Mechanical and Production Engineering Department

MECH 3132 Engineering Management Tutorials

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Text Book: Operations Management by Heizer and Render

Operations and Productivity

Problem 1:

Mance Fraily, the Production Manager at Ralts Mills, can currently expect his operation to produce 1000 square yards of fabric for each ton of raw cotton. Each ton of raw cotton requires 5 labor hours to process. He believes that he can buy a better quality raw cotton, which will enable him to produce 1200 square yards per ton of raw cotton with the same labor hours.

What will be the impact on productivity (measured in square yards per labor-hour) if he purchases the higher quality raw cotton?

Problem 2:

C. A. Ratchet, the local auto mechanic, finds that it usually takes him 2 hours to diagnose and fix a typical problem. What is his daily productivity (assume an 8 hour day)?

Mr. Ratchet believes he can purchase a small computer trouble-shooting device, which will allow him to find and fix a problem in the incredible (at least to his customers!) time of 1 hour. He will, however, have to spend an extra hour each morning adjusting the computerized diagnostic device. What will be the impact on his productivity if he purchases the device?

Problem 3:

Joanna French is currently working a total of 12 hours per day to produce 240 dolls. She thinks that by changing the paint used for the facial features and fingernails that she can increase her rate to 360 dolls per day. Total material cost for each doll is approximately $3.50; she has to invest $20 in the necessary supplies (expendables) per day; energy costs are assumed to be only $4.00 per day; and she thinks she should be making $10 per hour for her time. Viewing this from a total (multifactor) productivity perspective, what is her productivity at present and with the new paint?

Problem 4:

How would total (multifactor) productivity change if using the new paint raised Ms. French's material costs by $0.50 per doll?

Problem 5:

If she uses the new paint, by what amount could Ms. French's material costs increase without reducing total (multifactor) productivity?

Operations Strategy in a Global Environment

Problem 1:

Identify how changes in the external environment may affect the OM strategy for a company. For example, what impact are the following factors likely to have on OM strategy?

a. The occurrence of a major storm or hurricane.
b. Terrorist attacks of 9/11/01.
c. The much discussed decrease in the quality of American primary and secondary school systems.
d. Trade Legislation such as WTO and NAFTA and changes in tariffs and quotas.
e. The rapid rate at which the cost of health insurance is increasing.
f. The Internet.

Problem 2:

Identify how the changes in the internal environment affect the OM strategy for a company. For example, what impact are the following factors likely to have on OM strategy?

a. The increased use of Local and Wide Area Networks (LANs and WANs)
b. An increased emphasis on service
c. The increased role of women in the workplace
d. The seemingly increasing rate at which both internal and external environments change.

Problem 3:

Operations managers are called upon to support the organization's strategy. OM does this with some combination of one of three strategies. What are these three strategies**?**

Forecasting

Problem 1:

Auto sales at Carmen's Chevrolet are shown below. Develop a 3-week moving average.

Week	Auto Sales
1	8
2	10
3	9
4	11
5	10
6	13
7	-

Problem 2:

Carmen's decides to forecast auto sales by weighting the three weeks as follows:

Weights Applied	Period
3	Last week
2	Two weeks ago
1	Three weeks ago
6	Total

Problem 3:

A firm uses simple exponential smoothing with $\alpha = 0.1$ to forecast demand. The forecast for the week of January 1 was 500 units whereas the actual demand turned out to be 450 units. Calculate the demand forecast for the week of January 8.

Problem 4:

Exponential smoothing is used to forecast automobile battery sales. Two value of α are examined, $\alpha = 0.8$ and $\alpha = 0.5$. Evaluate the accuracy of each smoothing constant. Which is preferable? (Assume the forecast for January was 22 batteries.) Actual sales are given below:

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August 04

Month	Actual Battery Sales	Forecast
January	20	22
February	21	
March	15	
April	14	
May	13	
June	16	

Problem 5:

Use the sales data given below to determine: (a) the least squares trend line, and (b) the predicted value for 2003 sales.

Year	Sales (Units)
1996	100
1997	110
1998	122
1999	130
2000	139
2001	152
2002	164

To minimize computations, transform the value of x (time) to simpler numbers. In this case, designate year 1996 as year 1, 1997 as year 2, etc.

Problem 6:

Given the forecast demand and actual demand for 10-foot fishing boats, compute the tracking signal and MAD.

Year	Forecast Demand	Actual Demand
1	78	71
2	75	80
3	83	101
4	84	84
5	88	60
6	85	73

Problem: 7

Over the past year Meredith and Smunt Manufacturing had annual sales of 10,000 portable water pumps. The average quarterly sales for the past 5 years have averaged: spring 4,000, summer 3,000, fall 2,000 and winter 1,000. Compute the quarterly index.

Problem: 8

Using the data in Problem 7, Meredith and Smunt Manufacturing expects sales of pumps to grow by 10% next year. Compute next year's sales and the sales for each quarter.

Design of Goods and Services

Problem 1:

You wish to compete in the super premium ice cream market. The task is to determine the *wants* of the super premium market and the attributes/*hows* to be met by their firm. Use the house of quality concept.

Market research has revealed that customers feel four factors are significant in making a buying decision. A "rich" taste is most important followed by smooth texture, distinct flavor, and a sweet taste. From a production standpoint, important factors are the sugar content, the amount of butterfat, low air content, and natural flavors.

Problem 2:

Prepare a bill-of-material for a ham and cheese sandwich.

Problem 3:

Prepare an assembly chart for a ham and cheese sandwich.

