

HBSP Global Supply Chain Simulation Debrief

Jarrold Goentzel
goentzel@mit.edu

Materials adapted from debrief slides created by
Enspire Learning and Harvard Business Publishing

©Jarrod Goentzel

Debrief Questions

Design & Forecasting

- How did you decide which options to choose?
- How did you arrive at your forecasts?

Production

- How did you decide which supplier(s) to use?
- How did you determine the order quantities and timing?
- Was it worth the extra \$1 million for 3 month instead of 4 month lead time for the far supplier?
- Was it worth the extra \$1 million for extra capacity (40 vs. 35) for the close supplier?
- How often did you use \$2M change orders? Why?
- Did you buy \$2M market information? Why or why not?

©Jarrod Goentzel

Design Room

Submit

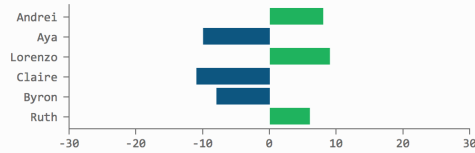
Estimated Model Demand

Without Options, Monthly Units in thousands

	Andrei	Aya	Lorenzo	Claire	Byron	Ruth	Consensus
Model A	63	54	64	59	64	56	63
Model B	36	18	38	28	38	22	33

Estimated Monthly Impact of Selected options on Demand

in thousands, impact the same for both models



Estimated Impact of Selected Options on Per-Unit Profit

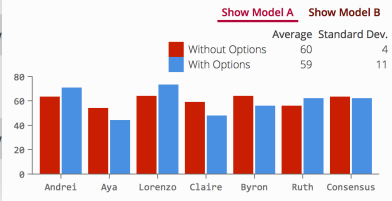
in US dollars

	Price	Cost	Profit
Base Model A	\$200	\$130	\$70
Model A w/ options	\$240	\$165	\$75
Base Model B	\$240	\$150	\$90
Model B w/ options	\$280	\$185	\$95

Product Options

Estimated Demand Forecast

with and without options, in thousands a month



View Discussion



Andrei

The third option is stylish covers. My research indicates that this option will slightly decrease sales.



Aya

Andrei, style matters in mobile phones. They can serve as a status symbol, and the high end market demands style.

©Jarrod Goentzel

Forecasting Room

Submit

Congratulations, the design options for the two mobile phone lines have been specified. You will now have to predict the total demand for each product line.

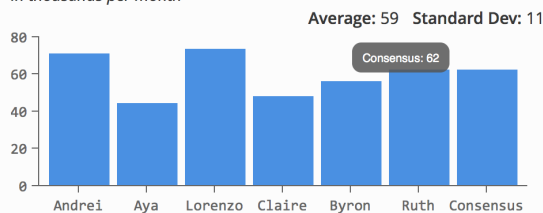
Your forecasting team members have come up with a consensus for what they believe demand will be for the mobile phone lines.

However, the board of your company is interested in your personal estimates as well.

The numbers you will forecast after entering the forecasting room will not affect your production schedule, but they will help you later as you determine where and how to source your products.

Model A: Monthly Estimated Demand May–December

in thousands per month



Model B: Monthly Estimated Demand May–December

in thousands per month

Unit Data with Options as Chosen

costs are an estimate from the lowest-cost contract manufacturer

	Model A	Model B
Unit Price	\$240.00	\$280.00
Unit Cost	\$165.00	\$185.00
Unit Profit	\$75.00	\$95.00

Markdown Price*	\$148.50	\$55.50
Monthly Holding Cost	\$4.80	\$5.60

*at the end of the year, all models left in stock will be sold to a consolidator at this price

Enter Your Demand Estimates

This is your forecast for what monthly demand will be each month from May through December. There is no demand expected from January through April.

