Precedence Diagram Method

CSTM 462
Planning & Scheduling
Activity Sequencing
Tools and Techniques

1. Precedence Diagramming Method (PDM)
2. Arrow Diagramming Method (ADM)
3. Schedule Network Templates
4. Dependency Determination
5. Applying Leads and Lags

Inputs

1. Project Scope Statement
2. Activity List
3. Activity Attributes
4. Milestones List
5. Approved Change Request

Activity Sequencing

Outputs

1. Project Schedule Network Diagram
2. Activity List (Updates)
3. Activity Attributes (updates)
4. Requested Changes
Precedence Diagramming Method (PDM)

“PDM is more flexible than AON or AOA networks because PDM allows the overlapping of concurrent activities. Additionally, almost all commercially available microcomputer-based project management systems are based on PDM.”
Activity Logic

Precedence

Precedence assumes that succeeding activities cannot start until all preceding activities are complete.

- A predecessor activity is any activity that must be completed before a given activity can be started.
- A successor activity is any activity that cannot start until a given activity has been completed.
Building a Schedule

Activity Relationships

• Conventional
• Start to Start
• Finish to Finish
• Start to Finish
• Finish to Start Positive
• Finish to Start Negative

Examples
Lag Points

- All lags have a calculated duration and a good reason
- If using start-to-start lags, use corresponding finish-to-finish lag
- If using finish-to-finish lags, use corresponding start-to-start lag
- Avoid lags when possible
Activity Relationships

- Finish-to-start- Most common. The earliest the next activity can begin is when a certain activity is completed.
- Start-to-start- Is used to show how the start of one activity triggers the start of a successor activity.
- Finish-to-finish- Necessary for the initial activity to remain ahead of its successor activity. Completion is contingent upon completion of its predecessor.
- Start-to-finish- Seldom if ever used in the construction industry.

- Lag-The relationship arrows can have lags associated with them. A lag signifies that there must be some predetermined waiting period between activities. A minimum number of days that must elapse between activities.
Finish To Start
Why?

300
Place Ftgs
6

FS + 5

400
Set Stl Cols
9
Start to Start Relationship

Start of Hang Drywall = Start of Erect Studs + 5 Day Lag = 5

Start of Hang Drywall

Start of Erect Studs

SS + 5

Hang Drywall

Lag Time

Five Day Starting Lag
Start to Start
Why

100 EXC FTGS
6

SS + 2

200 FORM REINF FTGS
12
Finish to Finish Relationship

5 Day finishing lag

- Erect Studs
- Hang Drywall

FF Lag
Finish to Finish
Why?

300
POUR FTGS
1

FF + 2

330
STRIP FTGS
1
Activity Relationships

- **Finish-to-start**- Most common. The earliest the next activity can begin is when a certain activity is completed.
- **Start-to-start**- Is used to show how the start of one activity triggers the start of a successor activity.
- **Finish-to-finish**- Necessary for the initial activity to remain ahead of its successor activity. Completion is contingent upon completion of its predecessor.
- **Lag**- The relationship arrows can have lags associated with them. A lag signifies that there must be some predetermined waiting period between activities. A minimum number of days that must elapse between activities.
Precedence Diagramming Method
Activity Node Layout

<table>
<thead>
<tr>
<th>Activity ID</th>
<th>Activity Description</th>
<th>ES</th>
<th>Duration</th>
<th>EF</th>
<th>LS</th>
<th>Total Float</th>
<th>LF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Precedence Diagramming Method

<table>
<thead>
<tr>
<th></th>
<th>ES</th>
<th>12</th>
<th>EF</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS</td>
<td>23</td>
<td></td>
<td>LF</td>
<td>30</td>
</tr>
<tr>
<td>TF</td>
<td>11</td>
<td></td>
<td>FF</td>
<td>11</td>
</tr>
</tbody>
</table>

Pour Deck 5

100

8
Network Report

- Activity Number
- Activity Description
- Planned Duration
- Early start
- Early Finish
- Late Start
- Late Finish
- Total Float

- This information is the minimum information needed to plan and manage a construction project using a network schedule.
Forward and Backward Pass

- On a activity network they are required in order to calculate the early and late start and finish times for each network activity.
- The calculation of total float and its importance in managing a construction project.
- We will be using day as the time unit in the following projects.
Forward Pass Defined

• The purpose of performing a forward pass on a network schedule is to calculate the following:
  – The earliest time each activity in the network can start and finish.
  – The minimum overall duration of the project.
Backward Pass defined

The purpose of performing a backward pass on a network is to calculate the latest time that each activity in the network can start and finish and still maintain the minimum overall duration of the project as calculated by the forward pass.
Forward and Backward Calculations

• Forward Pass
  • EF = ES + Duration
  • ES = Max EF of related predecessor

• Backward Pass
  • LS = LF – Duration
  • LF = Min LS of related successor

• Total Float
  • TF = LS – ES = LF - EF
Terminology

Key Terms

- **Forward Pass** - A calculation starting with the first activity and culminating with the last activity performed to find the early dates and the duration of a specific project.