Problem 4:

Michael's Engineering, Inc. manufactures components for the ever-changing notebook computer business. He is considering moving from a small custom design facility to an operation capable of much more rapid design of components. This means that Michael must consider upgrading his CAD equipment. Option 1 is to purchase two new desktop CAD systems at $100,000 each. Option 2 is to purchase an integrated system and the related server at $500,000. Michael's sales manager has estimated that if the market for notebook computers continues to expand, sales over the life of either system will be $1,000,000. He places the odds of this happening at 40%. He thinks the likelihood of the

market having already peaked to be 60% and future sales to be only $700,000. What do you suggest Michael do and what is the EMV of this decision?

Process Strategy

Problem 1:

Taggert Custom Machine Shop has a contract for 130,000 units of a new product. James Taggert, the owner, has calculated the cost for three process alternatives. Which process should he choose for this new contract?

	General Purpose Equipment (GPE)	Flexible Manufacturing (FMS)	Dedicated Automation (DA)
Fixed Costs	$150,000	$350,000	$950,000
Variable Costs	$10	$8	$6

Problem 2:

Solve Problem 1 graphically

Problem 3:

Using either your analytical solution found in Problem 1 or the graphical solution found in Problem 2, identify the volume ranges where each process should be used.

Problem 4:

If Taggert Custom Machine is able to convince the customer to renew the contract for another one or two years, what implications does this have for his decision?

Location Strategies

Problem 1:

A major drug store chain wishes to build a new warehouse to serve the whole Midwest. At the moment, it is looking at three possible locations. The factors, weights, and ratings being considered are given below:

		Ratings		
Factor	Weights	Peoria	Des Moines	Chicago
Nearness to markets	20	4	7	5
Labor cost	5	8	8	4
Taxes	15	8	9	7
Nearness to suppliers	10	10	6	10

Which city should they choose?

Problem 2:

Balfour's is considering building a plant in one of three possible locations. They have estimated the following parameters for each location:

Location	Fixed Cost	Variable Cost
Waco, Texas	$300,000	$5.75
Tijuana, Mexico	$800,000	$2.75
Fayetteville, Arkansas	$100,000	$8.00

For what unit sales volume should they choose each location?

Problem 3:

Our main distribution center in Phoenix, AZ is due to be replaced with a much larger, more modern facility that can handle the tremendous needs that have developed with the city's growth. Fresh produce travels to the seven store locations several times a day making site selection critical for efficient distribution. Using the data in the following table, determine the map coordinates for the proposed new distribution center.

Store Locations	Map Coordinates (x,y)	Truck Round Trips per Day
Mesa	(10,5)	3
Glendale	(3,8)	3
Camelback	(4,7)	2
Scottsdale	(15,10)	6
Apache Junction	(13,3)	5
Sun City	(1,12)	3
Pima	(5,5)	10

Problem 4:

The following table gives the map coordinates and the shipping loads for a set of cities that we wish to connect though a central "hub." Near what map coordinates should the hub be located?

City	Map Coordinate (x,y)	Shipping Load
A	(5,10)	5
B	(6,8)	10
C	(4,9)	15
D	(9,5)	5
E	(7,9)	15
F	(3,2)	10
G	(2,6)	5

Layout Strategy

Problem 1:

As in most kitchens, the baking ovens in Lori's Kitchen in New Orleans are located in one area near the cooking burners. The refrigerators are located next to each other as are the dishwashing facilities. A work area of tabletops is set aside for cutting, mixing, dough rolling, and assembling of final servings, although different table areas may be reserved for each of these functions.

Given the following Interdepartmental Activity Matrix, develop an appropriate layout for Lori's Kitchen.

	Interdepartmental Activity Matrix			
	Cooking Burners (A)	Refrigerators (B)	Dishwashing (C)	Work Area (D)
Cooking burners (A)	-	7	193	12
Refrigerator (B)		-	4	82
Dishwashing (C)			-	222
Work Area (D)				-

The present layout is:

A	B	C	D

with a distance of 10 feet between adjacent areas.

Computing the Load * Distance measure:

	Load * Distance	
A to B	7 * 10	70
A to C	193*20	3860
A to D	12*30	360
B to C	4*10	40
B to D	82*20	1640
C to D	222*10	2220
Total		8190

Develop a preferred layout. What is the sum of the loads * distance of your new layout?

Problem 2:

A firm must produce 40 units/day during an 8-hour workday. Tasks, times, and predecessor activities are given below.

Task	Time (Minutes)	Predecessor(s)
A	2	-
B	2	A
C	8	-
D	6	C
E	3	B
F	10	D, E
G	4	F
H	3	G
Total	38 minutes	

Determine the cycle time and the appropriate number of workstations to produce the 40 units per day.

Problem 3:

Task Element	Time (Minutes)	Element Predecessor
A	1	-
B	1	A
C	2	B
D	1	B
E	3	C, D
F	1	A
G	1	F
H	2	G
I	1	E, H

Given a cycle time of 4 minutes, develop an appropriate layout.

What is the efficiency of your layout?

Decision-Making Tools

Problem 1:

Bascomb's Candy is considering the introduction of a new line of products. In order to produce the new line, the bakery is considering either a major or minor renovation of the current plant. The market for the new line of products could be either favorable or unfavorable. Bascomb's Candy has the option of not developing the new product line at all. Develop the appropriate decision tree.

Problem 2:

With major renovation, at Bascomb's Candy (See Problem 1 above) the payoff from a favorable market is \$100,000 and from an unfavorable market $\$-90{,}000$. Minor renovations and favorable market has a payoff of \$40,000 and an unfavorable market $\$-20{,}000$. Assuming that a favorable market and an unfavorable market are equally likely, solve the decision tree.

Problem 3:

Jeff Heyl, the owner of Bascomb's Candy (Problem 1 and 2 above) realizes that he should get more information before making his final decision. He decides to contract with a market research firm to conduct a market survey. How much should Jeff be willing to pay for accurate information (i.e. What is the Expected Value of Perfect Information, EVPI?)?