CASE
10

MacPherson Refrigeration Limited

In October, Linda Metzler, newly appointed production planning manager of MacPherson Refrigeration, Ltd. (MRL) of Stratford, Ontario was formulating the production plan for the year beginning on January 1. The plan was to be submitted to the plant's general manager by the end of the month.

BACKGROUND

MRL had sales of about $28.5 million. The company had begun in Stratford in 1954 specializing in commercial refrigeration. In 1972, the company opened a new 300,000 square foot plant in Stratford and diversified into the consumer refrigeration market. Subsequently, MRL had added air conditioners to its freezer and refrigerator lines. The company sold its Hercules brand appliances through independent furniture and appliance stores in southern Ontario.

THE STRATFORD PLANT

Since 1962, manufacturing efficiency at the plant had increased dramatically through changes in both process design and assembly technology. Annual output per worker had increased from about 240 appliances in 1963 to the present level of about 450 appliances and was expected to be about 480 appliances next year. The Canadian market was too small to allow the productivity levels of American appliance manufacturers, but MRL was considered to be relatively efficient by Canadian standards.

The Stratford plant had the physical capacity to make only 13,000 appliances per month.

THE PLANNING PROCESS

Each year in September the marketing and sales department produced a forecast of appliances by month for the next year. The production planning department used these forecasts to plan production for the next year. The first step in the planning process was to construct an aggregate production plan which consisted of planned gross production by month for the year. This plan did not indicate

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EXHIBIT 1
Level Production Plan to Meet Peak Demand

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Production plan												
Shipment forecast	4400	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Production plan	8440	8440	8440	8440	8440	8440	8440	8440	8440	8440	8440	8440
Shipments	4400	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Inventory*	4280	8320	10760	11200	13040	9680	5120	2360	0	840	3280	6120
Extraordinary labour costs												
No. of workers	211	211	211	211	211	211	211	211	211	211	211	211
Hirings	51	—	—	—	—	—	—	—	—	—	—	—
Layoffs	—	—	—	—	—	—	—	—	—	—	—	—
Worker months overtime	—	—	—	—	—	—	—	—	—	—	—	—

Cost of alternative 1			
Hiring costs	51 × 1800	=	91,800
Layoff costs	0	=	0
Inventory holding costs	75,000 × 8	=	600,000
Labour costs			
Regular	211 × 12 × 2400	=	6,076,800
Overtime	0	=	0
Total			$6,768,600

*Finished Goods Inventory on December 31 predicted to be 240 units.

numbers of specific appliance types, sizes, or models to be made each month but, as the name indicates, was an aggregate. Linda Metzler's task in October was the construction of this aggregate plan. As the production periods approached later in the year, master production plans would be formulated which would be specific regarding appliance type, model number, etc.

The September forecast is presented in each of Exhibits 1–3. It shows the expected seasonal fluctuations and the aggregate number of appliances to be shipped each month. Linda knew that there would be significant variation of specific appliance types within each month but she also knew that each type of appliance required roughly similar materials and labour resources. For aggregate planning purposes then, the number of appliances to be shipped would be sufficient.

THE AGGREGATE PLAN

In preparation for her decision, Linda gathered the following information:

1. As of October 1, MRL employed 160 hourly paid unionized production workers. Their two-year contract signed in February of last year called for an increase of $0.75 per hour effective next January 1, bringing the average hourly rate to $10.50. With fringe benefits, the monthly cost to MRL would be about $2,400 per worker. Under the agreement, overtime was 1.5 times the regular hourly rate but not all fringes were affected so a worker-month of overtime cost about $3,300. The standard work week was

EXHIBIT 2

Chase Production Plan with Constant Workforce and Overtime

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Production plan												
Shipment forecast	4400	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Production plan	4160	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Shipments	4400	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Inventory*	—	—	—	—	—	—	—	—	—	—	—	—
Extraordinary labour costs												
No. of workers	199	199	199	199	199	199	199	199	199	199	199	199
Hirings	39	—	—	—	—	—	—	—	—	—	—	—
Layoffs	—	—	—	—	—	—	—	—	—	—	—	—
Worker months overtime	—	—	—	1.0	—	96.0	126.0	81.0	71.0	—	—	—

Cost of alternative 2			
Hiring costs	39 × 1800	=	70,200
Layoff costs	0	=	0
Inventory holding costs	0	=	0
Labour costs			
Regular	199 × 12 × 2400	=	5,731,200
Overtime	375 × 3300	=	1,237,500
Total			$7,038,900

*Finished goods inventory on December 31 predicted to be 240 units.

