Network Techniques for Project Management
(Part-1)

Plan 401: Project Evaluation and Management

Network Techniques

PERT
(Program Evaluation Review Technique)

CPM
(Critical Path Method)

• Designed to handle risk and uncertainty
• Probabilistic

• Concerned with trade-off between cost and time
• Deterministic
Development of Project Network

• **Precedence relationship**  
  A relationship that determines a sequence for undertaking activities; it specifies that one activity cannot start until a preceding activity has been completed.

• **Activity-on-arc (AOA) network**  
  An approach used to create a network diagram that uses arcs to represent activities and nodes to represent events.

• **Activity-on-node (AON) network**  
  An approach used to create a network diagram, in which nodes represent activities and arcs represent the precedence relationships between them.

• **Event**  
  The point at which one or more activities are to be completed and one or more other activities are to begin.

Rules for Network Construction

1. Each activity must have a preceding and succeeding event. An activity is numerically denoted by a pair of preceding and succeeding events.

2. Each events should have a distinct number. Usually number at the head of the arrow is greater than that at its tail.
Rules for Network Construction (cont.)

3. There should be no loops in the project network.

4. Not more than one activity can have the same preceding and succeeding events

Rules for Network Construction (cont.)

Dummy activity:

A dummy activity is an imaginary activity which can be accomplished in zero time and which does not consume resources. It may also be used to represent a constraint.
a) Activities (1-2) and (1-3) can start simultaneously.
b) Activity (1-2) proceeds activity (2-4) and (2-6)
c) Activities (3-4) and (3-5) can start only on completion of activity (1-3).
d) Activity (4-7) can start only after (2-4) and (3-4) have been completed.
e) Activities (5-7) and (5-9) can not start till activities (2-4), (3-4) and (3-5) are completed.
f) Activities (6-8) and (6-7) can start only on completion of (2-6).
g) Activity (8-9) follows activity (6-8).
h) Activities (8-9), (7-9) and (5-9) can be taken up simultaneously for completion of the project.

Network Construction

![Network Diagram](attachment:network_diagram.png)
Time Estimation

1. Optimistic time (To)
2. Most likely time (Tm)
3. Pessimistic time (Tp)

\[ Te = \frac{To + 4Tm + Tp}{6} \]

Te = weighted arithmetic average time

Determination of critical path

1. **Calculate the Earliest Occurrence Time (EOT) for each event** when the event can be completed at the earliest.
Determination of critical path (cont.)

2. Calculate the Latest Occurrence Time (LOT) for each event
   latest allowable time by which the event can occur

Determination of critical path (cont.)

3. Calculate the Slack for each event
   \[ \text{Slack} = \text{LOT} - \text{EOT} \]

<table>
<thead>
<tr>
<th>Event</th>
<th>LOT</th>
<th>EOT</th>
<th>Slack</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>28</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
3. Obtain the Critical Path

![Critical Path Diagram]

Critical Path = 1-2-5

Activity Floats

1. Total Float
2. Free Float
3. Independent Float

Total Float

TF (i,j) = LOT (j) – EOT (i) – d (i,j)

TF (2,4) = 26 – 13 – 2 = 11 weeks
**Free Float**

\[ FF(i,j) = EOT(j) - EOT(i) - d(i,j) \]

\[
\begin{array}{c}
2 \\
13
\end{array}
\quad 2 \quad
\begin{array}{c}
4 \\
20
\end{array}
\]

\[ FF(2,4) = 20 - 13 - 2 = 5 \text{ weeks} \]

**Independent Float**

\[ IF(i,j) = EOT(j) - LOT(i) - d(i,j) \]

\[
\begin{array}{c}
2 \\
13
\end{array}
\quad 2 \quad
\begin{array}{c}
4 \\
20
\end{array}
\]

\[ IF(2,4) = 20 - 13 - 2 = 5 \text{ weeks} \]