Introduction

Different scheduling methods have been developed over the years that require various levels of sophistication and knowledge to use them effectively. An appropriate method must be chosen depending on the project and the intended use. To determine the best scheduling practices for a project, the following should be considered: project risk, impact to traffic, environmental impact, likelihood of project delay, constraints to the schedule, and number of concurrent operations.

The most widely used scheduling methods are the bar chart (a simple graphical format) and Critical Path Method (CPM) scheduling, a more advanced method that utilizes software to schedule projects. The advantages of CPM scheduling are the ability to show a detailed project breakdown, utilize different calendars, perform cost and resource loading, track the critical path, and perform delay analysis and mitigation. Software choices include Microsoft Project and the more widely used and advanced Primavera. CPM schedules have many uses: monitoring project progress, tracking milestones, establishing delay responsibility and extent, revealing conflicts between different trades, and as tools for communication. However, CPM scheduling requires training, and small projects with straightforward activities often do not need a complicated scheduling method.

DOTs commonly request the following information from their contractors: baseline schedule depicting all the activities, duration, and sequence; updated schedule showing the current project progress; and a narrative report showing the status of milestones, description of the critical path and near-critical activities, calendars used, and possible future delays and mitigation plans. Most DOTs review contractor submittals for conformance to the specifications but do not perform an in-depth analysis for the details in the schedule itself since this responsibility falls on the contractor. The main purpose of this research was to investigate the Indiana Department of Transportation’s (INDOT’s) current scheduling methods as well as the best practices of other DOTs and consequently suggest a simplified guideline for use by field personnel to analyze schedule progress and propose other changes to scheduling methods and specifications. To accomplish this two questionnaire surveys and six telephone interviews were performed.

Findings

The first survey gathered data from INDOT about the scheduling practices used for its projects. A total of 65 personnel participated in this survey, which was conducted from May 13 to June 11, 2016, and was divided into four areas: (1) scheduling specifications, (2) enforcing issues, (3) field personnel skill set and understanding of the specifications and scheduling methods/commercial software, and (4) ideas for scheduling technologies/tools/software. This first survey revealed the following:

- Contractors do not always follow the specifications or submit updated schedules in a timely manner.
- INDOT has seldom withheld payments to force contractors to comply with the scheduling specifications.
- INDOT requires either bar charts or CPM schedules from contractors. Bar charts are most commonly used, but they do not classify the scheduling needs depending on set project criteria.
- INDOT personnel lack the experience and training required to review CPM schedules.

The second survey gathered data from other state DOTs (Michigan, Texas, Vermont, Virginia, and Washington State) about the scheduling practices used for their projects. A total of 31 DOTs with 35 respondents participated in the survey. This second survey revealed the following:

- Contractors do not always follow the specifications or submit updated schedules in a timely manner.
- DOTs delay and withhold payments to force contractors to comply with the scheduling specifications.
- Both bar charts and CPM schedules are commonly used. The scheduling method is dependent on the type of project and magnitude of complexity.
- DOTs either accept or reject contractors’ submitted baseline/updated schedules based on conformance to the specifications and do not approve the plans themselves.
- Contractors with employees trained in CPM are more
timely with their schedule submittals, especially with regard to time impact analysis reports.

• The majority of the DOTs do not conduct a review of contractors’ resources to ensure availability. However, some DOTs include a special provision for certain projects with costs higher than $20 million and for more complicated projects that would require the submittal of a resource-loaded schedule.

Phone interviews were conducted to verify some of the information gathered in the surveys as well as to collect more information about scheduling practices. The research team found that some DOTs have project classifications with respective required scheduling practices based on a set of criteria such as project complexity, number of bid items, and risks involved. Some also train their employees in scheduling techniques either by in-house personnel or outside training, while others have a scheduling engineer, especially for their larger projects.

Implementation

Based on the analysis of the results of the surveys, phone interviews, and literature review conducted, this research team developed the following guidelines for INDOT to follow with regard to its scheduling practices:

1. Specification-related issues:
   • Enforce requirements in current specifications with a penalty for non-compliance.
   • Customize scheduling requirements by project type/number of bid items/project cost.
   • Create a template/checklist for reviewing projects.
   • Enforce compliance of new requirements.
   • Ensure that the contractor knows INDOT’s scheduling expectations.
   • For larger and more complex projects, request a CPM schedule using Primavera.
   • Request a narrative for all projects that explains the basic assumptions made for the software, the sequence of work, and an explanation of the critical path.

2. INDOT (personnel)-related issues:
   • Provide customized training to INDOT field personnel to increase their knowledge in CPM scheduling.
   • Hire a scheduler to be involved in reviewing all CPM schedules and training INDOT field personnel. Although it is recommended to train INDOT personnel in scheduling, they already have other tasks which are more critical to their job. Hence, a full-time scheduler is needed. Depending on the number and complexity of the projects, the number of schedulers can be determined. Some DOTs hire one scheduler per district.
   • For large projects, hire a consulting firm to be responsible for the schedule review and delay analysis. Many DOTs rely on outside consultants since they do not have the resources or the required training to do the job.
   • Use Citrix or WebPM for online access to Primavera on-site instead of having to download the software on every computer.

3. Contractor-related issues:
   • Create a separate pay item in the bid items list specifically for schedule submittals with a specific cost. This should include the baseline and updates. This would force the contractor to submit the baseline/updates on time or otherwise risk a delay in payment of the monthly invoice.
   • Conduct a scheduling meeting prior to the start of work with the contractor to discuss the scheduling requirements and expectations. A joint training can also be beneficial to get both sides on the same page.
   • Enforce penalties or withhold payments in response to contractor delays in schedule/update submission.
   • Create a timeline with the contractor for schedule and update submittal.
   • Ensure that the contractor has the required skill set to submit the required schedules by including a provision in the contract.
   • Schedule regular meetings with the contractor based on project complexity and size.

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