EXHIBIT 3

Chase Production Plan with Varying Workforce

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Production plan												
Shipment forecast	4400	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Production plan	4160	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Shipments	4400	4400	6000	8000	6600	11800	13000	11200	10800	7600	6000	5600
Inventory*	—	—	—	—	—	—	—	—	—	—	—	—
Extraordinary labour costs												
No. of workers	104	110	150	200	165	295	325	280	270	190	150	140
Hirings	—	6	40	50	—	130	30	—	—	—	—	—
Layoffs	56	—	—	—	35	—	—	45	10	80	40	10
Worker months overtime	—	—	—	—	—	—	—	—	—	—	—	—

Cost of alternative 3			
Hiring costs	256 × 1800	=	460,800
Layoff costs	276 × 1200	=	331,200
Inventory holding costs	0	=	0
Labour costs			
Regular	2377 × 2400	=	5,704,800
Overtime	0	=	0
Total		=	$6,496,800

*Finished goods inventory on December 31 predicted to be 240 units.

40 hours. The aggregate plan in effect until December 31 called for a total production workforce of 160 at that time.

2. The personnel department estimated that hiring, training, and related expenses amounted to $1,800 per worker. It also estimated a total of $1,200 per worker for severance and other layoff expenses.
3. The accounting department predicted that it would cost about $8 to hold an appliance in inventory for a month during the next year. Raw materials were readily available from regional sources on short notice. The current aggregate plan, supported by marketing's most recent revised forecasts and the master production schedule, predicted an inventory of 240 finished units on December 31.
4. Although MRL manufactured some parts and subassemblies, the plant was primarily a final assembly operation with a throughput time of about three days. The company used an MRP-based planning system. For aggregate planning purposes, management had found that it was adequate to assume that all worker hours scheduled in a particular month would contribute directly to output in the same month. Similarly, experience had shown that no special allowances for learning needed to be considered.
5. There appeared to be three basic tools available to meet demand fluctuations, each of which involved both quantitative and qualitative trade-offs:
   a)–building inventory to meet peaks
   b)–using overtime
   c)–hiring and laying off workers.

THE ALTERNATIVES

Linda identified three alternatives the company could follow in meeting forecasted demand:

1. The production level and the workforce could be held constant throughout the year at a level sufficient to meet the peak demand period. In periods of low demand inventory would be accumulated and would be drawn down during peak demand periods. Linda was attracted by the protection this plan offered against unforeseen demand changes. This plan is shown in Exhibit 1.
2. The production level could vary to meet demand with a constant workforce by the use of overtime in peak months and restricted output in slow months. The workforce would be held at just the number to meet average monthly requirements. MRL would incur no inventory carrying costs with such a scheme. However, Linda wondered if excessive overtime might lead to lower efficiency or if restricted production might promote poor work habits and low morale. This plan is shown in Exhibit 2.
3. Some of these potential problems could be overcome by a strategy that met demand by varying workforce levels. Linda's calculations showed this to be the cheapest of the three alternatives (see Exhibit 3). However, she was well aware that union relations and employee morale could be adversely affected by frequent layoffs. As well, hiring and training new em-

ployees brought their own headaches, especially in a limited labour market such as existed in Stratford.

THE DECISION

Linda knew that these three very different plans were by no means the only feasible ones available. She realized that her decision on an aggregate plan would involve both quantitative and qualitative trade-offs. One nagging thought in the back of her mind was that no matter which plan she chose, she might never know if a better one existed.