

M7L7a. Optimization Business Case

Slide #1



ATM
TEXAS A&M UNIVERSITY
Engineering

Optimization Business Case
(Part a)

Dr. Xiaomin Yang

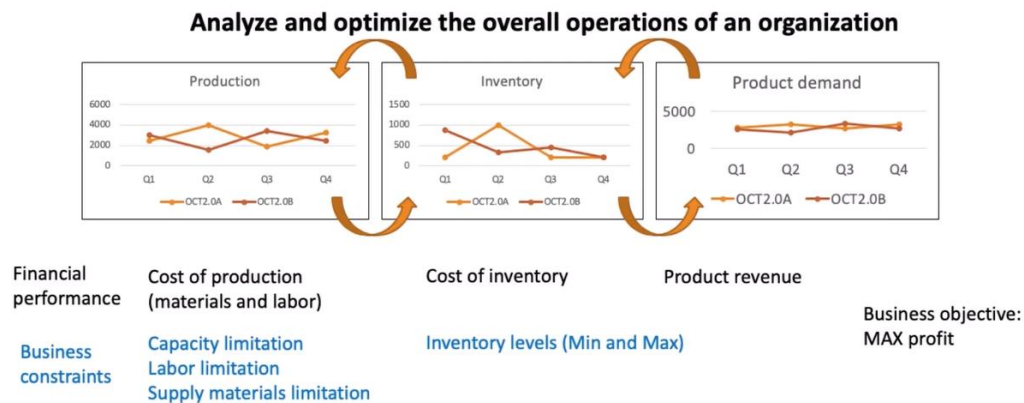
TCMT 612 | Technical Management
Decision Making

MASTERS OF ENGINEERING TECHNICAL MANAGEMENT

Let me illustrate the production and inventory level optimization with a business case.

Slide #2

Production Optimization – Aggregate Planning



The business context is the same as the business case in the production business optimization case.

Your company makes two types of laser optics units for optical coherence tomography machines in its Houston plant.

Your sales department provides the quarterly demand forecast of both products, OCT 2.0A and OCT 2.0B.

We need to decide their quarterly production and inventory levels, respectively, based on demand projection to maximize the operation profit.

Production cost includes both materials and labor cost items.










We will also consider the cost of inventory in your analysis.

The revenue is a function of the projected quarterly demand and unit price of the product.

The three business constraints are the plant capacity, labor, and supply materials limitation in each quarter.

Slide #3

Operation and production business case

	Demand Forecast					 Organization Marketing & sales	
	Q1	Q2	Q3	Q4	Total		
	OCT2.0A	2745	3216	2700	3256		11917
	OCT2.0B	2534	2144	3300	2664		10642
	Selling price					 Marketing & sales Business intelligence	
	Q1	Q2	Q3	Q4	Average		
	OCT2.0A	\$ 4,085	\$ 4,214	\$ 4,515	\$4,300		\$4,279
	OCT2.0B	\$ 4,275	\$4,410	\$4,725	\$4,500		\$4,478
	Material cost/unit					 Procurement Operations	
	Q1	Q2	Q3	Q4	Average		
	OCT2.0A	950	980	1050	1000		\$995
	OCT2.0B	855	882	945	900		\$896
	Labor hrs/unit					 HR Operations	
	Q1	Q2	Q3	Q4	Average		
	OCT2.0A	9.7	9.7	9.7	9.7		9.7
	OCT2.0B	11.0	11.0	11.0	11.0		11.0
	Labor rate/hr					 HR Operations	
	Q1	Q2	Q3	Q4	Average		
	OCT2.0A	\$55	\$58	\$58	\$60		\$58
	OCT2.0B	\$55	\$58	\$58	\$60		\$58

The business data are presented in these tables. First, your sales and marketing group provides the demand forecasts of OCT 2.0A and OCT 2.0B in each quarter of next year. For example, they project the demand for OCT 2.0A and OCT 2.0B of 2,745 units and 2,534 units respectively in the first quarter of next year.




Your sales and marketing group also provides the projected selling price of each model based on their market intelligence studies. For instance, the price of OCT 2.0A will be \$4,085, while OCT 2.0B will be \$4,275.

Your marketing departments offer different levels of discount according to the seasonal demands, while the full price of each model remains the same in the next year. Also, your procurement group projects the quarterly cost of raw materials.

The cost of raw materials is consistent with the demands of the machines. Required labor time per unit remains the same across the year, while the hourly rate increases along the quarter. This trend is consistent with a normal compensation adjustment schedule.

