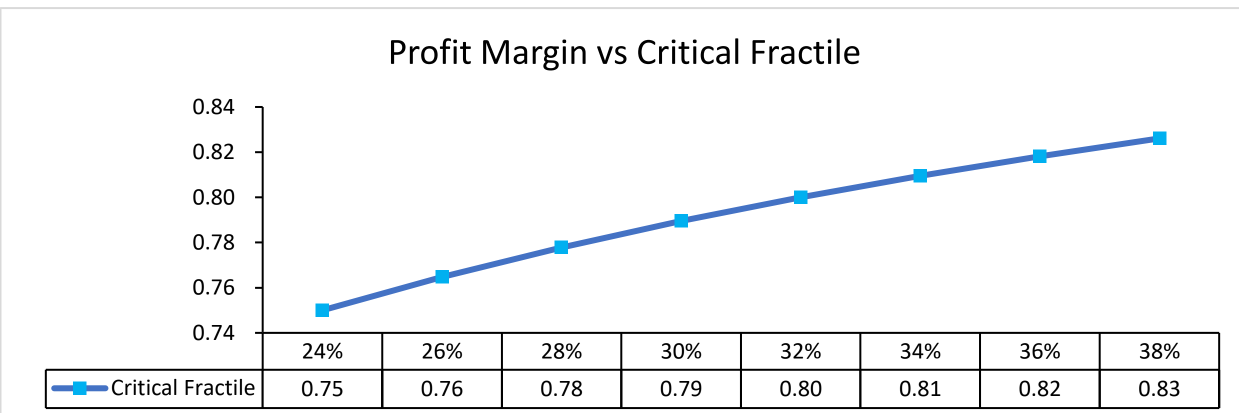
The optimal solution of how much inventory to produce depends on the critical fractile of how the costs of over-stocking or stocking out interact (Appendix 1).Here is an analysis on the impact of changing the cost structure on the optimal order quantity. Satisfying demand is dependent on the following costs:

- Wholesale Selling Price
- Cost Price
- Salvage Costs (Costs associated with selling extra goods after demand is met)
- Penalty Costs (Costs associated with a loss of goodwill)

This figure below provides an idea of the variation in the loss function with an increase in the percentage of satisfied demands.



As the loss on salvage decreases it may look like it is a positive influence. However, this is not the case as it is important to note that an increase in salvage value does not necessarily imply an increase in profits. The next graph illustrates the variation of profit margin with the percentage of satisfied demands.



The explanation is very intuitive. With the increase in the number of satisfied demands, it can only lead to an increased profit margin.

