MAPPING OF STATE TRANSPORTATION AGENCIES’ PRACTICES TO CONSULTANT OVERSIGHT FOR CONSTRUCTION ENGINEERING AND INSPECTION SERVICES

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Abstract

Over the past couple of decades, State transportation agencies (STAs) have outsourced various functional activities traditionally performed by in-house personnel in reaction to increasing workloads and diminishing number of staff. In order to cope with the situation, STAs have developed and implemented various tools and practices for the management and oversight of Construction Engineering and Inspection (CEI) services. A national CEI survey was conducted by the authors, which provided a detail mapping of various tools and practices used for CEI services and the understanding of the primary advantages and disadvantages of using CEI consultants. The survey found that a wide variety of tools and practices are used by STAs for defining the scope of work for CEI services to consultant selection and administration of CEI consultant contracts. Statistical analyses (ANOVA analysis) estimate that CEI consultant management and oversight practices vary significantly among STAs, which may imply various underlying factors of choosing one practice over another. One of the most important findings of this survey is the value of CEI consultant services as realized by the STAs. The survey found that the CEI consultant services provide STAs the improved ability to handle peak workloads, provide the flexibility of adding or reducing staff quickly, and bring special expertise that may not otherwise be available in-house. However, reported challenges of working with CEI consultants include developing and maintaining CEI consultants’ familiarity with in-house processes and procedures, assuring CEI qualifications, and the relative cost of CEI consultants compared to in-house staff.
INTRODUCTION

“During recent years, most state highway agencies have reduced the total number of permanent employees” (1). That statement is just as true today as when it was first stated 25 years ago as part of the 1989 NCHRP Synthesis study by Newman on Use of Consultants for Construction Engineering and Inspection. Today, adequate construction staffing remains one of the most critical resources for successful performance of highway construction projects, since state transportation agencies (STAs) across the country continue to face a lack of sufficient in-house personnel. STAs are doing more work with fewer agency employees than they were 10 years ago (2). As STAs’ capital improvement expenditures and work volume increased over these same years, outsourcing many functional activities through public-private partnership has become a common practice in many STAs (3, 4). Construction engineering and inspection (CEI) consultants serve as an adjunct to STAs and offer a flexible strategy to reduce their workloads while also leveraging specialty expertise through competitive pricing. CEI consultants provide efficient and cost effective services in various levels of STAs’ operations. These include but not limited to construction, documentation, training, work zone safety, concrete testing, asphalt inspection, traffic control, constructability reviews, scheduling, geotechnical services, temporary staffing, and more.

Many transportation projects come to fruition through the collaborative efforts of STAs, governmental agencies and private owners working closely with consultants. Numerous studies have been conducted that reviewed trends of CEI consultant services, arguments for and against outsourcing, drawbacks in the present systems, and ways in which they can be overcome. Wilmot (2013) reported that between 1950 and 2000, new STAs activities outsourcing increased more than 300% (5). A 2003 NCHRP study found that the rate of outsourcing grew or stayed at the same high levels for the 95% of all STAs’ activities sampled (6). The same study reported that staff constraints, schedules, skill requirements, and workload were the main reason for the decision to outsource. Some studies claim that contracting outside agencies for key services improves government’s efficiency and is cost effective (7,8). Another study argues that private sector firms can be penalized for poor services, which is an incentive to perform better (9). No such penalty exists for government. Governments can benefit from innovation generated by the private sector as they try to complete a project in the most cost-effective manner (10, 11, 12). Outsourcing strategies are not free from limitations, however. An NCHRP web document 59 reported that cost savings in outsourcing are comparable to those of traditional methods, and it may require a specialized contract and program management staff, which could be more costly than their current staff (13). Other challenges identified are: ensuring that private firms work with the best interest of the public, ensuring that consultants are well qualified and familiar with STAs procedures, and maintaining the control in providing key services to outside stakeholders (5). In order to overcome these drawbacks, and with the evolution of new project delivery methods, enactment of new legislatures and regulations, numerous outsourcing practices have emerged for consultant services management. STAs’ outsourcing continues to be a part of STAs efforts to deliver effective and successful projects and services to the people.

