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 (LF).

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**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.

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**Example 8.1** Construct an early Gantt chart for the following project.

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**Example 8.1 (cont.)**

**Step 1**

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Example 8.1 (cont.)

Step 2

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Example 8.1 (cont.)

Step 3

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Example 8.1 (cont.)

Step 4

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

\[
\text{Staff Utilisation} = \frac{\sum_{i \in A} t_i s_i}{\max \left( \sum_{i \in A} s_i \right) L}
\]

where \( n \) is the number of activities

\( t_i \) is the duration of activity \( i \)

\( s_i \) is the staff requirements of activity \( i \)

\( A \) is the set of activities being executed at time \( t \)

\( L \) is the duration of the project

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

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**Staff Profile and Utilisation**

The **staff profile**, showing the overall staff needs during the project, can be obtained with the project schedule (Gantt chart) and the staff requirements of each task.

**Staff utilisation** gives an indication of how the average efficiency in which the available staff hours are being utilised during the project.

**Resource smoothing** if often used to re-allocate resources and re-schedule activities when staff (or other resources) is not available at the required level. The non-critical tasks are re-scheduled within their time window avoiding as much overlap as possible.
Example 8.3 (cont.)
Staff utilisation = \( \frac{6 \times 16 + 5 \times 21 + 2 \times 8 + 15}{84} = 0.857 = 85.7\% \)

Exercise 8.1 Construct the early Gantt, staff profile and calculate staff utilisation for the following project.

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<th>Task</th>
<th>Precedence</th>
<th>Duration</th>
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<th>KP</th>
<th>LS</th>
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Staff utilisation = 0.5765 = 57.65%
Additional Reading

Chapter 5 of Maylor, 2003

Chapter 3 of Kendall and Kendall, 2005