- **Backward Pass** - A scheduling calculation done to determine the activity late dates. This calculation begins with the last activity and project duration and culminates with the first activity.

- **Float** - The number of days that an event or lag can be delayed or extended without impacting the completion of the project.

- **Early Start (ES)** - The earliest that an activity can start.

- **Early Finish (EF)** - The earliest that an activity can possibly finish.

- **Late start (LS)** - The latest that an activity can start and not impact project completion.

- **Late Finish (LF)** - The latest that an activity can be completed without impacting the project completion.

- **Critical Path** - Longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
Critical Path

The critical path is composed of a continuous chain of activities through the network schedule with zero total float. All activities on the critical path must start and finish on the planned early start and finish times. Failure of a critical path activity to start or finish at the planned early and late finish times will result in the overall project duration being extended.

TF = 0
Critical Path

• Critical path definitions
  – Critical path activities have negative or zero total float
  – The longest uninterrupted chain of activities through a project
• Any delay to any activity on the critical path will delay the finish date of the project or other intermediate milestones.
• Monitoring near critical activities and reviewing for reality
Total Float

Total float is a measure of leeway in starting and completing an activity. Total float assumes that all activities preceding the activity being studied are finished as early as possible and all successor activities are started as late as possible. Total float is commonly used in managing construction projects as a means of identifying critical activities and critical activity paths through the network.

\[ TF = LF - EF \]
Float

• Float is:
  – Amount of time the finish of an activity can be delayed without affecting the end date of the project or intermediate milestones that have a finish no later than constraint
  – Free float is the amount of time an activity can slip without affecting its immediate successor or successors
  – Float is sometimes referred to as slack or slide time
  – Float ownership issues
Terminology
Key Terms

• Forward Pass- A calculation starting with the first activity and culminating with the last activity performed to find the early dates and the duration of a specific project.
• Backward Pass- A scheduling calculation done to determine the activity late dates. This calculation begins with the last activity and project duration and culminates with the first activity.
• Float- The number of days that an event or lag can be delayed or extended without impacting the completion of the project.
• Early Start (ES)- The earliest that an activity can start.
• Early Finish (EF)- The earliest that an activity can possibly finish.
• Late start (LS)- The latest that an activity can start and not impact project completion.
• Late Finish (LF)- The latest that an activity can be completed without impacting the project completion.
• Critical Path- Longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
Example

Draw the precedence diagram for the following project.

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Duration Days</th>
<th>Predecessors *</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Move In</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>B Set Up Scaffolds</td>
<td>3</td>
<td>A</td>
</tr>
<tr>
<td>C Tear Off Old Shingles</td>
<td>3</td>
<td>B/1</td>
</tr>
<tr>
<td>D Inspect Roof and Deck</td>
<td>1</td>
<td>C SS/1</td>
</tr>
<tr>
<td>E Remove Old to Yard</td>
<td>3</td>
<td>C FF/2</td>
</tr>
<tr>
<td>F Purchase New Shingles</td>
<td>2</td>
<td>C SS/1</td>
</tr>
<tr>
<td>G Install New Shingles</td>
<td>5</td>
<td>C,D,F</td>
</tr>
<tr>
<td>H Clean Up</td>
<td>3</td>
<td>E,G</td>
</tr>
<tr>
<td>I Move Out</td>
<td>2</td>
<td>H</td>
</tr>
</tbody>
</table>

*Under Predecessors, the following notation is used:
- x/#: Activity x must finish # days before this activity can begin.
- x SS/#: The # of days after activity x starts that this activity can begin.
- x FF/#: This activity cannot finish until # days after x is completed.
- x SF/#: This activity must finish # days before x can start.
Rules to Live By

1. Include procurement activities including critical lead times.
2. Look to establish clear logic and relationships with activities to develop different paths.
3. WBS breaks down the project. WBS does not have logic relationships to activities.
4. Start the project with a start milestone and finish the project with a finish milestone.
5. All activities require a successor and predecessor except the first and last activity.
6. **No open end activities** If you utilize a SS relationship be sure to have a FF tie.
7. Do not use constraints for this class.
8. All activities should be no more than ten days in duration.