Over the years, STAs have developed and implemented various tools and practices for the management and oversight of CEI contract services. However, little has been done to summarize CEI tools and practices and evaluate their usage among STAs. This paper presents a mapping of the functions and/or activities performed by CEI consultants - the tools and/or functions being
used, the level of use and frequency usage of the tools among STAs, and the primary advantage and disadvantage of using CEI consultants. The paper also presents how CEI consultant practices has changed in the last few decades, since previously related studies were completed, and how CEI tools and practices vary among STAs.

CEI FUNCTION TABLE
A table was developed to show the functions and tasks that different STAs consider to be CEI services (Table 1). The table was developed after a thorough review of drafts of scope of works from different STAs, requests for proposals, consultant services manuals, and pamphlets describing their understanding of the scope for CEI services (14 - 22). A Mississippi transportation agency report was used as guidelines to establish CEI main functional categories (23). All similar tasks were then group together under the most suitable functional category based on the documents mentioned above.

SURVEY INSTRUMENT
In order to understand various tools and practices that are used by STAs for the management and oversight of CEI services, an electronic survey was developed and distributed to all 50 states’ transportation agencies. The survey collected information on topics such as STAs’ CEI program characteristics, tools for the selection of consultants, contract administration and closeout processes, payment procedures, insurance, routine contact with CEI consultants, and impact of CEI consultant services on STAs’ operations. The survey was organized based on the CEI functions described in Table 1.

DATA ANALYSIS AND RESULTS
The national CEI survey was conducted from January to March, 2014. A total of 44 complete responses were received from STAs with a response rate of 88%. The survey respondents consisted of STAs’ project managers, supervisors, technical experts, and construction professionals. Of them, 89% had more than 10 years of experience with their agencies. STAs provided an estimate of the number of CEI contracts issued in 2013. As shown in Figure 1, the number of CEI contracts issued in 2013 ranged from 0 to 350. Michigan (350), Florida (323), Oklahoma (100), and Wisconsin (100) issued significantly higher number of CEI contracts whereas Delaware, Minnesota, Nevada, New Hampshire, and South Dakota indicated that they did not issue any CEI contracts in 2013. Considering Michigan and Florida as outliers, the average number of CEI contracts issued in 2013 was 23. In comparison, the average number of CEI contracts was found to be 55 in Newman’s 1989 study (1). Figure 2 shows the volume of CEI consultant work estimated as the percentage of total STA budget per state transportation agency. CEI budgets varied from zero to 12.1% of STA budget among reporting agencies. A thirty-three and sixty-seven percentile ranking is used to identify Low, Medium and High users of CEI services.

The following sections include an in-depth analysis of the national CEI survey. The survey responses were first collected in a numeric rating scale and then converted into a weighted average, which is referred to as the usage score in this paper. The usage score is calculated by multiplying the frequency with the rating divided by total frequency and it signifies relative use of a particular tool or practice among all the STAs. Afterwards, An ANOVA analysis was conducted to identify whether the usage of different tools and practices for CEI services differ significantly among STAs. In addition, a two way ANOVA analysis was conducted to identify
how CEI tools and practices vary among Low, Medium and High users of CEI services as identified in Figure 2.
TABLE 1 Functions and Tasks that SHAs consider to be Construction Engineering and Inspection Services

