Commissioning the Project Schedule

Matthew S. Malinosky, PE, LEED AP BD+C, CCP
Mechanical Engineer

Molly B. Meyer, PE, LEED AP BD+C, CEM
Mechanical Engineer
The Building Commissioning Association is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This program is registered with AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
A project schedule is a document that integrates ongoing dynamic efforts. To avoid confusion, delays, rework, and additional expense, it is necessary to maintain a comprehensive and accurate schedule.

In order to achieve this, it is vital that all parties whose activities appear on the project’s critical path are regularly solicited to provide accurate information.

This course will define the process of Commissioning the Project Schedule and the benefits that result from doing so.
At the end of this session, participants will be able to:

1. Be able to identify commissioning-related critical path project activities
2. Be able to identify several consequences of a mismanaged schedule
3. Understand the importance of multi-level communication
4. Understand how to communicate the schedule requirements to the project team
5. Learn several best practices of schedule management
Let's Talk

Discussions are much more interesting than lectures.

If you have a question during the presentation, feel free to ask!
Participant Poll

Which best describes your work?

- Owner / Owner’s Rep
- Facility Manager
- Designer
- General Contractor / CM
- Subcontractor
- Commissioning Provider
- Other
Terminology

The definition of “complete”

• Substantial Completion
• AHJ Approval
• Owner Occupancy / Beneficial Occupancy
• Phased Completion
• Maintenance Acceptance
• Operational Acceptance
Common Obstacles: Design Phase

Design Phase Obstacles

• Multiple design packages
• Vague specification requirements
• Who is managing the design phase schedule?
  ○ Timing of design packages
  ○ Timing of Cx-related design elements
• Value engineering
Construction Phase Obstacles

- Lack of understanding of the commissioning process
- Phased work and/or phased turnover
- Organization, size, and usability of master schedule
- Timing of initial schedule submission and frequency of updates
- CxA does not have control of schedule
Case Study #1

Challenges

• Multiple bid sets across a given discipline
• Occupied multi-phase turnover
• Lack of commissioning support from team
• Redesign due to value engineering
• Unclear / unfinished design resulting in many early addenda and change orders
Case Study #1

Result

• Poor long term systems documentation
• Unclear project acceptance criteria
• Impact on construction phase schedule
  ○ Extended submittal review process
  ○ Acceptance period extended
  ○ Owner pushed to accept systems prior to functioning per the owner’s project requirements
Case Study #1

Recommendation

• Don’t rush design to keep the construction schedule
• Design within the construction budget
• If design phase needs to be extended, the construction phase does too.
• If this situation is unavoidable, early schedule coordination is even more important
Identify Cx-related critical path activities

Are the necessary utilities available?
  • Electricity, heating water, chilled water, data

Is drywall & casework complete?
  • Equipment start-up/thermostat installation

Is pre-test documentation complete?
  • QC/start-up reports
  • Readiness checklists
  • TAB report
  • Trend data
Case Study #2

Challenges

• Recognizing Cx-related tasks
• Understanding Cx-related task sequencing

Result

• Schedule slipping

Recommendation

• Early communication and education
A mismanaged schedule can lead to:

- Work sequence confusion
- Rework and wasted time
- Additional cost
- Lost credibility
Importance of multi-level communication

Multi-level communication promotes:

• Accountability for early construction work
• Smoother coordination of work
• Avoid end-of-project finger-pointing
• Who should be involved?
Case Study #3

Challenges

• Renovation + addition added complexity
• Lack of multi-level communication
• Understanding Cx-related task sequencing

Result

• Highly compressed sequence of work
• Premature functional performance testing
• Large number of deficiencies

Recommendation

• Solicit early input from all parties on the critical path
Communicating schedule requirements

Effective communication is key

- In-person meetings
- Scheduling tool flexibility
- Take charge if schedule isn’t being managed
Case Study #4

Challenges

• Pull scheduling method
  ○ Two month outlook (ie: no up-to-date long term schedule)

• Work results are not documented/distributed

• Information did not reach field technicians
Result

- No document to integrate Cx activities into
- Initial Functional Testing was attempted before systems were ready.

Recommendation

- Develop & distribute a Cx-specific schedule
- Insist Field Technicians be involved early and attend appropriate meetings.
## Case Study #4

### Start-up Activities & Prefunctional Checklist Completion by CM
- Prefunctional Checklist Review by GSE
- Functional Performance Testing
- Retesting

*X* indicates milestone date when prefuctional package is submitted to Cx team.

