Estimating Activity Durations

CSTM 462
✓ Estimate activity durations

- Activity durations should be estimated based on available resources which include labor, material and equipment.
- These durations should reflect the planned resource productivity on anticipated site conditions.
- Key to production monitoring and controlling day-to-day construction.
# General Conditions

- Notice to Proceed
- Mobilize
- Submit Chillers
- Approve Chillers
- Order and Deliver Chillers #1 and #2
- Owner Provide Temporary System
- Punchlist
- Project Substantial Completion

## Chiller #1

- Access and Protection Chiller #1
- Demolish Existing Equipment Pads Chiller #1
- Install Isolation Valves Chiller #1
- Disconnect and Remove Existing Piping Chiller #1
- Modify Concrete Pad Chiller #1
- Set Chiller #1
- Install New Chiller #1
- Clean-Up Chiller Room #1

## Chiller #2

- Access and Protection Chiller #2
- Demolish Existing Equipment Pads Chiller #2
- Install Isolation Valves Chiller #2
- Disconnect and Remove Existing Piping Chiller #2
- Modify Concrete Pad Chiller #2
- Set Chiller #2
- Install New Chiller #2
- Clean-Up Chiller Room #2
Time Unit Selection

Activity durations can be expressed in any convenient time unit, depending on the objective of the scheduling effort. These units include the following:

- Years
- Months
- Weeks
- Days (most common)
- Hours (rarely used)
Resource Availability

The key to estimating activity durations is the availability of resources. These resources include the following:

• Labor
• Equipment
• Material
• Subcontractors
Quantity and Productivity Data Sources

- Quantity Takeoff
- Bid Estimate
- Past Experience
- Outside Information
- Estimating Guides
- Industry and trade organizations
- Manufacturers, Fabricators and suppliers
- Specialty Contractors
Calculating Activity Durations

Two elements go into calculating durations...

– Work Quantity
– Production Rate

\[
 \text{Activity Duration} = \frac{\text{Work Quantity}}{\text{Production Rate}}
\]

therefore...

\[
\frac{500 \text{ cy}}{50 \text{ cy/day}} = 10 \text{ days}
\]
Necessary Information

• Quantity of Work
• Production Rate
  – Total Hours
  – Based on a Crew
• Productivity
• Crew Mix
• Work Schedule
• Project Calendar
Estimating Durations

**Work Quantity** \(\times\) **Production Rate** = **Total Hours**

- From Material Take-Off (aka Quantity Survey)
- Manhours per unit or MH/Qty

Common units include… LS, EA, LF, CY, SF, BF and SY

\[(\text{TOTAL HOURS} \times \text{Productivity Factor (Actual to Estimate)}) / \text{Burn Rate} = \text{DURATION (usually days)}\]

Factors that Impact Productivity:
- Weather
- Proper Equipment
- Supervision
- Work Conditions
- Learning Curve
- Ability/Experience/Skill Level
- Rework

Factors that Determine Burn Rate:
- Crew Mix… Number of Workers
- Work Schedule… 5-8’s, 6-9’s, etc.

Burn rate = (crew mix) \(\times\) (work schedule)

1 carpenter and 3 laborers working 5-8’s therefore, the burn rate is…

4 workers \(\times\) 8 hrs./day = 32 hours/day
Sample Problem - Givens…

How long will it take to complete this activity?

Activity: CIP Concrete Grade Beam
Quantity: 3,000 sf
Production Rate: .08 mh/sf
Crew Mix: 3 Carpenters & 2 Laborers
Work Schedule: 40 hour work week w/ 5 - 8’s

Note: No productivity factor is provided…assume 1.0
Sample Problem - Solution

Step #1:
Work Quantity x Production Rate = Total Hours

\[ 3,000 \text{ sf} \times 0.08 \text{ mh/sf} = 240 \text{ hours} \]

Step #2:

\[
\left( \text{TOTAL HOURS} \times \frac{\text{Productivity Factor (Actual to Estimate)}}{\text{Burn Rate}} \right) = \text{DURATION (usually days)}
\]

\[
\left( 240 \text{ mh} \times 1.0 \right) / 40 \text{ mh/day}^* = 6 \text{ days}
\]