Section 2.4.2: Analysis of Uncertainty in Forecasting

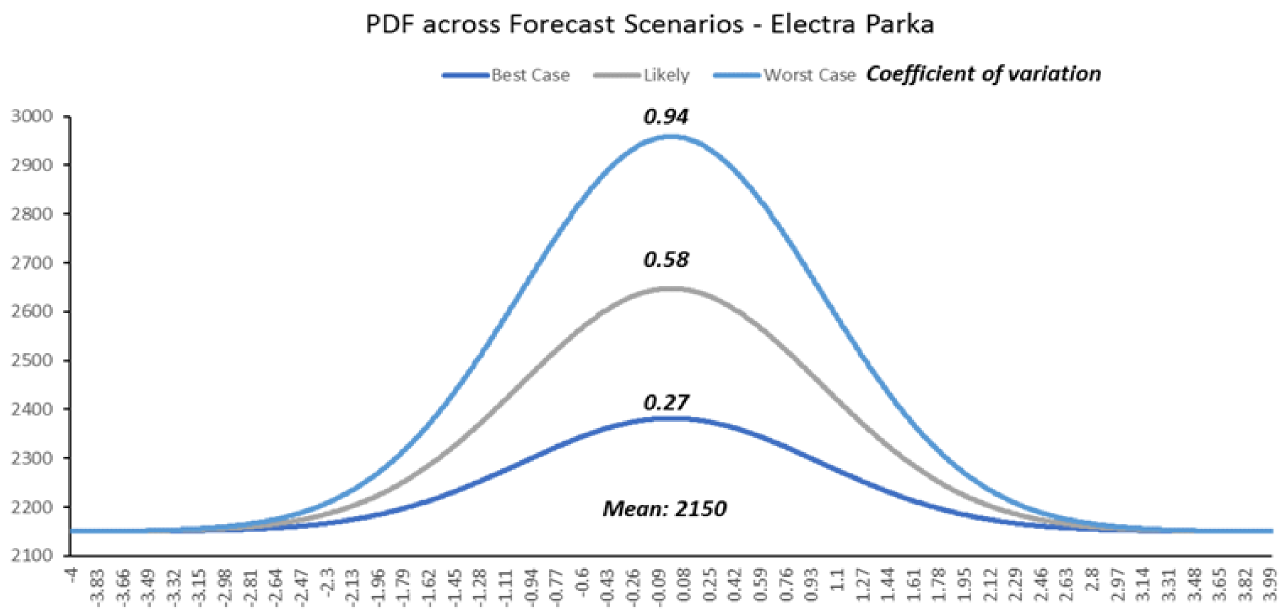
Wally has come up with a rather innovative solution to the forecasting difficulties that Obermeyer faced. Earlier the company had a practice of using a “Buying Committee” which comprised of 6 members. The committee made production orders based on group consensus. But for the 93-94 season, Wally instructed each member of the Buying Committee to independently forecast demand for a sample of 10 women’s parkas. These 10 styles represented 10% of the company’s total demand (20,000 units); and the forecast for each parka style was then modeled as normally distributed with a mean of the 6 forecasts. Wally noted that in previous years the forecast accuracy was more reliable when the committee had higher levels of agreement of product demand. (The uncertainty of a parka style was approximately twice the uncertainty that the committee had predicted). This method implied a total order quantity of 26,360 parkas across the 10 styles, with an expected profit of $525,386. (Appendix 1)

The effect of better or worse forecast accuracy is now considered. If the standard deviation is changed from twice the committee prediction to a forecast with a coefficient of variation of 0.3, the total order quantity is ~24k parkas, with an expected profit of ~$589k. (Appendix 2)

Using the 2x standard deviation, the Coefficient of Variation is computed for each parka style. The highest coefficient of variation (0.94) amongst these styles. Applying this value to obtain a case where there is a high uncertainty in the market, the optimal order quantity ~32k, with an expected profit of ~$375k. **(**Appendix 3). Notice that higher the uncertainty in the market causes higher safety stock leading to lower profits.

Considering the other extreme case of applying the least coefficient of variation (0.27) among all parkas and applying them to all other styles, the opposite effect occurs. The order quantity is just ~23k; and expected profit jumps to ~$600k. (Appendix 3). Lower uncertainty in the market causes the organization to be less cautious about not satisfying demand and leads to higher profits.

The above two cases are extreme and are unlikely to occur. For a more likely market scenario a middle value of coefficient of variation (0.58) results in an order quantity of ~27k, with an expected profit ~$495k. (Appendix 3) See the graph below of how the different forecast scenarios change the order quantity of the Electra Parka.



Section 2.4.3: Order size and difficulties in forecasting

Currently Sport Obermeyer places two orders for production with Obersport. The first order is placed in late November based purely on the forecast. The second order is placed after the Las Vegas show in March, when around 80% of the total expected orders are placed by retailers. Thus, the second order is based on both the forecast and the actual orders placed. Each order is about half of the total production quantity.

