

MECHOFF CASE STUDY

MECHOFF is a small company operating in the field of mechanical components for industrial air conditioning systems. Since its foundation, 30 years ago, the company has been growing and now it has 30 operators working in the shop floor.

The main customers of MECHOFF are producers of industrial air conditioning systems who consider quality as the main strength of MECHOFF. Nevertheless, the top management of the company is now worried because the company is not achieving the same efficiency rate improvement as it was during the first years from its foundation. The profitability of the company is not at risk, though the slow decline in internal performance is considered an alarm signal that could open the path to more relevant problems in the future.

According to the operations manager some difficulties may be explained by the more and more frequent outsourcing. When some years ago the internal capacity was not sufficient any more to meet the demand, outsourcing some manufacturing activities was considered the cheapest solution.

Nevertheless, at that time, outsourcing was used in extreme situations, three times in a quarter. The situation has deeply changed in the last years: all steps of milling and grinding of SP product family are outsourced without even making a short check on internal capacity.

Since the production of a component cannot be assigned only to one sub-supplier due to problems of reliability of sourcing, guaranteeing a high and stable quality level has become more and more difficult. Moreover, when high volumes are required, some sub-suppliers, usually small companies, cannot meet required delivery time and deliver late some components obliging MECHOFF to revise its plans in order to satisfy its customer needs.

Demand of SP family products is growing and the company is interested in accepting the order of a new customer to produce a new product that can be added to the same family. If this order were accepted, the yearly volume required would be 2000 units for the first two years (after the first three years it is not possible to forecast the desired volume).

MECHOFF top management would be interested in knowing in which way the company could satisfy the demand internally. More specifically, the key point is understanding whether it is possible to meet demand without buying any new machines (just varying the number of shifts) or whether it is necessary to buy new machines (in this case it is necessary to compute the right number of machines). In the latter case, space would not be a constraint since, when the new production site was designed 5 years ago, the possibility of a new expansion of the manufacturing plant was taken into account and some extra space was included in the design of layout.

DATA

Now it is possible to identify 5 distinct areas in the shop floor based on the processing that is done. In table 1 it is possible to see the number and types of machines that are available.

Type of machine	Number of machines currently available
Universal miller (M1)	2
Drilling machine (M2)	5
Machining center (M3)	8
Lathe (M4)	2
Face grinder (M5)	12

TABLE 1: Types and number of machines currently available

From a rough analysis carried out by the production manager, it has emerged that the drilling department is not well saturated since, usually, only 4 out of 5 machines are working. Therefore, it is common opinion that the available capacity is enough also for the new products.

According to a rough analysis, it has been evaluated that the availability of machines is 0.95. The human coefficient has been fixed to 0.94.

Information about working time and setup time of different components on different machines are respectively in Table 2 and Table 3. The reference mix is given by the 3 product families that are realized internally (PZ, DI e RO) and by the new family SP. Working times and setup times for the new products have been estimated by the production manager based on the similarity of the new item with other pieces that are currently worked.

Setup times include:

- upload of working programme
- picking of the correct tools from the tool warehouse
- fitting
- machine cleaning

In fact, in setup times are included all the activities that are needed to prepare the machine to work a batch of products. The setup is always done when the machine is not working, therefore production is stopped

	M1	M2	M3	M4	M5
PZ1	0.55	1.25			
PZ2	0.25		0.5	0.2	
PZ3	0.4	0.5		0.65	
PZ4	0.4		1.25	0.35	
DI1	0.2	0.2		0.15	0.5
DI2	0.2	0.4		0.14	1
DI3	0.3			0.17	0.7
DI4		1		0.25	0.2
DI5	0.2			0.2	
RO1			0.4		0.5
RO2			0.3		0.95
RO3			1		0.98

RO4			0.2		1.05
RO5			0.5		0.65
SP1	0.5	0.3			1.2
SP2	0.45	0.5			0.8
SP3	0.3	0.2			0.9
SP4	0.6	0.8			1.5

TABLE 2: Working time (hours/unit)

All departments work for 2 shifts of 7.5 hours, five days a week (220 days a year). The top management wants all departments to work the same number of shifts in order to make management easier and to avoid the presence of WIP that would cumulate between departments. In case of need, operators can be asked to work overtime. According to the agreement with the Trade Unions overtime cannot be more than 2 hours a day and no more than 8 hours on Saturday.

	M1	M2	M3	M4	M5
PZ1	3	3			
PZ2	1.5		3	2	
PZ3	2	3		2.5	
PZ4	2		5.5	3	
DI1	2	1.5		2	1
DI2	1.5	1		3	0.5
DI3	1.5			2	1
DI4		2		2	0.5
DI5	1			3	
RO1			1		2.5
RO2			2		3
RO3			1		2.5
RO4			2.2		3
RO5			2		4
SP1	1.5	0.5			2
SP2	1	1			1.5
SP3	1.2	1.5			1
SP4	2	2			2

TABLE 3: Setup time (hours/batch)

All the data that can be useful to find the best solution to enlarge production capacity have been collected. In table 4 it is possible to see the yearly demand for all components and the number of lots that are dispatched every year.

On average the discard coefficient (i.e. scrap rate) is 4%, this value can be used also for the SP family.

The cost for new machines has been grouped in Table 5. Use $m_i=0.05$

The cost for workforce is 13.5€/h for an operator working during the first shift, 14.5€/h for an operator working during the second shift and 15.5€/h for an operator working during the third shift. The hourly cost for the overtime is 21 €/h.

To take into account the hours that could be lost because of bottlenecks, it has been decided to use 0.8 as scheduling efficiency.

ATTENTION

If any data is missing assume a suitable value for them.

Code	Yearly demand (units/year)	Number of batches per year (batches/year)
PZ1	500	10
PZ2	500	12
PZ3	500	18
PZ4	500	9
DI1	2500	40
DI2	3400	40
DI3	6250	30
DI4	5000	25
DI5	500	15
RO1	8000	30
RO2	500	5
RO3	6500	20
RO4	500	10
RO5	10000	50
SP1	5000	25
SP2	7000	35
SP3	2600	13
SP4	2000	20

TABLE 4: Yearly demand and number of batches that are done every year

	M1	M2	M3	M4	M5
Machine cost (€/machine)	150000	300000	200000	250000	250000

TABLE 5: Cost of machines