

1) Introduction:

Our company is involved in the manufacture of engine timing and transmission chains. Our objective here is to modify the production system of our company. To free up our capital and to provide long-term benefits for our firm, we need to:

- a: Reduce our inventory,
- b: Reduce our WIP inventory,
- c: Improve product quality.

We are serving two main markets: Original Equipment Manufacturers (OEM), like GM, Ford, and Chrysler, and after-market firms which supply replacement parts. Problems first arise because of the highly inaccurate OEM estimates and delivery schedules. Sometimes, the differences go up or down as much as 100%. This particular problem leads to plant shutdowns, contract penalties, and loss of prospective customers (loss of market share, in other words).

On the other hand, after-market orders are more accurate since they are received less often and they always provide specific quantities. However, after-market orders account just for 25% of our business.

Besides, we do face a foreign competition which has been forcing us both to concentrate on product quality (which is already given above) and to lower our costs. To highlight the problem areas, we have to have tight cost control measures and implement Total Quality Control (TQC). Even though we have an Inspection Part in our model, we see that we still have some problems regarding the defective products, -chains.

2) Major Areas of Concern Regarding the Manufacturing Process:

- In parts fabrication stations, batch processing system uses several weeks worth of WIP inventory at each stage of manufacture.
- Link process is highly inefficient, which yields almost a 50% scrap rate.
- In fabrication part, there are several days worth of partially finished products which drive our inventory costs up.

3) The Number of Machines Needed For the Third Work Cell:

Third work cell includes Assembly, Riveting, Hook-Up & Pre-Stress, and Inspection machines, which are used for the production of 3/8 by 5/8 by 58 3800 and 3/8 by 3/4 by 54 3800 Series Transmission Chains. Our objective is to prevent any bottleneck and reduce WIP inventory, and thus, to choose sufficient number of machines of each type to achieve the desired demand.

Workstation #1 (Assembly):

	Demand (1)	Demand Considering Scrap (5%) (2)	Unit Processing Times (3)	Unit Processing Time (4)	Production
1	1,200	1,263 [(1)/.95]	2.083/min.	606 [(2)/(3)]	
2	1,400	1,474 [(1)/.95]	2.5/min.	590 [(2)/(3)]	
				+-----	
					1,196 min.
				Setups	10 min.
				+-----	
					1,206 min.
				Maintenance	45 min.
				+-----	

1,251 min.

Each day: 480 min.

$1,251/480=2.6=3$ machines

Setups (for 2 more machines) 20 min.

Maintenance (") 90 min.

+-----

1,361 min.

$1,361/480=2.84=3$ machines (no change).

Workstation #2 (Riveting):

Production time (process 1) = $1,263/10.833=117$

Production time (process 2) = $1,474/10.833=136$

Total : 253

Setups : 20

Maintenance : 15

Total (including setups and maintenance) : 288 $288/480=0.6=1$ machine

Workstation #3 (Hook-Up & Pre-Stress):

Production time (process 1) = $1,263/2.708=466$

Production time (process 2) = $1,474/2.708=544$

Total : 1,010

Setups : 40

Maintenance : 15

Total (including setups and maintenance) : 1,065 $1,065/480=2.22=3$ machines

Setups (for 2 more machines) : 80

Maintenance(for 2 more machines) : 30

Total (including setups and maintenance

of 3 machines) : 1,175 $1,175/480=2.45=3$ mach. (no change)

Workstation #4 (Inspection):

Production time (process 1)= $1,263/12.5=101$

Production time (process 2)= $1,474/12.5=118$

Total : 219

Setups : 50

Maintenance : 30

Total (including setups and maintenance) : 299 $299/480=0.6=1$ machine

From the above calculations, the 4 workstations require the following number of machines:

Assembly: 3 Riveting: 1 Hook-Up: 3 Inspection: 1

4) XCELL Model:

Using the above calculations, we developed a model under XCELL. We used 2 hyper-workstations (at Assembly and Hook-Up) where we divided the processing times by the number of machines. Buffers were used between the workstations to store our WIP inventory. Normal outputs were preferred from the workstations to the buffers. At the very end of the model, we used 3 shipping areas, one of which was scrap, and the other two were regular for the shipment of the two products. Scrap rate was determined to be 5% of the total output. Moreover, low trigger at assembly was used in conjunction with the shipping areas. As for the maintenance, all of the 4 workstations were assigned a maintenance team.

5) Results and Possible Problems:

After we ran the model, we saw that because of the fractional part of the number of machines which we rounded to the next integer, we had been having problems. As an example, in the third workstation, even though the exact number of machines was 2.22, we chose 3 machines. With the result for each unit of production, therefore, we are producing $(0.8) \times (\text{production output})$ more. We observed that this causes slight bottlenecks in the following workstation. However, the overall results achieved were satisfactory and fulfilled our expectations.

Another foreseeable problem would arise if either the Riveting machine or the Inspection machine unexpectedly breaks down. We believe that this might cause a problem just because we only have one machine each in these particular workstations.

For the results, please see Appendix.



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