If Sport Obermeyer could place multiple small orders; but still did not have actual demand before March, this would add complexity from creating multiple forecasts, each one striving to improve the overall demand. Creating multiple forecast will increase the effort on management and require both time and resources. Smaller orders are helpful when the orders are placed when new information about the demand is known. For example, Sport Obermeyer could send a small order of sample parkas to retailers. Based on their feedback, the next order can be placed incorporating this new information. With long term strategic changes like these in the ordering policy, short orders may drastically improve the forecast. But under the current conditions, placing more orders will increase difficulty of forecasting without adding value.

Production Planning

As mentioned in in the introductory section and the cutting and sewing section Obersport has two major plants in Hong Kong and China. The objective of this section is to understand how market information, uncertainty of parka styles and costs have an effect of placing orders. It also includes methods to leverage the capabilities of both the Hong Kong and China plant.

Recall from the previous section that Wally has a total of 20,000 units of parkas that he needs to produce. The production of these 20,000 units start in February and are split into two separate orders of 10,000 each. An important point to note here is that not all 20,000 is needed at once.

First Order

The first order of 10,000 parkas can be divided in a ratio of 6000:4000 (Hong Kong: China). Based on the table (Appendix 5) there are parka styles with different costs and uncertainties. The ordering policy involves sending those parkas with lower uncertainty and higher costs to Hong Kong (Gail, Entice, Isis and ½ of Assault). This is because based on the forecasts there is a higher certainty associated to the sale of these styles. Another reason to send these styles to Hong Kong is the higher quality of craftsmanship. The quality of the Hong Kong plant ensures that these styles will avoid potential returns hence avoiding extra repair costs.

Since China has less proficient workers and a longer time to produce parkas, lesser number of styles are sent to this factory. For the first order the remaining quantity of Assault not sent to Hong Kong along with the Teri parka are sent to China.

Second Order

Once the first order has been sent to the factories, the second order of 10,000 is to be dealt with. By this time, it is assumed that more market information is gathered and the uncertainty associated with the rest of the parkas is reduced. After the secondary forecast and based on the 6000:4000 ratio mentioned earlier, the parkas can be divided with those facing greater uncertainty sent to China and the others sent to Hong Kong.

Section 2.5: Recommendations

Based on the quantitative analyses carried out, there are several short term and long term methods by which we can manage uncertainty. Managing costs, improving forecasts and optimizing production schedule can be the organization’s short term goals, whereas various marketing methods and product design changes can help manage uncertainty in the long run.

Section 2.5.1: Managing Costs

Salvage costs: From section 2.4.1 clearly increasing salvage costs leads to a satisfying higher percentage of demand. This can be achieved by making deals with various surplus stores who can buy unsold product after the season is over.

Reducing component costs: Among the smaller components such as zippers, snaps, D-rings and various others, Sport Obermeyer is purchasing a larger than required variety of these components. By pooling the components across different styles of parkas, the organization can reduce lead times and inventory associated with these components.

Manufacturing Costs: Currently, the plant in Hong Kong has multiple cross training programs to help its workers produce higher quality goods. If some investment is made for similar training programs in China, the organization will see a very large benefit over the long term.

Optimizing Ordering Schedule: As mentioned in section 2.4.3, the order cycle can be optimized across the plants in China and Hong Kong. This will help in production of higher quality of goods, saving on return costs.

Section 2.5.2: Improving forecasts

The current method of forecasting involves individual committee members making forecasts followed by computing the average of all members. Instead, individual weights can be assigned to each committee member based on their past performances and then computing a weighted average for the forecast. Another method to improve forecasts is to attempt to gather market information earlier. Once the organization has the knowledge of the market and its competitors, the primary forecast can be made better due to the reduction of uncertainty in parka styles. Once more information about the market is gathered, multiple forecasts can be carried out and hence dividing the production quantity into multiple orders.

Various marketing methods can also be employed to help reduce uncertainty in the long term.

