

Consultants on Highway Construction To Estimate Total Cost and Maintainace

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Abstract

It is difficult for STAs to manage complex transportation networks while coping with aging, experienced, and turnover STA construction workforces as well as a rise in the use of advisory services to monitor STA construction operations. Keeping up with project needs requires the employment of construction-related human resources, which STAs get from Construction and Engineering Inspection (CEI) consultants. However, no data has been gathered on the effect of CEIs on project costs and schedules. Data from 305 completed highway building projects across 16 STAs is being used to fill up this information gap. CEI consultants were found to have more full-time equivalent construction employees on their projects than projects using solely agency personnel, according to the research. When compared to programs that depended only on agency employees, it had no impact on project costs. CEI consultants The average expense overrun on CEI projects was 20.2 percent, but the average schedule overrun on projects staffed by agencies was 27.7 percent. On average, the project was completed sooner than expected. A statistically significant difference existed between the beginning and ending times of the experiment.

More and more complicated projects are being built by STAs under more aggressive time constraints. STAs are going through a lot of personnel changes at the same time that this transformation is taking place. STAs are losing veteran staffers to retirement, and they are being replaced by younger, less-experienced workers who are taking on greater responsibility early in their careers. Retiring employees in certain STAs are not even being considered for replacement. STA employees across all divisions are feeling the effects of these adjustments, but those in charge of building roadway infrastructure are especially hard hit (1, 2). Between 2000 and 2010, STA lane kilometers rose by an average of 4.1 percent, whereas the number of full-time equivalent employees declined by 9.7 percent over the same transit period. In response to the controlled road system standardizing full-time equivalents (FFE), STAs' FTE per million dollars of capital investment reduced by an average of 37.3% for responding STAs (3). Many services formerly performed by STA personnel have been outsourced due to

growing workloads and shrinking manpower. As a result of the wide range of services these consultants provide and the critical nature of their work, they are an absolutely necessary resource (4, 5). STAs may benefit from advice from CEI experts on how to maximize their construction workforce. Even though STAs use CEI consultants to staff agency projects, very little research has been done on the consequences of their use on project costs and schedule results. This article focuses on the impact of CEI consultants on highway construction project performance and staffing levels. To be more explicit, this research adds to our understanding of:

- For highway building projects, CEI experts are utilized for a variety of purposes.

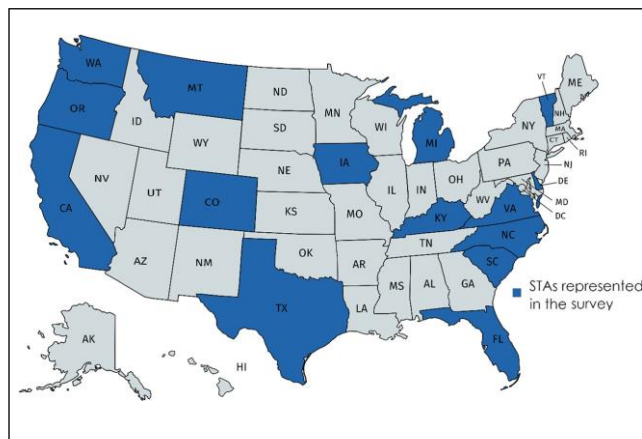


Figure1. STAs represented in the projects survey.

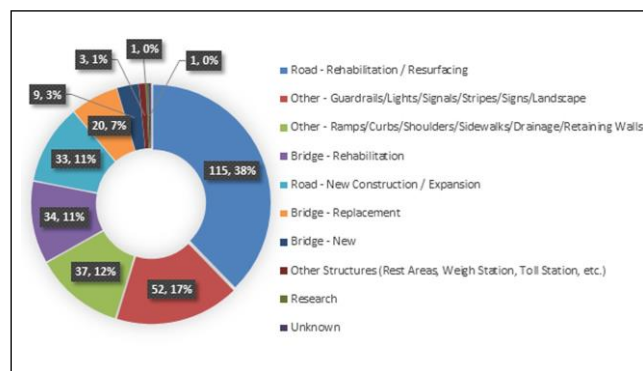


Figure2. Number of survey responses by project type.

