Planning & Scheduling
CSTM 462

Managing a project through time and resources.
The need for proper planning and scheduling.
Project Management Objectives

1. Eliminate or reduce project RISK.
2. Obtain a thorough understanding of PROJECT OBJECTIVES/MILESTONES.
3. Formulate strategy for achieving objectives with available RESOURCES.
4. Develop a framework for MONITORING AND CONTROLLING THE PROJECT.
What is it?

Defining activities for a project, through their relationships we can identify the project duration.

We will learn a new way of managing projects through the critical path method.
Learning Objectives

• Understand the Scheduling players

• Time is of the essence
  – Success or Failure
  – Think in Man-hours
    • Estimators can lead to costs schedulers look to
      hours.

• Understand WBS

• Understanding Steps
Understand the Scheduling players

Worker

Owner

And all between.
Why schedule the construction project?

**Owner**
- Owner requirement
- Communication of the construction plan
- Monitor and measure progress
- Manage change

**General Contractor/Subcontractor/Supervisors/Worker in Field**
- Establish production goals
- Manage change
- Communication of the construction plan
Time is of the essence

– Success or Failure
– Think in Man-hours
  • Estimators can lead to costs schedulers look to hours.
Time is of the Essence

Time shall be strictly of the essence of the contract. The Contractor shall promptly begin the work under the contract and all portions of the project made the subject of the contract shall be begun and so prosecuted with necessary plant, equipment, procedures, and overtime that they shall be completed and ready for full use in the time stated in the special conditions.
Understand WBS
A **Work Breakdown Structure** helps in organizing *what* needs to be done in small packages of activities.
Work Breakdown Structure

The work breakdown structure (WBS) is a hierarchical system that represents the construction project in increasing levels of detail to define, organize and display the project work in measurable and manageable components.
# Work Breakdown Structure

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2</td>
<td>Subproject</td>
</tr>
<tr>
<td>Level 3</td>
<td>Sub-network</td>
</tr>
<tr>
<td>Level 4</td>
<td>Activity</td>
</tr>
<tr>
<td>Level 5</td>
<td>Sub-activity</td>
</tr>
</tbody>
</table>
WBS LEVEL 1:
1. Bicycle 100
   1.1 Frame Set 15
   1.2 Crank Set 5
   1.3 Wheels 30
   1.4 Braking System 5
   1.5 Shifting System 5
   1.6 Integration 35
   1.7 Project Mgt 5
   100

WBS LEVEL 2:
1. Bicycle
   1.1 Frame Set
     1.1.1 Frame 7
     1.1.2 Handlebar 2
     1.1.3 Fork 3
     1.1.4 Seat 3
   1.2 Crank Set 5
   1.3 Wheels
     1.3.1 Front Wheel 13
     1.3.2 Rear Wheel 17
   1.4 Braking System 5
   1.5 Shifting System 5
   1.6 Integration
     1.6.1 Concept 3
     1.6.2 Design 5
     1.6.3 Assembly 10
     1.6.4 Testing 17
   1.7 Project Mgt 5
   100

WBS LEVEL 3:
1. Bicycle
   1.1 Frame Set
   1.2 Crank Set
   1.3 Wheels
   1.4 Braking System
   1.5 Shifting System
   1.6 Integration
   1.7 Project Mgt
   100
Work Breakdown Structure

- **Construction**
  - Footings
  - Floor Slab
  - Framing
- **Start-up Mobilization**
- **Procurement**
- **Administration**
- **Start-Up Testing**

- **Sitework**
- **Footings**
  - Excavate Footings
  - Reinforce Footings
  - Place Footings
  - Building
  - Shop
  - Play Area
Example
WBS

3 Unit Townhouse
• Unit One (WBS)
  – Site Work (WBS)
    • Excavate Footings (Activity)
  – Build foundations (WBS)
  – Erect structure (WBS)
  – Install Mechanical/Electrical (WBS)
    • Electrical Rough-In (Activity)
    • Electrical Finish (Activity)
  – Interior finish (WBS)
  – Exterior Finish (WBS)
WBS-Residence