1. Obtain early orders from top 25 customers by inviting them to come to Aspen before the Las Vegas trade show and view the new line. This will reduce uncertainty in the national demand forecast to lower margins of error. The incentives could be: all expenses paid, Aspen skiing, and discount pricing
2. Sport Obermeyer could offer “early snowbird specials” to entice customers to purchase early in the season. The earlier in the season reliable sales data is available, the more time.
3. Sport Obermeyer must react and place replenishment orders and avoid the frequent lost sales they are experiencing currently. It has the potential to build brand image, as dedicated skiers would be more likely to wear Sport Obermeyer products. Another idea, giving pro’s the samples to wear in the end of season competitions would entice amateur and recreational skiers for the new product line launch in the next season.
4. Find ways to eliminate air shipments from Asia by reducing lead times. Each day less equates to $25,000 (daily cost of air shipments). Prioritize highly dependable supply chain over lower cost. Increase safety stock of inexpensive components and components shared by several styles. And reduce variability in design. For example: standardize zipper length, tape color, slider shape, gauge, color, and material to <10 varieties for each “gender” (Fisher, 1997, p.114).

5. Select styles with the most reliable forecast for early production. These styles are the ones in which the six individual board member's forecasts agreed. (Hammond, 1994, p. 1)
6. Collaborate with retailers to relax order delivery deadlines from full delivery at the beginning of the season to phased deliveries throughout. (Less inventory carrying cost for them, better forecast information and shorter lead times for Obermeyer).

Section 3: Summary and Conclusion:

Sport Obermeyer operates in an inherently uncertain marketplace. The planning for a season starts almost two years earlier and production quantities must be made based on past trends and intuition. Being a fashion-sensitive product, the company must offer a wide variety of styles of Ski Parkas to be competitive. This leads to a complex supply chain with long lead times and complex organizational dynamics. Sport Obermeyer currently tries to counter the uncertainty by pre-positioning its most important components (to reduce the lead time) and utilizes an "expert opinion" forecast by involving multiple stakeholders into the process.

Uncertainty creeps into the supply chain due to multiple reasons. Sport Obermeyer must place their first production order almost 4 months before it gains any clarity on the actual demand. The company offers a wide range of ski parkas due to which it must order and maintain a large inventory of components. Certain components have long lead times (8-12 weeks) which pushes back the effective deadlines for production. Since they outsource production to China and Hong Kong, there are significant logistics involved in transporting the finished goods to retailers on time. Production is done through multiple partners and sub-contractors which leads to complex production planning.

Sport Obermeyer wishes to manage uncertainty and control costs based on the existing forecasts. For a company of innovative fashion, a very responsive supply chain is needed. Based on the analysis, short as well as long term solutions have been recommended.

Short term solutions would include improving forecasts, managing costs and optimizing the production schedule. Forecasting methods can be tweaked by gathering information about the market earlier. By doing this multiple forecasts can be carried out and the production quantities can be split into multiple orders. Another potential short term solution can be varying the costs within the supply chain. By pooling component costs, lead times and inventory can be reduced.

Long term solutions to the problem include marketing methods to promote the product, advertise using pro skiers and early “snowbird” discount offers. Next steps would be to consider ways to shorten the design process, invest in knowledge sharing between Hong Kong and China, and to begin broadening targeted market to international customers.

Section 4: Appendix

Appendix 1. Expected profit for women's parka for 1993-1994 season

Assumptions:

- Cost Price is 76% of the wholesale selling Price
- Since goods are sold at 8% loss of selling price, Salvage cost = Cost Price – (8% of Selling Price)
- Cost of underage = Loss in profit
- Hence, the penalty/shortage cost is set to zero so that the loss of profit doesn't get counted twice.
- Cost of underage = Cost Price – Salvage cost = 8% of selling Price

Appendix 2. Calculation of orders and expected profit using 2x standard deviation

Critical Fractile (i.e. Probability of demand being satisfied) = 0.75

Style	Period Demand	2x Standard deviation	y*	Expected Profit
Gail	1,017	388	1279	$29,155
Isis	1,042	646	1478	$23,056
Entice	1,358	496	1693	$28,589
Assault	2,525	680	2984	$63,194
Teri	1,100	762	1614	$28,708
Electra	2,150	807	2694	$97,294
Stephanie	1,113	1,048	1820	$25,674
Seduced	4,017	1,113	4768	$81,191
Anita	3,296	2,094	4708	$67,778
Daphne	2,383	1,394	3323	$80,747
		Total	**26360**	**$525,386**

Appendix 3. Calculation of orders and expected profit using 0.3 CoV

CV or Coefficient of variation is the ratio of mean demand and its standard deviation.