Model A k/month

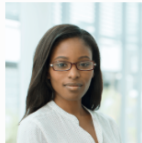
Model B k/month

SUPPLIER		UNITS / MONTH		BEGIN PRODUCTION											
☐	FarFarAway	A	0 k	B	0 k	Select A Month ▼									
PRODUCTION HISTORY <i>in thousands per month</i>															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
A		0	0	0	0	0	0	0	0	0	0	0	0	A \$165	
B		0	0	0	0	0	0	0	0	0	0	0	0	B \$185	4 mo
UNIT COST LEAD TIME CAPACITY SETUP COSTS															
☐	FarAway	A	0 k	B	0 k	Select A Month ▼									
PRODUCTION HISTORY <i>in thousands per month</i>															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
A		0	0	0	0	0	0	0	0	0	0	0	0	A \$165	
B		0	0	0	0	0	0	0	0	0	0	0	0	B \$185	3 mo
UNIT COST LEAD TIME CAPACITY SETUP COSTS															
☐	PrettyClose	A	0 k	B	0 k	Select A Month ▼									
PRODUCTION HISTORY <i>in thousands per month</i>															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
A		0	0	0	0	0	0	0	0	0	0	0	0	A \$175	
B		0	0	0	0	0	0	0	0	0	0	0	0	B \$195	0 mo
UNIT COST LEAD TIME CAPACITY SETUP COSTS															
☐	VeryClose	A	0 k	B	0 k	Select A Month ▼									
PRODUCTION HISTORY <i>in thousands per month</i>															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
A		0	0	0	0	0	0	0	0	0	0	0	0	A \$175	
B		0	0	0	0	0	0	0	0	0	0	0	0	B \$195	0 mo
UNIT COST LEAD TIME CAPACITY SETUP COSTS															

The Board



Mia



Carla



Ankit



Matheo



Adele

- How did you perform?
- What was each Board member looking for?

Board Votes Results

Team	Year 1	Year 2	Year 3	Year 4	Total	Rank
Andrea Ramos	4	4	4	5	17	1
Horacio Muela	4	4	3	5	16	2
Nestor Felicio	3	4	4	4	15	3
Juan Abullarade	4	4	3	4	15	3
Vinod Dudeja	2	4	3	5	14	5
Chaitra Manjunatha	2	4	3	5	14	5
Alejandro Rossi	3	3	3	5	14	5
Andres Ballon	2	3	4	4	13	8
Jacob Hall	2	2	4	5	13	8
Marlon Catalano	3	2	3	5	13	8
Marion Konnerth	2	3	3	5	13	8
Raj Nellore	2	3	3	5	13	8
Alison Heuser	3	3	2	4	12	13
Rob Lomas	2	3	3	4	12	13
Suraj Phull	2	3	3	4	12	13
Amin Ramadan	2	3	3	4	12	13
Toshitada Tanaka	1	2	3	5	11	17
Dan Harrison	2	2	3	4	11	17
Sergio Perez	2	1	3	5	11	17
Leo Ducrot	2	3	3	3	11	17
Vitor Miranda	2	3	1	5	11	17
Jesus Haces	2	3	3	3	11	17
Alan Alor	2	2	2	4	10	23
Chang Sub Chang	3	1	3	3	10	23
Wei Zheng	1	2	2	4	9	25
Maria Reyes	2	4	0	3	9	25
Bruno Espinoza	1	2	3	3	9	25
Deepti Biswal	1	1	3	4	9	25
Andres Uribe	2	2	1	4	9	25
Matteo Natale	1	2	2	3	8	30
Mauricio Nieto	2	2	1	3	8	30
Jose Figueroa	2	1	1	4	8	30
Fiona Liem	1	1	2	0	4	33
Avg	2.2	2.6	2.6	4.0	11.4	
Min	1	1	0	0	4	
Max	4	4	4	5	17	