<table>
<thead>
<tr>
<th>System</th>
<th>Est Duration (Hrs)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilled Water System</td>
<td>8</td>
<td>x</td>
</tr>
<tr>
<td>Free Cooling Sequence (requires cold weather)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Condenser Water Heat Recovery / Domestic Water Preheat</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Chiller Room Emergency Ventilation</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td>Low Temperature Chilled Water System</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Steam and Condensate System</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Heating Hot Water Systems</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>AHU</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Terminal Units</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2nd Floor Make-up and Exhaust</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Blower Coils</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Plumbing Water Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Softening System</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td>Domestic Booster System</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water System</td>
<td>6</td>
<td>x</td>
</tr>
<tr>
<td>Disinfection System</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Sump Pumps</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>RO/DI System Interfaces to BAS</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Fire Water Storage</strong></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Fuel Oil (Pumps, Day Tanks, Filtration)</strong></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Pretest 5/31/12, testing during load bank 6/11/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHU X-1</td>
<td>6</td>
<td>4/23/2012</td>
</tr>
<tr>
<td>AHU X-2</td>
<td>6</td>
<td>4/23/2012</td>
</tr>
</tbody>
</table>
To increase the chances of success:

- Educate the team on the sequence of work
- Be proactive, persistent, and patient
- Get owner’s support
- Include commissioning in completion goal
- Take action – give the project team something to react to
Sample specification schedule activities

3.2 COMMISSIONING SCHEDULING

A. Include at least the following commissioning milestone activities in the master construction schedule (not a separate commissioning schedule):
   1. Operations and maintenance manuals submission
   2. Equipment training agenda submission
   3. Systems training agenda submission
   4. Quality Control Testing procedures and report format submissions
   5. Major Equipment Startup/Energization report format submissions
   6. Quality Control Testing execution (multiple milestones expected)
   7. Major Equipment Startup/Energization execution (multiple milestones expected)
   8. Testing and balancing
   9. Equipment training sessions
   10. Systems training sessions
   11. Construction checklist completion
   12. Functional performance testing
   13. Correction period
   14. Functional performance retesting (as necessary)
   15. Maintenance Acceptance
   16. Operational Acceptance
   17. Warranty period peak season testing

B. Each Commissioning activity shall be linked to a construction activity. Commissioning milestone activities should float with the construction activity.

C. The Construction Manager shall be responsible to coordinate all site events so that the commissioning process is not impeded by other site activities.
## Sample schedule

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Duration</th>
<th>Start Date</th>
<th>Finish Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling Grid</td>
<td>15d</td>
<td>11/29/11 A</td>
<td>12/19/11 A</td>
</tr>
<tr>
<td>Ceramic/Quarry Tile</td>
<td>20d</td>
<td>11/29/11 A</td>
<td>12/28/11 A</td>
</tr>
<tr>
<td>Terrazzo</td>
<td>25d</td>
<td>12/01/11 A</td>
<td>01/09/12</td>
</tr>
<tr>
<td>Millwork</td>
<td>27d</td>
<td>12/12/11 A</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Mechanical Finishes</td>
<td>26d</td>
<td>12/13/11 A</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Electrical Finishes</td>
<td>23d</td>
<td>12/16/11 A</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Permanent Power to Equipment</td>
<td>0d</td>
<td>12/16/11 A</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Ceiling Tile</td>
<td>21d</td>
<td>12/20/11 A</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Doors &amp; Hardware</td>
<td>21d</td>
<td>12/27/11 A</td>
<td>01/25/12</td>
</tr>
<tr>
<td>Floor Finishes</td>
<td>21d</td>
<td>12/27/11 A</td>
<td>01/25/12</td>
</tr>
<tr>
<td>Equipment Start Up</td>
<td>10d</td>
<td>01/09/12*</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Controls Pretesting &amp; Graphics</td>
<td>10d</td>
<td>01/09/12*</td>
<td>01/20/12</td>
</tr>
<tr>
<td>Test &amp; Balance</td>
<td>5d</td>
<td>01/23/12</td>
<td>01/27/12</td>
</tr>
<tr>
<td>Installation Checklists Submitted to QSE</td>
<td>5d</td>
<td>01/25/12</td>
<td>01/27/12</td>
</tr>
<tr>
<td>Test &amp; Balance Verification</td>
<td>1d</td>
<td>01/27/12</td>
<td></td>
</tr>
<tr>
<td>Substantial Completion</td>
<td>0d</td>
<td>01/27/12</td>
<td></td>
</tr>
<tr>
<td>Owner Furnishings/Equipment</td>
<td>15d</td>
<td>01/30/12</td>
<td>02/17/12</td>
</tr>
<tr>
<td>Punch List</td>
<td>10d</td>
<td>01/30/12</td>
<td>02/10/12</td>
</tr>
<tr>
<td>Functional Performance Testing</td>
<td>5d</td>
<td>01/30/12</td>
<td>02/03/12</td>
</tr>
<tr>
<td>Deficiency Correction Period</td>
<td>5d</td>
<td>02/06/12</td>
<td>02/10/12</td>
</tr>
<tr>
<td>Retesting</td>
<td>5d</td>
<td>02/13/12</td>
<td>02/17/12</td>
</tr>
<tr>
<td>Owner Training - Lighting Controls</td>
<td>2d</td>
<td>02/13/12</td>
<td>02/14/12</td>
</tr>
<tr>
<td>Owner Move In</td>
<td>0d</td>
<td>02/17/12*</td>
<td></td>
</tr>
<tr>
<td>Owner Training - Mechanical</td>
<td>5d</td>
<td>02/20/12</td>
<td>02/24/12*</td>
</tr>
</tbody>
</table>