CV for all styles = 0.3

Style	Period Demand	2x Standard deviation	y*	Expected Profit
Gail	1,017	305.1	1223	$30,575
Isis	1,042	312.6	1253	$28,194
Entice	1,358	407.4	1633	$29,692
Assault	2,525	757.5	3036	$62,109
Teri	1,100	330	1323	$36,978
Electra	2,150	645	2585	$101,656
Stephanie	1,113	333.9	1338	$40,457
Seduced	4,017	1205.1	4830	$80,144
Anita	3,296	988.8	3963	$83,776
Daphne	2,383	714.9	2865	$96,391
		Total	**24048**	**$589,971**

Appendix 4. Calculation of orders and expected profit for varying uncertainty

"Best Case" CV = 0.27

"Worst Case" CV = 0.94

"Likely" CV = 0.58

The demand distribution based on new level of uncertainty:

Style	Demand Mean	Best Case Std Dev	Likely Std Dev	Worst Case Std Dev
Gail	1017	275	590	956
Isis	1042	281	604	979
Entice	1358	367	788	1277
Assault	2525	682	1465	2374
Teri	1100	297	638	1034
Electra	2150	581	1247	2021
Stephanie	1113	301	646	1046
Seduced	4017	1085	2330	3776
Anita	3296	890	1912	3098
Daphne	2383	643	1382	2240

Computing the corresponding order up value (y*) and expected profits

	Order up value (y*)			***Expected Profit***		
Style	**Best Case**	**Likely**	**Worst Case**	**Best Case**	**Likely**	**Worst Case**
Gail	1202	1415	1662	$ 31,097	$ 25,699	$ 19,431
Isis	1232	1450	1703	$ 28,675	$ 23,698	$ 17,918
Entice	1605	1889	2219	$ 30,199	$ 24,957	$ 18,870
Assault	2985	3513	4126	$ 63,170	$ 52,205	$ 39,471
Teri	1300	1530	1797	$ 37,610	$ 31,082	$ 23,500
Electra	2542	2991	3513	$ 103,393	$ 85,446	$ 64,604
Stephanie	1316	1548	1819	$ 41,148	$ 34,006	$ 25,711
Seduced	4749	5588	6564	$ 81,514	$ 67,365	$ 50,933
Anita	3896	4585	5386	$ 85,207	$ 70,417	$ 53,241
Daphne	2817	3315	3894	$ 98,037	$ 81,020	$ 61,258
Total	**23643**	**27825**	**32682**	**$ 600,051**	**$ 495,894**	**$374,938**

Appendix 5. Order priority of parkas by uncertainty and cost price

Style	Average Forecast	2x Standard deviation	Estimated Cost Price	y*	Expected Profit
Gail	1017	388	$ 84	1279	$ 29,155
Entice	1358	496	$ 61	1693	$ 28,589
Isis	1042	646	$ 75	1478	$ 23,056
Assault	2525	680	$ 68	2984	$ 63,194
Teri	1100	762	$ 93	1614	$ 28,708
Electra	2150	807	$ 131	2694	$ 97,294
Stephanie	1113	1048	$ 101	1820	$ 25,674
Seduced	4017	1113	$ 55	4768	$ 81,191
Daphne	2383	1394	$ 112	3323	$ 80,747
Anita	3296	2094	$ 71	4708	$ 67,778
				26360	**$ 525,386**

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