Capacity Management in Manufacturing Environments

Presented by
Prof. Richard Wilding
Cranfield School of Management

Notes:
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Capacity Management in Manufacturing Environments

Prof. Richard Wilding.

Capacity Management

Aggregate Capacity Management
A Hotel in Cleethorpes with 100 bedrooms

Rough-Cut Capacity Planning
3 coach parties each week (average size of 50)

Capacity Requirements Planning
7 families with babies and only 2 cots

Notes:

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Determine Capacity Required

PLANNING
Selection of products
Identification of markets
Determine capacity required
Develop strategy for resources

CONTROL
Manipulate resources for changes in demand

Notes:

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Capacity Management in Manufacturing Environments

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Notes:

Capacity Requirements

Forecast + Orders + Policies

Demand

\[ \times \]

Bill of Materials

Part Quantity

\[ \times \]

Routing Sheet/
Process Plan

Process Time for
Men or Machines

Hierarchic Bill of Materials

Notes:
Operation or Routing Sheet

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Drawing Number</th>
<th>Issue Number</th>
<th>Located</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2064</td>
<td>Axle</td>
<td>T2064012</td>
<td>4/2</td>
<td>DD1224</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Raw Form</th>
<th>Raw Mat./Unit</th>
<th>R/S Number</th>
<th>Planner</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS970:1971045M10</td>
<td>1.5cm bar</td>
<td>0.85m length</td>
<td>PP64/20/4</td>
<td>JCB</td>
<td>18 Aug 93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Op No.</th>
<th>M/C Tool</th>
<th>Operation Description</th>
<th>Gauge</th>
<th>Time</th>
<th>SU</th>
<th>Run</th>
<th>Scrap</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Saw</td>
<td>Cut-off to 83cm length</td>
<td></td>
<td>2</td>
<td></td>
<td>Bar end</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>Lathe</td>
<td>Feed stock to stop. Turn 50mm length to 10mm dia +/- 0.1</td>
<td>LG320</td>
<td>15</td>
<td>2.2</td>
<td>1.5%</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>“</td>
<td>Reverse Stock and Repeat</td>
<td>LG320</td>
<td>-</td>
<td>2.3</td>
<td>1.5%</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>TM2</td>
<td>Thread both ends</td>
<td>TG197</td>
<td>15</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
<td>Inspect. (Check threads, length)</td>
<td>TG205</td>
<td>1.5</td>
<td></td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>Plate</td>
<td>Stop off both ends. Cu plate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>H/T</td>
<td>Case harden bearing surfaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td></td>
<td>Inspect. (Check Hardness)</td>
<td>Vickers</td>
<td>5</td>
<td></td>
<td>2%</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

Capacity Available

Hours for Men or Machines: X

A Factor due to:

- Breakdown
- Scrap
- Rework
- Maintenance
- Efficiency
- Learning
- Holidays
- Illness
- Absenteeism
- Absenteeism
- Poor Data
- Incentives

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**General Form of the Learning Curve**

\[ T_n = T_1 n^x \]

**Production Time/Unit**

\( T_n \)

**No. of Units Produced**

\( n \)

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**Rough Cut Capacity Planning**

**A Factor**

70 to 85 %

**263 work centres?**

**Bottlenecks**

**Groups of like Resources**

**Critical Resources**

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Notes:
DEVELOP STRATEGY FOR USE OF RESOURCES

PLANNING
Selection of products
Identification of markets
Determine capacity required
Develop strategy for resources

CONTROL
Manipulate resources for changes in demand

Capacity Management Trade-off

Notes:
The Capacity Management Problem

Volume

Demand

Capacity

Time

SOLUTIONS ?

Notes:

Strategy 1 :- Make Capacity easy to vary

- Hire/Fire
- Sub-contract labour
- Short-term contracts
- Flexible work-force

- Overtime
- Additional Shifts

- Sub-contract

- Buy/lease machines

- Buy or Make

Notes:
Strategy 2: Remove the need to vary Capacity

A) Maintain Excess Capacity

B) Reduce/Smooth Fluctuations

1) Fix Upper Limit on Capacity
   - Loss of Business
   - Customer Waiting

2) Use Stock to Absorb Fluctuations

MANIPULATE RESOURCES FOR CHANGES IN DEMAND

Notes:
Control Tools

- Cumulative Sum Charts
- Break-Even Analysis
- Linear Programming
- Discrete Event Simulation

Notes:
Notes:
The Objective Function:
\[ \text{Profit} = 1.2A + 1.4B \]

The Solution:
- 16.9 Product A per hour
- 12.9 Product B per hour
- Profit of £38.39 per hour

How do you keep your Job?
Notes:
Acknowledgement

This session was jointly developed by Dr. Richard Wilding and his colleagues, particularly Mr. Mike Newton, when he was employed at the Warwick Manufacturing Group, University of Warwick, U.K. The author would like to acknowledge their input and advice on the material presented.