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PROJECT SUMMARY

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BETTER CONSTRUCTION PROJECT MANAGEMENT THROUGH BETTER SCHEDULING

This project investigated the relationship between project scheduling and project delivery. Specifically, the project sought to 1) determine the best practices of using Critical Path Method (CPM) for project management, 2) determine whether a South Carolina Department of Transportation (SCDOT) project is delivered on time when Critical Path Method (CPM) is used, and 3) identify the factors that influence project delay.

RESEARCH

In this project, descriptive and statistical analyses were conducted on data joined from two databases: SiteManager® and Primavera®. The dataset consists of 2,097 projects let after February 2007 and substantially completed by August 2015.

In addition, an online survey was conducted to determine state-of-the-practice on CPM scheduling by states department of transportation (DOTs), resident construction engineers, and contractors.

Chi-square tests were conducted to evaluate the strength of any association between scheduled/unscheduled projects and delay/no-delay. Also, t-tests were conducted to determine if there were statistically significant differences in delay (number of days) between scheduled and unscheduled projects. These statistical tests were performed for each project type, size, duration, and location.

Logistic regression models, probability density functions, text analytics, and neural network models were developed to predict project delay.

RESULTS

Responses from 23 state DOTs and 51 Resident Construction Engineers (RCE) and 45 contractors from 16 different states were received. Nearly 96% of the state DOTs use CPM for project management. 55% of the RCE indicated that the time between notice-to-proceed and first work date consumes a significant portion of the total duration and 60% of the RCEs believe that CPM does not reduce change orders. About 75% of contractors keep

separate schedules than the ones provided to the RCEs. Table 1 presents descriptive statistics of the provided dataset. Having a CPM schedule provided by the contractor did not result in a statistically significant reduction in the number of delayed projects or the average length of the delay. The contract bid amount was found to be statistically significant in explaining project delay.

Text analytics of daily work reports did not provide useful predictions of project delay. The neural network model correctly predicted a project will be delayed 54% of the time.

Table 1. Comparison of scheduled vs. unscheduled projects

	Scheduled Project	Not Scheduled Projects
Total	1,158 (55.22%)	939 (44.78%)
Number of delayed projects	629 (54.43%)	446 (47.49%)
Number of delayed projects adjusting for change orders	168 (14.51%)	151 (16.08%)
Average delay (days)	54.79	28.54
Average delay adjusting for change orders (days)	−9.79	−14.57
Number of projects completed on budget	647 (55.87%)	836 (89.03%)

Probability distributions were determined for project delay. The best fit distribution for delayed projects was found to be the Pearson 6 (4 Parameter), and the best fit distribution for the early completion projects was found to be the Johnson SB. Using these distributions and the Total Law of Probability, one can estimate the probability of a project being delayed. For example, it was found that the probability that the duration of a SCDOT project being extended beyond the average delay (36.57% past the original duration) is 0.24; in other words, approximately 1 in 4 SCDOT projects will be delayed longer than the average delay.

RECOMMENDATIONS

The current selection criteria for requiring a CPM schedule be provided to the SCDOT depends upon design field review or estimates. The level of scheduling effort should be tied to the risk of managing delay for a project as well as the impact of that delay to SCDOT stakeholders. Other state DOTs have implemented a more detailed procedure in their selection. For example, Virginia DOT uses five levels of scheduling that depend on certain risk parameters (complexity, constraints, uncertainty and delay consequence). Additionally, the SCDOT could implement scheduling criteria based on a combination of project bid amount and project duration. Some state DOTs have already implemented this procedure (e.g., Caltrans).

The SCDOT should consider incorporating probabilistic information about project delay into the schedules, such as providing a range for the activity duration in the CPM schedule instead of simply using the expected duration. Lastly, it is recommended that the SCDOT consider including a provision in future contracts to ensure that all personnel (SCDOT and contractors) are using the same schedule for project management.

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