<table>
<thead>
<tr>
<th>LIAISON</th>
<th>MEETINGS</th>
<th>DOCUMENTATION</th>
<th>APPLICATIONS FOR PAYMENT</th>
<th>POST CONSTRUCTION SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilitate communication between all parties(^{(14)})</td>
<td>Set, attend, assist or conduct pre-construction conference, and other meetings(^{(14, 15, 17, 20, 22)})</td>
<td>Manage contractor’s RFPs(^{(19)})</td>
<td>Review &amp; submit contractor’s applications for payments(^{(14, 15, 17, 22)})</td>
<td></td>
</tr>
<tr>
<td>Ensure all project parties stay informed of project status(^{(14, 17, 22)})</td>
<td>RECORD PREPARATION &amp; MAINTENANCE</td>
<td>Track &amp; update changes to construction documents(^{(14, 18, 19)})</td>
<td>Field measure quantities for payment purposes(^{(14, 15, 17, 20, 22)})</td>
<td></td>
</tr>
<tr>
<td>Work with all necessary parties to meet contract &amp; project requirements(^{(15)})</td>
<td>Maintain record-keeping &amp; prepare required reports of contractor’s activities(^{(2, 14, 17, 23)})</td>
<td>Review &amp; submit and/or be responsible for approval of plans, shop drawings, drawings, and product information(^{(18, 19, 20, 21)})</td>
<td>Submit final “as-built plans”(^{(24, 16, 17, 19, 20)})</td>
<td></td>
</tr>
<tr>
<td>Provide answers &amp; resolutions in a timely manner(^{(14, 16, 23)})</td>
<td>Prepare &amp; submit field reports and records(^{(16, 17, 18, 23)})</td>
<td>Prepare project and/or closeout documentation(^{(16, 17, 19, 22)})</td>
<td>Revise &amp; submit final estimate(^{(14, 18, 19)})</td>
<td></td>
</tr>
<tr>
<td>Report to and be directly accountable to DOT(^{(17)})</td>
<td>Maintain accurate record of communications between parties(^{(14)})</td>
<td>Analyze &amp; interpret contract documents(^{(14, 13, 19)})</td>
<td>Submit offer of final estimate to contractor(^{(24)})</td>
<td></td>
</tr>
<tr>
<td>BUDGET</td>
<td>Review project records for compliance with Department’s criteria(^{(17)})</td>
<td>Prepare &amp; distribute correspondence(^{(15, 16, 23)})</td>
<td>Authorize monthly payments to contractor(^{(22)})</td>
<td></td>
</tr>
<tr>
<td>Monitor &amp; recommend(^{(15)})</td>
<td>CHANDE ORDERS</td>
<td>Review &amp; submit contractor’s construction plan(^{(13, 22)})</td>
<td>MONITOR &amp; DOCUMENTATION</td>
<td></td>
</tr>
<tr>
<td>Manage budget(^{(12)})</td>
<td>Review, estimate, prepare, &amp; manage change orders(^{(20, 21, 22)})</td>
<td>Submit contractor evaluation form(^{(17)})</td>
<td>Prepare claim analysis support documentation(^{(18, 21)})</td>
<td></td>
</tr>
<tr>
<td>SURVEY CONTROL</td>
<td>WORK ORDERS</td>
<td></td>
<td>Assist or analyze and/or settle claims(^{(14, 15, 16, 22)})</td>
<td></td>
</tr>
<tr>
<td>Survey preparation, control, verification(^{(14, 15, 18, 26, 22, 23)})</td>
<td>Prepare work orders(^{(12, 22)})</td>
<td></td>
<td>Prepare &amp; process close out claim documentation(^{(14)})</td>
<td></td>
</tr>
<tr>
<td>Assist in survey work(^{(22)})</td>
<td>Review work orders(^{(13)})</td>
<td></td>
<td>Assist in preparation of arbitration hearings or litigations(^{(10)})</td>
<td></td>
</tr>
<tr>
<td>Supply survey crew or licensed surveyor(^{(19, 22)})</td>
<td>UTILITIES</td>
<td>SCHEDULE</td>
<td>Provide qualified staff witnesses(^{(14, 23)})</td>
<td></td>
</tr>
<tr>
<td>Coordinate utility work or relocation(^{(14, 18, 19)})</td>
<td>Verify conformance with contract documents(^{(14)})</td>
<td></td>