- Build 1800 SF Residential Structure
  - Foundation
    - Survey Site
    - Excavate Pour Footings
  - Framing/Structure
  - Exterior Cladding
  - Finishes
  - M/E/P
    - Lay block foundation walls
Notice to Proceed
Mobilize
Submit Chillers
Access and Protection Chiller #1
Approve Chillers
Demolish Existing Equipment Pads Chiller #1
Access and Protection Chiller #2
Order and Deliver Chillers #1 and #2
Install Isolation Valves Chiller #1
Disconnect and Remove Existing Piping Chiller #1
Demolish Existing Equipment Pads Chiller #2
Install Isolation Valves Chiller #2
Modify Concrete Pad Chiller #1
Disconnect and Remove Existing Piping Chiller #2
Set Chiller #1
Owner Provide Temporary System
Install New Chiller #1
Modify Concrete Pad Chiller #2
Set Chiller #2
Install New Chiller #2
Clean-Up Chiller Room #1
Clean-Up Chiller Room #2
Punchlist
Project Substantial Completion
Project Duration
Let's look at it as a layperson.

- Steps to complete a project.
  - Brushing your teeth
  - Cooking dinner
What is it?

Defining activities for a project, through their relationships we can identify the project duration.

The relationships of each activity
- When one activity can start
- The sequence of each activity
- The duration of each and when it can finish.

We will learn a new way of managing projects through the critical path method.
Understanding Steps

• Everyone identifies steps differently.
• Standards in Industry
• The Key is:

➤ LEVEL OF DETAIL
Level of Detail

• Owner requirement
• As needed to manage the project
• Sequencing & Experience
• No more than five days
• Type of work
  – Hour to day duration
• Project Requirements
<table>
<thead>
<tr>
<th>Description</th>
<th>Original Duration</th>
<th>Total Float</th>
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</thead>
<tbody>
<tr>
<td>1 - Simple Lag Scheduling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive Pile</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Pour Concrete</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Structural Steel</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>2 - Better Scheduling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive Pile West Side</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Drive Pile East Side</td>
<td>10</td>
<td>10d</td>
</tr>
<tr>
<td>Pour Concrete West Side</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Pour Concrete East Side</td>
<td>5</td>
<td>5d</td>
</tr>
<tr>
<td>Structural Steel West Side</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Structural Steel East Side</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>
Nature of the Work

• Productivity should increase as experience is gained for repetitive tasks. Activities composed of repetitive tasks should benefit from the increased task productivity and have decreasing activity durations.

• Depending on the work, difficulty can increase if uncommon work tasks are grouped together in an activity.
# of Activities or Steps

Room
Deck
Residence

Warehouse
Movie Theater
Office Building
School
Regional Airport

Hospital
Hydroelectric
Dam
Power Plant
Nuclear Plant
CPM Scheduling

<table>
<thead>
<tr>
<th>Task</th>
<th>Start</th>
<th>Finish</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task A</td>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Task B</td>
<td>6</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Task C</td>
<td>11</td>
<td>15</td>
<td>4</td>
</tr>
</tbody>
</table>

Diagram of CPM Scheduling showing task dependencies and durations.

**Notes:**
- Task A depends on Task B
- Task C depends on Task B
- Duration of each task is 4 days

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**Timeline:**
- Task A starts on Day 1 and finishes on Day 5
- Task B starts on Day 6 and finishes on Day 10
- Task C starts on Day 11 and finishes on Day 15

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**Conclusion:**
- The project is completed on Day 15
- All tasks are completed within the scheduled duration of 4 days each
BAR CHARTS

- The most commonly used method of planning and scheduling construction projects.
- A historical tid-bit in the history of planning and scheduling.
- The bar chart was developed by Henry L. Gantt around the turn of the century and is sometimes referred to as the **GANTT CHART**
Bar Chart Schedules

Bar Chart Preparation

- Identify Activities
- Estimate Activity Durations
- Develop Activity Sequence
- Construct Bar Chart
Constructing a Bar (Gantt) Chart

- How should the bar (Gantt) chart schedule be laid out?
- What time units should be used?
- Should work days or calendar days be used?
- What about non-continuous work?
Gantt Chart Advantages & Disadvantages

• Easy to prepare
• Easily Understood
• A good communication tool

• Does not show the relationships between activities.
• Lack of relationships between activities.
• Difficult to determine what the effect of an activity that is ahead or behind schedule will have on the overall project.