Profits Results

Team	Year 1	Year 2	Year 3	Year 4	Total	Rank
Andres Ballon	\$ 52,464	\$ 50,395	\$ 42,280	\$ 48,430	\$ 193,569	1
Toshitada Tanaka	\$ 49,514	\$ 46,752	\$ 45,814	\$ 50,398	\$ 192,477	2
Vinod Dudeja	\$ 45,981	\$ 50,880	\$ 46,903	\$ 48,453	\$ 192,216	3
Alison Heuser	\$ 49,515	\$ 50,093	\$ 40,256	\$ 51,126	\$ 190,991	4
Jacob Hall	\$ 47,520	\$ 46,493	\$ 42,475	\$ 50,691	\$ 187,179	5
Marlon Catalano	\$ 48,138	\$ 44,699	\$ 45,213	\$ 49,035	\$ 187,084	6
Dan Harrison	\$ 42,175	\$ 50,639	\$ 41,419	\$ 50,813	\$ 185,045	7
Marion Konnerth	\$ 46,465	\$ 45,051	\$ 43,163	\$ 48,635	\$ 183,313	8
Nestor Felicio	\$ 46,629	\$ 46,823	\$ 41,961	\$ 46,714	\$ 182,128	9
Chaitra Manjunatha	\$ 43,939	\$ 45,074	\$ 45,348	\$ 47,647	\$ 182,008	10
Rob Lomas	\$ 46,095	\$ 43,149	\$ 42,222	\$ 50,201	\$ 181,666	11
Alan Alor	\$ 43,072	\$ 47,817	\$ 42,828	\$ 44,684	\$ 178,401	12
Andrea Ramos	\$ 46,866	\$ 44,038	\$ 40,906	\$ 46,356	\$ 178,165	13
Wei Zheng	\$ 44,997	\$ 45,140	\$ 41,031	\$ 46,984	\$ 178,153	14
Chang Sub Chang	\$ 45,333	\$ 47,228	\$ 39,039	\$ 46,465	\$ 178,065	15
Alejandro Rossi	\$ 42,015	\$ 42,323	\$ 46,388	\$ 46,383	\$ 177,109	16
Sergio Perez	\$ 46,691	\$ 37,369	\$ 46,388	\$ 46,383	\$ 176,830	17
Raj Nellore	\$ 49,462	\$ 44,313	\$ 37,521	\$ 44,669	\$ 175,965	18
Fiona Liem	\$ 46,957	\$ 44,957	\$ 36,423	\$ 44,860	\$ 173,197	19
Maria Reyes	\$ 44,015	\$ 42,008	\$ 36,564	\$ 49,948	\$ 172,536	20
Bruno Espinoza	\$ 39,478	\$ 41,662	\$ 43,257	\$ 47,515	\$ 171,911	21
Leo Ducrot	\$ 43,842	\$ 47,038	\$ 38,400	\$ 41,732	\$ 171,012	22
Matteo Natale	\$ 39,478	\$ 41,027	\$ 42,257	\$ 47,515	\$ 170,276	23
Horacio Muela	\$ 44,967	\$ 41,839	\$ 42,301	\$ 40,110	\$ 169,217	24
Suraj Phull	\$ 44,733	\$ 47,869	\$ 30,326	\$ 43,645	\$ 166,573	25
Juan Abullarade	\$ 45,967	\$ 38,732	\$ 42,301	\$ 37,630	\$ 164,630	26
Vitor Miranda	\$ 40,159	\$ 44,073	\$ 30,659	\$ 48,172	\$ 163,062	27
Deepti Biswal	\$ 47,937	\$ 24,485	\$ 38,505	\$ 48,513	\$ 159,440	28
Andres Uribe	\$ 39,406	\$ 42,295	\$ 27,419	\$ 42,238	\$ 151,357	29
Amin Ramadan	\$ 36,159	\$ 33,593	\$ 37,724	\$ 42,842	\$ 150,318	30
Mauricio Nieto	\$ 34,684	\$ 27,563	\$ 22,805	\$ 49,511	\$ 134,563	31
Jesus Haces	\$ 20,765	\$ 48,951	\$ 14,149	\$ 48,419	\$ 132,284	32
Jose Figueroa	\$ 32,666	\$ (18,097)	\$ 37,530	\$ 45,068	\$ 97,167	33
Avg	\$ 43,578	\$ 41,705	\$ 39,145	\$ 46,721	\$ 171,149	
Min	\$ 20,765	\$ (18,097)	\$ 14,149	\$ 37,630		
Max	\$ 52,464	\$ 50,880	\$ 46,903	\$ 51,126		