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<td></td>
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<tr>
<td>Inspection</td>
<td>CONSTRUCTION WORK</td>
<td>GEOTECHNICAL</td>
<td>MATERIAL SAMPLING &amp; TESTING</td>
<td>QUALITY MANAGEMENT</td>
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<tr>
<td>Monitor contractor's activities daily or periodically(^{14,16-23})</td>
<td>Monitor progress &amp; quality of work(^{14})</td>
<td>Perform sampling, and testing of component materials &amp; completed work(^{14,15,17,19-22})</td>
<td>Provide or revise and submit QA Plan(^{14,17,22})</td>
<td></td>
</tr>
<tr>
<td>Monitor contractor's compliance with plans &amp; specs(^{14,17,23})</td>
<td>Attend geotechnical meetings(^{14})</td>
<td>Arrange &amp; transport sample to be tested to appropriate location(^{14,20})</td>
<td>Perform testing quality assurance(^{16,19})</td>
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<tr>
<td>Perform final inspection and/or coordinate parties attendance(^{20})</td>
<td>Review &amp; make recommendations on contractor's installation plans(^{14})</td>
<td>Performed required tests &amp; inspections(^{14})</td>
<td>Perform quality control of contractor's activities(^{14,15,26})</td>
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</tr>
<tr>
<td>Report &amp; recommend or direct on design or field construction issues (^{13,23,22})</td>
<td>Observe &amp; report on adequacy of work(^{14,17})</td>
<td>Verify materials and/or applicable documents to ensure testing was performed(^{14,16,17,20,22})</td>
<td>Determine if work conforms to contract documents(^{20})</td>
<td></td>
</tr>
<tr>
<td>Coordinate inspection assignments(^{15,22})</td>
<td>Prepare &amp; submit pile driving data &amp; piling record(^{14})</td>
<td>Submit all sampled materials or certify material testing(^{17,19})</td>
<td>Observe contractor's work to determine quality of work(^{17})</td>
<td></td>
</tr>
<tr>
<td>Identify, report &amp; instruct contractor to correct discrepancies(^{14,17})</td>
<td></td>
<td>Supervise material sampling &amp; testing(^{13,23,22})</td>
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<tr>
<td>Review constructability or bidability or other issues(^{13,22})</td>
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<tr>
<td>Act as inspector(^{17})</td>
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<table>
<thead>
<tr>
<th>Human Res</th>
<th>PERSONNEL</th>
<th>TRAINING</th>
<th>PROJECT STAFFING</th>
<th>PUBLIC RELATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide &amp;/or, supervise &amp;/or manage personnel(^{15,17,20,23})</td>
<td>Consultant to provide training to their staff(^{14,19,22})</td>
<td>Make recommendations or submit plan on project staffing(^{15,22})</td>
<td>Keep community aware of status &amp; traffic impacts(^{14})</td>
<td></td>
</tr>
<tr>
<td>Review compliance with EEO, wage rates, &amp; labor policies(^{14,16,17,18,20,23})</td>
<td></td>
<td>Coordinate staffing needs and inspector assignments(^{17,22})</td>
<td>Provide current &amp; accurate info through website linked to DOT(^{14})</td>
<td></td>
</tr>
<tr>
<td>Provide vehicles, equipment, &amp; supplies as required by contract(^{17,23})</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Responsible for performance &amp; actions of staff(^{11})</td>
<td></td>
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</table>
Torres, Uddin, Goodrum, and Molenaar

