Project Scheduling

Scheduling = Planning + time

Why construction schedule?

- Knowing activities timing and project completion time
- Having resources available on site in the correct time
- Making corrective actions if schedule shows that the plan will result in late completion
- Assessing the value of penalties on project late completion
- Determining project cash flow
- Evaluating effect of change orders on project completion
- Determining value of project delay and the responsible parties
Project Scheduling

The Critical Path Method (CPM)

- Most Widely used method for project scheduling
- Calculates the minimum completion time for a project
- Calculates activities timings
- Computer programs use CPM, handle large projects
  - Forward path
  - Backward path
  - Float calculations
  - Critical activates

What creates activities’ timings?

- Consider the example of traveling to Alex.
- Travel to Cairo 2 hours at 10 AM
- Meeting for 2 hours
- Travel to Alex 3 hrs
- Meeting for 2 hrs starting at 6 PM
Project Scheduling

1. CPM for Activity on Arrows

Forward path
- ET for the first node = 0
- ET_j = ET_i + dx
- ES_x = ET_i
- EF_x = ES_x + dx

Backward path
- LT for the last node = its ET
- LT_i = LT_j - dx
- LF_x = LT_j
- LS_x = LF_x - dx

Free Float (FF) = ET_j - ET_i - d
= smallest ES (of succeeding act.) - EF (of current act.)

Total Float = LF - ES

TF = LF - EF = LS - ES
Project Scheduling

1. CPM for Activity on Arrows

Critical activities & critical path

- Activities with TF = 0 are critical
- These activities need special attention during construction
- A set of critical activities form a critical path
- The critical path is a continuous path of critical activities
- The critical path is the longest one in the network
- More than critical path can be formed

Example

```
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>7</td>
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<td>d1</td>
<td>d2</td>
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13/01/2002 Emad Elbeltagi
Project Scheduling

2. CPM for Activity on Nodes (PDM)

**Forward path**
- $ES_i$ for the first Activity = 0
- $EF_i = ES_i + d_i$
- $ES_j = EF_i - \text{overlap}_{ij}$

**Backward path**
- $LF$ for the last activity = its $EF$
- $LS_j = LF_j - d_j$
- $LF_i = LS_j + \text{overlap}_{ij}$

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Project Scheduling

2. PDM

**Example**

- A (3)  ->  B (3)
- A (3)  ->  C (4)
- C (4)  ->  D (6)
- C (4)  ->  E (5)
3. Time-Scaled Diagram

- Activities are drawn to scale according to its duration
- Relationships are represented using Horizontal or vertical lines
- It can be drawn using calendar dates
- Activities times can read directly from the chart
- It can be used to calculate resource usage or cost

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**Diagram:**

```
1  2  3  4  5  6  7

A   3   B
   3   C

3   4   1''

1        2    3    4    5    6    7    8    9    10   11   12   13   14

A (3 days) has no predecessor
B (3 days), C (4 days), & D (6 days) depend on A
E ((5 days) depends on B, C, and D
```
Project Scheduling

Bar Chart (Gantt Chart)

- Time versus activity chart
- Simple representation and easy to read
- Early bar chart

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<th>0</th>
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Project Scheduling

Bar Chart (Gantt Chart)

- It can use calendar dates
- It can be drawn using late start times
- Late start bar chart

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Project Scheduling

Bar Chart (Gantt Chart)

- It can be used for resource and cost analysis

Criticism to Network Techniques

- Duration driven schedule
- Assumes resources are available
- Can not deal with project deadline
- Ignore project cost (minimum cost)
- Use deterministic durations