Combined Results: Weighted Average of Standardized Profit and Votes

Weights				67%		33%			
Team	Profit	Rank	Votes	Rank	Z Profit	Z Votes	Score	Rank	
Vinod Dudeja	\$ 192,216	3	14	5	1.06	1.09	1.07	1	
Andres Ballon	\$ 193,569	1	13	8	1.12	0.74	1.00	2	
Andrea Ramos	\$ 178,165	13	17	1	0.35	2.11	0.93	3	
Nestor Felicio	\$ 182,128	9	15	3	0.55	1.43	0.84	4	
Alison Heuser	\$ 190,991	4	12	13	1.00	0.40	0.80	5	
Jacob Hall	\$ 187,179	5	13	8	0.80	0.74	0.78	6	
Marlon Catalano	\$ 187,084	6	13	8	0.80	0.74	0.78	7	
Toshitada Tanaka	\$ 192,477	2	11	17	1.07	0.06	0.74	8	
Chaitra Manjunatha	\$ 182,008	10	14	5	0.54	1.09	0.72	9	
Marion Konnerth	\$ 183,313	8	13	8	0.61	0.74	0.65	10	
Alejandro Rossi	\$ 177,109	16	14	5	0.30	1.09	0.56	11	
Horacio Muela	\$ 169,217	24	16	2	-0.10	1.77	0.52	12	
Dan Harrison	\$ 185,045	7	11	17	0.70	0.06	0.49	13	
Rob Lomas	\$ 181,666	11	12	13	0.53	0.40	0.49	14	
Raj Nellore	\$ 175,965	18	13	8	0.24	0.74	0.41	15	
Juan Abullarade	\$ 164,630	26	15	3	-0.33	1.43	0.25	16	
Sergio Perez	\$ 176,830	17	11	17	0.29	0.06	0.21	17	
Alan Alor	\$ 178,401	12	10	24	0.36	-0.28	0.15	18	
Chang Sub Chang	\$ 178,065	15	10	24	0.35	-0.28	0.14	19	
Wei Zheng	\$ 178,153	14	9	28	0.35	-0.62	0.03	20	
Leo Ducrot	\$ 171,012	22	11	17	-0.01	0.06	0.02	21	
Suraj Phull	\$ 166,573	25	12	13	-0.23	0.40	-0.02	22	
Maria Reyes	\$ 172,536	20	9	28	0.07	-0.62	-0.16	23	
Bruno Espinoza	\$ 171,911	21	9	28	0.04	-0.62	-0.18	24	
Vitor Miranda	\$ 163,062	27	11	17	-0.41	0.06	-0.25	25	
Matteo Natale	\$ 170,276	23	8	33	-0.04	-0.97	-0.35	26	
Amin Ramadan	\$ 150,318	30	12	13	-1.05	0.40	-0.57	27	
Deepti Biswal	\$ 159,440	28	9	28	-0.59	-0.62	-0.60	28	
Fiona Liem	\$ 173,197	19	4	40	0.10	-2.33	-0.70	29	
Andres Uribe	\$ 151,357	29	9	28	-0.99	-0.62	-0.87	30	
Jesus Haces	\$ 132,284	32	11	17	-1.95	0.06	-1.29	31	
Mauricio Nieto	\$ 134,563	31	8	33	-1.84	-0.97	-1.55	32	
Jose Figueroa	\$ 97,167	33	8	33	-3.71	-0.97	-2.81	33	

Takeaways

- Accurate forecasts
 - Gather more data, especially individual forecasts
 - Capture the standard deviation of the individual forecasts
 - A small amount of pre-launch information or actual demand can really improve forecasts
- Responsive supply
 - Structurally aim to shorten lead times and increase reactive capacity
 - Consider which products to produce with speculative/reactive capacity
- Appropriate inventory*
 - There are incentives to produce more or less than the forecast
 - Critical Ratio based on the cost of being under/over (e.g. stockout/markdown cost) provides intuition for when to overproduce/underproduce, and by how much
 - Critical Ratio can also be used to set appropriate service levels for periodic review inventory policies

*WARNING: These principles come from the “newsvendor problem,” which cannot be fully applied to determine the “optimal” inventory in the simulation since key assumptions are not realized: e.g. ability carry inventory and issue change orders throughout the year, capacity constraints, supplier lead times. The intuition from the newsvendor problem – using the underage/overage costs to set inventory targets – can be broadly applied to optimize inventory and be very close to “optimal.” Email me if you would like to know more about the full theory.

©Jarrod Goentzel

Further Reading

Janice H. Hammond, Ananth Raman. "Sport Obermeyer Ltd." Harvard Business School Case (No. 9-695-022), August 15, 2006.

Fisher, M., J. Hammond, W. Obermeyer, and A. Raman. "Making Supply Meet Demand in an Uncertain World." *Harvard Business Review* 72, no. 3 (May-June 1994): 83-92.

Raman, A., M. Fisher, J. Hammond, and W. Obermeyer. "Accurate Response: The Key to Profiting from Quick Response." *Bobbin Magazine*, February 1994.

Raman, A., M. Fisher, J. Hammond, and W. Obermeyer. "Configuring a Supply Chain to Reduce the Cost of Demand Uncertainty." *Production and Operations Management Journal* 6, no. 3 (fall 1997): 211-225.

Raman, A., and M. Fisher. "Reducing the Cost of Demand Uncertainty through Accurate Response to Early Sales." *Operations Research* 44, no. 4 (January 1996): 87-99.

©Jarrod Goentzel