FIGURE 1 State transportation agencies’ CEI contracts in 2013.
FIGURE 2 CEI consultant work estimated as percentage of total highway budget per state transportation agency.

Usage of CEI Services among Different Sizes of Projects (in dollar volume)
The CEI national survey reveals that CEI services are currently being used more frequently on larger projects ($10M to above $40M) compared to medium and smaller projects (below $10M) (Figure 3). The survey also found that CEI services are used predominantly for almost 50% of all projects among all contracts issued in 2013.

Figure 4 shows usage of CEI services among different STAs’ functional categories. The survey found that STAs seek CEI services more frequently for construction monitoring and inspection (92%), scheduling (84%), review of change orders (78%), and post construction support (76%).
FIGURE 3 Use of CEI services under different project sizes.

FIGURE 4 Category usage of CEI services among STAs.
Processes Used to Define CEI Consultant Scope of Work

The survey found that among the four processes that are widely used by STAs to define consultant scope of work, as shown in Figure 5, statement of work in the contract agreement is the most frequently used tool followed by advertisement or RFP, and written scope statement. An ANOVA analysis found that tools usage differ significantly among STAs (p-value = 0.00), which is due to the more frequent use of statement of work in the contract agreement and advertisement or RFP tools compared to the other tool, scoping meeting. Further, two way ANOVA analysis revealed that tool usage does not vary significantly among Low, Medium, and High user of CEI services (p-value = 0.86). However, data showed that STAs who are identified as Medium user of CEI services utilize advertisement or RFP tools more frequently than other tools.

FIGURE 5 Processes used to define CEI consultant scope of work.

Processes used in the Selection of CEI Consultants

For the selection of CEI consultants, data analysis revealed that STAs advertise to bid for CEI consultant services through media outlets & ask for proposal most frequently. A significant number of STAs also reported that they develop a shortlist of CEI consultants based on their response to advertisements & ask for proposal (Figure 6). An ANOVA analysis shows that usage of different tools for the selection of CEI consultants do not vary significantly among all STAs (p-value = 0.59) nor among Low, Medium, and High users of CEI services (p-value = 0.46). However, the analysis finds:

- Low using STAs utilize the process of “Advertise to bid for CEI consultant services through media outlets & ask for proposal” most frequently;
- Medium using STAs utilize the process of “Select CEI consultants from a prequalification list of CEI consultants” most frequently; and
- High using STAs utilize the process of “Develop a shortlist of CEI consultants based on response to advertisements & ask for proposal” most frequently.

The survey also found that STAs almost always require CEI consultants to have professional liability insurance (97%). Some STAs also require consultants to carry error and omission insurance, owner’s protection insurance, automobile insurance, and worker’s compensation insurance.
FIGURE 6 Processes used in the selection of CEI consultants.

Processes Used in the Administration of Pre-construction and Contract Clarification and Modification, and Payment

During a project’s pre-construction phase, STAs most commonly prepare a list of documents (e.g. contract documents and amendments, correspondence, shop drawings, and change orders) that the CEI consultants will manage, which are later used as a closeout checklist. For the administration of contract clarification and modification, STAs internally review and approve changes to CEI consultant’s scope of work (usage score = 3.07) most frequently followed by maintaining a record of all changes to CEI consultant’s scope of work (usage score = 3.05), and verifying that a CEI consultant is responding to construction contractor’s request for assistance (usage score = 2.85). An ANOVA analysis found that usage of these tools varies significantly among STAs (p-value = 0.00), however they do not vary significantly among Low, Medium, and High user of CEI consultants (p-value = 0.83). The analysis estimates:

- Low using STAs utilize the process “Verify that CEI consultant is appropriately managing modifications to the contract” most frequently;
- Medium using STAs utilize the process “Maintain a record of all changes to CEI consultant’s scope of work” most frequently; and
- High using STAs utilize the process “Internally review and approve changes to CEI consultant’s scope of work” most frequently.

For payment, 95% of STAs require CEI consultants to submit monthly applications for payment for their services (usage score = 3.57).

