MONTANA MDT DEPARTMENT OF TRANSPORTATION

RESEARCH PROGRAMS

RESEARCH PROGRAMS USE ONLY
RESEARCH TOPIC STATEMENT NO: 15-013
DATE OF RECEIPT: 4/30/15

RESEARCH TOPIC STATEMENT

I. TITLE (required):
Effective Production Rate Estimation and Monitoring of controlling activities using Daily Work Report (DWR) Data

II. TOPIC STATEMENT (required):
The MDT manual on contract time determination provides a list of major cost items and corresponding production rates (MDT 2008). The rates were determined from various sources but were mainly based on previous experience and judgement of MDT engineers. The manual further recommends that the production rates must be revised every two years. However, the current production rates are six years old (2008). Additionally, the manual also states that factors such as type of construction, bad weather delays, complexity, cost, traffic volumes, length, etc. can also affect production rates. However, the manual does not clearly provide a structured procedure to quantify the effects of those factors and it recommends the use of engineering judgement to adjust those factors. The AASHTOWare - SiteManager recently implemented by MDT includes daily work reports for more than 700 projects. The proposed study will analyze the historical daily work reports to develop a method and a tool to determine reasonable production rates of controlling activities and also quantify the effects of the project characteristics, the weather, location, geology, traffic volumes, etc. on the production rates of major controlling pay items. The project will also develop a visual dashboard tool using the data from the SiteManager to check and monitor the progress of major activities during construction. The study is expected to significantly improve the contract time determination process of highway projects and the progress monitoring of controlling activities in construction.

III. BACKGROUND STATEMENT (required):
Contract time for state highway projects is the maximum time allowed in the contract for completion of all work contained in the contract documents. An accurate forecast of contract time is crucial to contract administration as the predicted duration and associated cost form a basis for budgeting, planning, monitoring and even litigation purposes. Excessive contract time is costly, extends the construction crew's exposure to traffic, prolongs the inconvenience to the public (unnecessary increase of road user costs), and subjects motorists to less than desirable safety conditions for longer periods of time. Insufficient contract time results in higher bids, overrun of contract time, increased claims, substandard performance, and safety issues. The contract time determination of a project heavily relies on the production rates of controlling activities (major activities that are on the critical path). Even though the accuracy of the production rates is so crucial for determining a project's contract time, most DOTs use production rates that were developed years ago. Also, these production rates are usually fixed values, so it is difficult to adjust the rates to reflect the project characteristics.

Resident engineers spend a significant amount of time and effort to collect Daily Work Report (DWR) data. DWR data includes data about ongoing activities such as the amount of work completed every day, materials used, equipment hours, labor hours, significant communications with contractors, and weather conditions. The DWR data provides very useful information to determine realistic production rates of controlling activities. This study will use this DWR data from MDT's SiteManager and perform several analyses such as production rate estimation, identification of the factors affecting production rates, and quantifying the effect of project characteristics on production rates and project schedules.Also, a real time progress monitoring of major controlling activities on site can be possible with a development of a visual dashboard tool linked with the SiteManager data.

IV. RESEARCH PROPOSED (required):

The goal of this proposed project is to develop a production rate estimating system of controlling activities of highway projects and a visual dashboard tool that allows construction engineers to monitor the progress of controlling activities during construction. The following tasks will be conducted to accomplish the goal.

Task1: Obtain Daily work report data: The entire daily work report data for more than 700 highway projects will be obtained for this study. Information about project characteristics will also be obtained and stored in a master database.

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Task 2: Apply data mining techniques to determine production rate of controlling activities: A methodology will be developed to reasonably estimate the production rate of controlling activities using the daily work report data. Also, an Excel based production rate estimation model that can consider major project characteristics will be developed based on the methodology.
Task 3: Case studies: Recent projects will be obtained and the production rate estimation model will be evaluated for its reliability and adjusted if necessary.
Task 4: Develop a visual dashboard tool to display real time statistics from the SiteManager database: This dashboard tool will allow the project team to quickly determine the realtime progress of major controlling activities compared with the expected productivities and progress. Some DOTs (Viriginia, Arkansas) have reported to have developed a customized reporting and dashboards to present the SiteManager data to facilitate the decision making process based on DWR data. A similar type of dashboard can be developed to meet the need of MDT. An example would be a quantity and/or cost underrun/overrun and individual & overall project progress statistics.

V. IT COMPONENT (required): Identify if the project includes an IT component (purchasing of IT hardware, development of databases, acquisition of existing applications, etc) or not. If so, describe IT component in as much detail as possible.

Iowa State University will need to purchase a license for Oracle database system unless MDT license can be used for this research purpose.

VI. URGENCY AND EXPECTED BENEFITS (required): This section must include a description of how this research will serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality and/or sensitivity to the environment.

Although a lot of time and efforts have been spent over time to collect and maintain DWR data, their use has been very limited. This study will directly use the existing DWR data and develop some application tools to support better project decisions such as construction time determination and project progress monitoring. MDT has a responsibility to determine a reasonable and realistic contract time and complete construction projects on time to ensure the highest possible serviceability of highways with the lowest possible level of road users' costs and discomfort. The active use of daily work reports data for developing the tools in this project can be used to justify the time and efforts of resident engineers and inspectors for DWRs.

VII. IMPLEMENTATION PLAN (required): Identify MDT office or entity outside of MDT responsible for implementation. Describe initial implementation plan, include timeframe for implementation.

The highway bureau will be responsible for implementation of the research results. The tool developed by the team can be maintained by the Engineering Computer Information Systems division for future updates and compatibility with updated systems. The implementation plan consists of:

1. Delivery of methodologies and tools developed from the study – month 1
2. Provide a key personnel – month 2
3. Implement the system as an integrated system for analyzing SiteManager data – month 3
4. Evaluate the methodology and tool – month 9
5. Update the methodology and tool as required – month 12

VIII. SUBMITTED BY: (required)

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IX. CHAMPION (optional): Must be internal to MDT, feel strongly that the research will benefit the Department, and is willing to chair the technical panel.

NAME Lisa Durbin
TITLE Bureau Chief
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X. SPONSOR(S) (optional): Must be internal to MDT (Division Administrator or higher) and willing to ensure implementation occurs, as appropriate.

NAME(S)_____

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Note: Submitter may attach continuation sheets if necessary. All research topics submitted become public property and submitters are not guaranteed to receive a contract for any work resulting from any submitted research topic.