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Operation and production business case - constraints

Constraints						Organization	
	Production capacity	Q1	Q2	Q3	Q4	Total	Executive
		5462	6325	5462	6325	23574	
	Labor hrs capacity	Q1	Q2	Q3	Q4	Total	Planning
		62370	56430	65340	58212	242352	
	Inventory requirements						Supply chain management Operations
	Min	Q1	Q2	Q3	Q4		
	OCT2.0A	200	200	200	200		
	OCT2.0B	200	200	200	200		
	Max						
	OCT2.0A	1000	1000	1000	1000		
	OCT2.0B	1000	1000	1000	1000		

The business constraints are, first, the production capacity in each quarter fluctuates slightly as planned maintenance in first and third quarters takes out some production capacity.

The labor hours also fluctuate in different quarters according to normal employee turnover patterns.

The inventory requirements include minimum and maximum inventory levels in each quarter.

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Operation and production business case - model

Unit produced	Q1	Q2	Q3	Q4	Total	
OCT2.0A	2445	4016	1900	3256	11617	Decision variables
OCT2.0B	3017	1588	3417	2420	10442	
Total	5462	5604	5317	5676	22059	
Capacity constraints	<=	<=	<=	<=	<=	Plant capacity constraint
	5462	6325	5462	6325	23574	

Labor	Q1	Q2	Q3	Q4	Total	
OCT2.0A	23716.5	38955.2	18430	31583.2	112684.9	
OCT2.0B	33187	17468	37587	26620	114862	
Total	56903.5	56423.2	56017	58203.2	227546.9	
Labor Constraints	<=	<=	<=	<=	<=	Human resource constraint
	62370	56430	65340	58212	242352	

Units demanded	Q1	Q2	Q3	Q4	Total	
OCT2.0A	2745	3216	2700	3256	11917	Demand forecast
OCT2.0B	2534	2144	3300	2664	10642	

The decision variables are the production levels of OCT 2.0A and OCT 2.0B in each quarter.

The total number of units to be made in each quarter is limited by the production capacity of the plant and human resource availability.

Both constraints are included in the model.

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Operation and production business case - inventory

Ending inventory	Q1	Q2	Q3	Q4
OCT2.0A	200	1000	200	200
OCT2.0B	883	327	444	200
Inventory constraints	>=	>=	>=	>=
OCT2.0A	200	200	200	200
OCT2.0B	200	200	200	200
	<=	<=	<=	<=
OCT2.0A	1000	1000	1000	1000
OCT2.0B	1000	1000	1000	1000

Inventory constraint

Most of the produced laser units will be sold and shipped to customers and the remaining will be placed in the warehouse as inventories.

The lower and upper limits of inventory are 200 units and 1,000 units for each model.

The calculation of the inventory constraints is shown in this table.

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Operation and production business case - economics

Quarterly production cost	Q1	Q2	Q3	Q4	Subtotal
OCT2.OA	\$3,627,158	\$6,185,343	\$3,059,333	\$5,149,413	\$18,021,246
OCT2.OB	\$4,404,820	\$2,409,393	\$5,399,714	\$3,773,869	\$15,987,796
				Subtotal	\$34,009,042

Quarterly inventory cost	Q1	Q2	Q3	Q4	Subtotal
OCT2.OA	\$7,788.38	\$14,554.65	\$15,216.15	\$5,171.55	\$42,731
OCT2.OB	\$14,274.98	\$14,675.94	\$9,776.38	\$8,326.20	\$47,054
				Subtotal	\$89,784

Quarterly total cost	Q1	Q2	Q3	Q4	Subtotal
OCT2.OA	\$3,634,945.88	\$6,199,897.45	\$3,074,548.65	\$5,154,584.39	\$18,063,976
OCT2.OB	\$4,419,094.98	\$2,424,068.94	\$5,409,490.63	\$3,782,195.20	\$16,034,850
				Total	\$34,098,826

Quarterly revenue	Q1	Q2	Q3	Q4	Subtotal
OCT2.OA	\$ 11,213,325	\$ 13,552,224	\$ 12,190,500	\$ 14,000,800	\$50,956,849
OCT2.OB	\$ 10,832,850	\$ 9,455,040	\$ 15,592,500	\$ 11,988,000	\$47,868,390
				Total	\$98,825,239

Quarter profit	Q1	Q2	Q3	Q4	Subtotal
OCT2.OA	\$ 7,578,379	\$ 7,352,327	\$ 9,115,951	\$ 8,846,216	\$ 32,892,873
OCT2.OB	\$ 6,413,755	\$ 7,030,971	\$ 10,183,009	\$ 8,205,805	\$ 31,833,540
				Total	\$ 64,726,413

Objective: maximize profit

This table calculates the production and inventory economics, which includes the production cost, inventory cost, and revenue in each quarter.

Total revenue, less total cost, is the operation profit.

Note that the fixed management cost and financial activity cost is not part of the operational optimization model.

The decision objective is to maximize the annual operation profit.