* Burn rate = (crew mix) x (work schedule)

\[ 5 \times 8 = 40 \text{ man-hours/day} \]
### Activity Duration Calculation

<table>
<thead>
<tr>
<th>Based on Material Quantity</th>
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</thead>
<tbody>
<tr>
<td><strong>Quantity to Install</strong></td>
</tr>
<tr>
<td><strong>Production Rate</strong></td>
</tr>
<tr>
<td><strong>Production Rate</strong></td>
</tr>
<tr>
<td><strong>Typical Crew Size</strong></td>
</tr>
<tr>
<td><strong>Work Hours</strong></td>
</tr>
</tbody>
</table>

Therefore:

- **Total Manhours:** $1440 \text{ MH}$
  
  \( \text{(Quantity x Production Rate)} \)

- **Burn manhours per day:** 32

- **Activity Duration:** 45.00 Work Days
  
  \( \text{(Total MH/Hours per Day x Crew Size)} \)

**Assign Resources:**
Factors Affecting Activity Durations

You plan it and guess what happens? Poor productivity in relation to:

• Nature of the work
• Labor and Equipment Productivity
• Management skill
• Material and Equipment Availability
• Seasonal Conditions
• Work Restrictions
• Quality of Work
• Concurrent Activities
Labor Productivity

How the actual job compares to the budget or estimate.

- Work hours
- % Complete
- Unit rate

This information can then be converted to a productivity factor which will increase or decrease the overall activity duration.
Considerations

• 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.
Considerations

• Productivity can vary significantly from project to project, location to location and crew to crew.
• Labor productivity is a function of a number of factors that include training, experience, motivation and labor restrictions among others.
Productivity Factor Example

Budget/Estimate contains 240 man-hours
Actual expended to date is 100 man-hours
Activity is fifty percent complete

• Option #1:
  – 100/120 = .8333

• Option #2
  – 120/100 = 1.2

Good or Bad?
Look at Productivity

- Actual/Budget Less than 1 is good!
- Budget/Actual More than 1 is good!

Each company may look at different…

*In this class a productivity rate of less than one is good.*
Calculation…Adding Productivity

Activity: CIP Concrete including form, reinforce, pour and finish

Quantity: 5,000 cubic yards

Crew Mix: 2 crews consisting of...

3 Carp & 2 Lab = 5 person crew

Production rate: 6 man-hours per cubic yard

(from the estimate)

Work Schedule: 40 hrs/week…w/ 5 - 8 hour days

Productivity Factor: .85 - based on beating the estimate
Sample Problem - Solution

Step #1:
Work Quantity $\times$ Production Rate = Total Hours

5,000 cy $\times$ 6.0 mh/cy = 30,000 hours

Step #2:

\[
\left( \frac{\text{TOTAL HOURS}}{\text{Productivity Factor (Actual to Estimate)}} \right) \div \text{Burn Rate} = \text{DURATION (usually days)}
\]

\[
(30,000 \text{ mh} \times .85^* ) \div 80 \text{ mh/day}^{**} = 318.75 \text{ days}
\]

...round up & say 319 days

* 30,000 hours $\times$ .85 = 25,500 hours

** Burn rate = (crew mix) $\times$ (work schedule)

(5 $\times$ 8) *(2 crews) = 80 man-hours/day
Crew Mix & Cost

Turn man-hours into Costs

Two crews consisting of...
- 3 carpenters & 2 laborers per crew

3 Carpenters @ 20.50/hour = $61.50
2 Laborers @ 16.25/hour = $32.50

• $32.50 + $61.50 = $94/5 = $18.80 Crew Average Wage Rate
• $18.80 x 2 crews = $37.60 Composite Average Wage

• $37.60 x 30,000 hours = $1,128,000.00

vs.

• $37.60 x 25,500 hours = $958,800.00

Resulting in a difference of $169,200
Variables to Evaluate for Duration

- Production Rate
- Quantity or work in place
- Total man-hours
- Project Calendar
- Work Schedule
- Crew Size or Mix
- Productivity