Large Scale Systems Design
G52LSS

Lecture 8 – Gantt Charts and CPM

- Gantt Charts
- Constructing Gantt Charts
- Staff Profile and Utilisation

Learning outcomes: interpret the information in Gantt charts; construct Gantt charts following Pert/CPM method; determine staff profile and staff utilisation for a project following the Gantt chart and staff requirements.

Gantt Charts

A project schedule represents the sequencing of the project activities and milestones in a clear and logical manner to facilitate project execution and control.

After the PERT/CPM analysis is completed, the following phase is to construct the GANTT chart and then to re-allocate resources and re-schedule if necessary.

A GANTT chart is a useful graphical tool to aid project management. In a Gantt chart tasks are represented as horizontal bars.

Characteristics of Gantt Charts

- The bar in each row identifies the corresponding task
- The horizontal position of the bar identifies start and end times of the task
- Bar length represents the duration of the task
- Offer simple and good visual communication
- Task durations can be compared easily
- Good for allocating resources and re-scheduling
- Precedence relationships is represented using arrows
- Critical activities are usually highlighted
- Slack times are represented using bars with dotted lines
- Milestones can be represented by special shapes
- Minor changes in data can cause major changes in the chart

Early start GANTT chart – the bar of each activity begins at the activity earliest start time (ES).

Late start GANTT chart – the bar of each activity ends at the activity latest finish time (LS).

Constructing Gantt Charts

The steps to construct an early Gantt chart using the information obtained from the PERT/CPM analysis are as follows:

1. Schedule the critical tasks in the correct position
2. Place the time windows in which the non-critical tasks can be scheduled (ES and LF)
3. Schedule the non-critical tasks according to their earliest starting (ES) times
4. Indicate precedence relationships between tasks

Note: to construct a late Gantt chart use the latest starting (LS) time to schedule non-critical tasks.
Example 8.1 Construct an early Gantt chart for the following project.

![Gantt Chart Diagram]

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>AE</th>
<th>SE</th>
<th>LF</th>
<th>LF</th>
<th>Slack</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>B</td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>C</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>E</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>C, D</td>
<td>3</td>
<td>11</td>
<td>14</td>
<td>11</td>
<td>0</td>
</tr>
</tbody>
</table>

Example 8.1 (cont.)

Step 1

![Gantt Chart Diagram]

Example 8.1 (cont.)

Step 2

![Gantt Chart Diagram]

Example 8.1 (cont.)

Step 3

![Gantt Chart Diagram]

Example 8.1 (cont.)

Step 4

![Gantt Chart Diagram]

Example 8.2 Construct a late Gantt chart for the following project.

![Gantt Chart Diagram]
The staff profile is a graph that gives the total required staff at every time in the project.

The staff utilisation is calculated by dividing the area of staff requirements by the area inside the staff profile envelope.

\[
\text{Staff Utilisation} = \frac{\sum_{i=1}^{n} t_i s_i}{\max_{i=1}^{n} \sum_{i} s_i L_i}
\]

where \(n\) is the number of activities
\(t_i\) is the duration of activity \(i\)
\(s_i\) is the staff requirements of activity \(i\)
\(A_i\) is the set of activities being executed at time \(t\)
\(L\) is the duration of the project

Example 8.3 Obtain the staff profile and staff utilisation for the following project.

Example 8.4 Construct the early Gantt, staff profile and calculate staff utilisation for the following project.
Exercise 8.1 (cont.)
The early Gantt chart

![Gantt chart with tasks labeled A to I]

Exercise 8.1 (cont.)
The staff profile and utilisation

![Staff utilisation graph with bars and percentage]

Staff utilisation = 0.5765 = 57.65%

Additional Reading

Chapter 5 of (Maylor, 2003)

Chapter 3 of (Kendall and Kendall, 2005)