MONTANA Department of Transportation
Research

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Performance Measures Report

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More Info:

The research is documented in Report FHWA/MT-23-001/9929-819

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ARTIFICIAL INTELLIGENCE (AI) BASED TOOL TO ESTIMATE CONTRACT TIME

https://www.mdt.mt.gov/research/projects/const/ai_based_contracting_tool.aspx

The Montana DOT (MDT) research project "Artificial Intelligence (AI) Based Tool to Estimate Contract Time" resulted in a Microsoft Excel based tool, named AI-PDET (Artificial Intelligence based Project Duration Estimation Tool). The AI-PDET is a top-down tool that can estimate a construction project's duration when a limited amount of project information is available during the preconstruction stages. The estimated project duration using this tool is helpful in the early stages of the project delivery process for project programming and budgeting purposes. It can also be used to check the reasonableness of the project duration estimate derived from detailed project scheduling activities, once more information on activity quantities, production rates, and activity sequencing logic become available in later design stages.

"Project bid days" and "total charged days" were used to analyze the schedule performances of the 1,090 highway projects from 2008 to 2019. Project bid days indicate the original contract time in working days before the beginning of the construction and the total charged days reflect the actual duration of the project in working days after completion. Figure 1 shows a histogram of projects by a different range of charged days. 75% of projects took less than 100 working days and more than 86% of the projects took less than 180 working days, indicating that the majority of MDT highway projects take less than a year to complete.

The project bid days were compared to the project charged days to evaluate the accuracy of contract time estimation before construction. Figure 2 illustrates the average percentage of the difference between estimated duration and actual duration for a different range of project bid days. The percentage was calculated using Equation 1.

$$\text{Percentage of time difference} = (\text{Charged days} - \text{Bid days})/(\text{Bid days})*100 \qquad \text{(Equation 1)}$$

For example, 17% of projects took less than 20 working days (Figure 1). Figure 2 shows the difference between estimated and actual project duration for these projects is -23.7%, meaning such projects were finished 23.7% sooner than estimated. The percentage rises with the increase of project bid days. In projects that take 120 to 140 days, the schedule overrun is on average 21.8% of the original working days. Figure 3.2 indicates that many projects have not been completed within the estimated time.

This analysis clearly reveals that MDT has overestimated the required time for short-term projects with the bid days less than 40 days but underestimated the required working days for the other longer-term projects. Both overestimation and underestimation are problematic and they can result in negative consequences such as high bid prices, lack of qualified bidders, poor work quality, claims and disputes, prolonged inconvenience to the traveling public, lack of innovations, increased administration costs, and safety issues (FHWA, 2002; Hildreth, 2005; H. S. Jeong et al., 2009).

MDT's goal is to continuously reduce the magnitude of underestimation and overestimation. The AI-PDET can play a significant role along with other bottom-up tools that were developed earlier for MDT. MDT can use Equation 1 to evaluate the contract time performance of any construction project in the future. By periodically evaluating the contract time performances of all completed projects within that period (for example, once a year), MDT can determine whether their capabilities of more accurately determining the contract time of a construction project or reducing the estimation errors have improved.

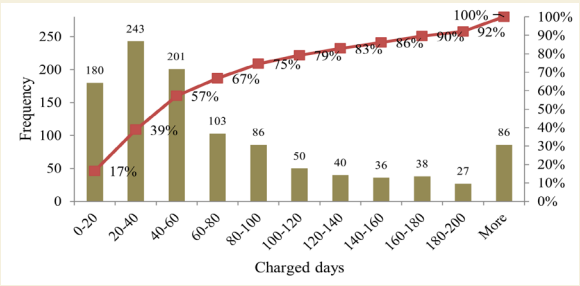

Figure 1: *Frequency of projects with different charged days*

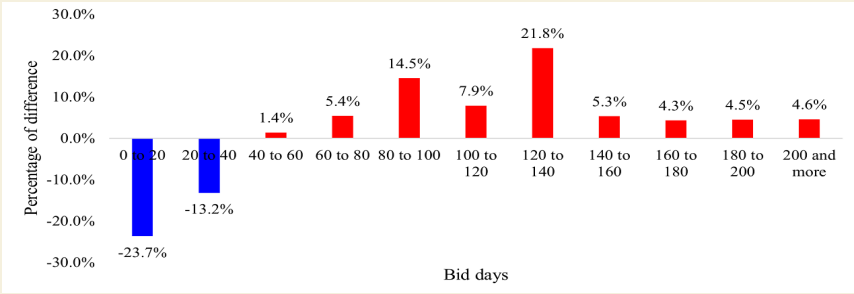

Figure 2: *Average percentage of the difference between bid days and charged days*

References

FHWA. (2002). *FHWA Guide for Construction Contract Time Determination Procedures*, https://www.fhwa.dot.gov/construction/contracts/t508015.cfm

Hildreth, J. C. (2005). *A Review of State DOT Methods for Determining Contract Times State DOT Methods for Determining Contract Times*, Virginia DOT, https://www.vdot.virginia.gov/business/resources/const/0501_StateDOTMethods.pdf

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