- CEI consultants have an influence on the cost and schedule performance of highway projects.
- Construction personnel numbers for highway construction projects are impacted by utilizing CEI consultants.

DataCollection

An extensive database of information on the performance of highway construction projects performed in the 18 STAs has been developed. Members of the AASHTO Technical Committee on Cost Estimation and the AASHTO Subcommittee on Construction who represent STA on these committees were contacted personally for the purpose of this study. The study team gathered data on the project's name, task kind, cost performance, schedule performance, and contact information. We have in our database a total of 7,154 projects which have been significantly finished between 2014 and 2016. One hundred eighty-eighty projects were found in the database of completed projects that showed a wide range of project types, sizes, locations, personnel levels, and performance. An online survey was sent to 783 project managers/resident engineers based on the information in the database, including their email addresses. Pre-filled project details including name, budget, start date, and end date were included in this survey for each person who responded to it. Questions on the following topics were included in the survey:

- Staffinglevels(whethertheprojectwassufficientlystaffed)
- UseofstateemployeesandCEIconsultants
- Rolesofconstructionstaff(stateemployeesand consultants)
- Functionsofconstructionstaff(stateemployeesand consultants)

Project managers/resident engineers from 16 STAs who worked on 305 recent highway construction projects completed the survey (Figure 1). The sample size yielded findings with a margin of error of 5.69 percent at the 95 percent level of confidence.

STAs have varying methods for identifying the various types of transportation construction. Each agency's database and FHWA reporting categories were utilized to categorize the examined projects into the following nine categories:

1. Road—newconstruction/expansion
2. Road—rehabilitation/resurfacing
3. Bridge—new
4. Bridge—replacement
5. Bridge—rehabilitation
6. Other—
ramps/curbs/shoulders/sidewalks/drainage/retainingwalls,andsoforth.
7. Other—guardrails/lights/signals/stripes/signs/landscape,andsoforth.
8. Otherstructures (restareas,weighstations,tollstations,etc.)
9. Research

Road restoration and resurfacing was the most popular topic in the survey. More over half of the comments (148 of 305) were for road and bridge upgrades, while the remaining 33% were for other projects, such as ramps, shoulders, sidewalks, drainage and guardrail as well as lighting and signage (Figure 2).

SurveyFindings

Overall StaffingLevelsandUtilizationofCEIConsultants

Nearly 40% (305 projects) were found to be understaffed, according to an online poll. There were enough full-time workers on 86.7 percent of the projects assessed, according to DOT policy and procedure manuals (FTEs). Full-time workers (FTEs) put in a minimum of 40 hours per week throughout the course of a standard work week. Staff shortages were the most prevalent cause for outsourcing CEI work. CEI consultants were involved in 117 out of the 305 projects that were analyzed, or 39% of the total.

In new road/expansion and bridge rehabilitation projects, the use of CEI consultants was greater than in other types of projects (Figure 3). A whopping 68.3

percent of the 31

Project Performance with CEI Consultants

CEI consultants may have an influence on budget and schedule performance, although available evidence is divided. Performance on highway building projects may vary depending on numerous factors, including the project characteristics, CEI consultants' expertise levels and authority levels. CEI consultants were compared against non-CEI consultants utilizing the finished project performance database as well as data acquired from a survey on the employment of the consultants.

It was determined that each project had an overrun in terms of the original contract value, expressed as a percentage of the expected workdays (or calendar days). CEI consultants were utilized on all projects, with or without significant discrepancies in cost overruns (3.34 percent vs. 3.36 percent , Table 2). To be sure, bringing in CEI's help improved the project's on-time delivery (p-value = 0.0012).

Table 1. Average Project Cost and Schedule Overrun

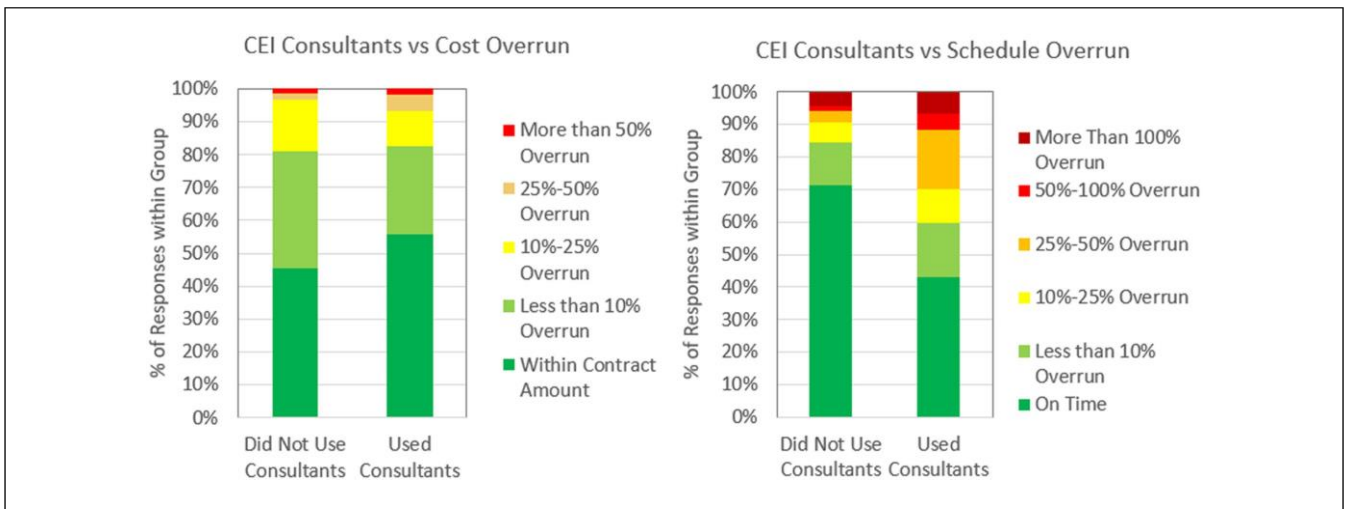


Figure 5. Distribution of project cost and schedule overrun.

Project Staffing Requirements with CEI Consultants

There were six separate jobs in the poll where respondents were asked to specify the number of full-time state employees and consultants allocated to them. There are six positions available, which include: In-House Engineer; Engineer; Surveyor; Intermediate; Junior; Administrative Personnel; and Inspectors. The following

descriptors were included in the voting since various STAs may use different job names for the same role.

- Residentengineer

Qualifications: Bachelor's Degree—Civil
EngineeringandLicensedProfessionalEngineer.

Sample work:

1. The designated area's construction contracts are administered by this person.
2. Inspects and corrects building plans and specifications based on the interpretation of these documents.
3. Plans, coordinates, and/or oversees the compilation of project paperwork and reports, including but not limited to budget estimates, change orders, and final plans, as well as reporting on contractor performance and payment status.
4. Recruits, hires, and manages staff in the layout and inspection department, as well as scheduling and distributing work and ensuring that sufficient training is provided to them.
5. Resolves construction issues by communicating with contractors and property owners, preparing department answers to contractor claims, and testifying as an expert witness in construction-related lawsuits.
6. Educates the public, the media, and government authorities on the building project.
7. Participates in project core teams and scoping sessions, providing technical experience and constructability advice.
8. Manages a field office, which includes finances, cars, and equipment purchases and upkeep.
9. To ensure the safety of construction workers, he conducts field inspections.
10. Investigates and negotiates remedies to construction issues, which may involve time extensions, cost modifications, or both.

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11. Follows the department's Affirmative Action Program while carrying out supervisory duties.
12. Other tasks and duties may be allocated from time to time.

Conclusion

The research analyzed data from 305 recently completed projects of different categories from 16 STAs. An evaluation of project performance and personnel levels was the primary focus of the study. Many functions that were formerly handled by in-house workers have been delegated to CEI consultants as a result of increased workloads and a shrinking workforce. There has been an increase in the usage of CEI consultants on highway building projects since 2014, according to a recent survey of jobs completed between 2014 and 2016.

These findings add to what is already known about the benefits of working with CEI consultants.

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