Processes Used to Administer Monitoring and Inspection of CEI Services

The survey reveals that for the monitoring and inspection of CEI services, transportation agencies most frequently verify that a CEI consultant adequately reviews the construction contractor’s application for payment (usage score = 2.81) (Figure 8). Many states require CEI consultants to submit progress reports (usage score = 2.5) and perform intermediate evaluations of CEI consultant’s performance” (usage score = 2.03). An ANOVA analysis found that the usage of the tools for monitoring and inspection of CEI services vary significantly (p-value = 0.02) among STAs, however, they do not once again vary significantly among Low, Medium, and High users of CEI services (p-value = 0.96). Data also revealed that the tool “Verify that CEI consultant
Prepare a list of the documentation that the CEI consultant will manage, which will be later used as a closeout checklist.

- Require CEI consultant to submit hold harmless agreement

Verify that CEI consultant is responding to construction contractor’s request for assistance

Verify that CEI consultant is appropriately managing modifications to the contract

Maintain a record of all changes to CEI consultant’s scope of work

Internally review and approve changes to CEI consultant’s scope of work

Adjust fixed fee of CEI consultant’s contract when the total contract amount is revised due to a change in the scope of work

Require monthly applications for payment from CEI consultant

Retain amount (Retainage) from CEI consultant’s applications for payment

**FIGURE 7 Processes used in the administration of pre-construction, contract clarification and modification, and payment**

adequately reviews construction contractor’s application for payment” is used heavily in all three user groups.
Processes Used to Administer Processes with Human Resources

For human resources management, STAs most occasionally provide training to a CEI consultant on their agency’s processes and procedures, provide CEI consultant access to STAs’ internal information system, and require agency’s project manager to get acquainted with the roles and skills of selected CEI consultant with usage score of 2.34, 2.19, and 2.18 respectively (Figure 9). An ANOVA analysis found that the tools used for human resources management of CEI services vary significantly \( (p\text{-value} = 0.00) \) among STAs, however, they do not vary significantly among Low, Medium, and High users of CEI services \( (p\text{-value} = 0.55) \).

Processes Used To Administer the Closeout Process

The survey found that to help administer the closeout process STAs most frequently verify that CEI consultant delivered all project documentation and records \( (usage\ score = 3.64) \) (Figure 10). A large number of STAs also verify that all work assignment by CEI consultant is complete \( (Figure \ 9) \). The survey found that the practice of retaining consultant payment is phasing out. Because of this, the ANOVA analysis found that the tools used for administering the closeout process are significantly
different (\(p\)-value = 0.00) among STAs, however, they do not vary significantly among Low, Medium, and High users of CEI services (\(p\)-value = 0.59). The analysis estimates:

- Low using STAs utilize the process “Verify that CEI consultant delivered all project documentation and records.” More frequently
- Medium using STAs utilize the process “Verify that CEI consultant delivered all project documentation and records.” More frequently
- High using STAs utilize the process “Verify that all work assigned to CEI consultant is complete” More frequently

FIGURE 10 Processes used to administer the closeout process.

Impact of CEI Services on STAs

The last part of the survey requested information on the impacts, both positive and negative, of CEI consultant services to the STAs. The survey found that the most important reason for STAs to bring in CEI consultant services is the improved ability to handle peak workloads with a usage score of 3.72 (Figure 11). A significant number of the STAs reported that CEI consultant services provide the flexibility of adding or reducing staff more quickly (usage score = 3.04), and CEI consultants bring special expertise that is not available in house (usage score = 2.83). Even though issues such as “CEI services are more competitive”, or “CEI services make it easier to obtain equipment” or “CEI services promote states’ goal of increasing privatization” were given high importance of outsourcing in many studies, this study found that STAs do not typically perceive them as important as other direct benefits that CEI consultant services offer.

The most significant challenge that STAs face when they bring in CEI services is developing consultants’ familiarity with in-house processes and procedures, with a usage score of 2.61 (Figure 12). Getting the CEI consultant acquainted with a STA’s internal processes can be time consuming and require a duplication of effort, which at least in the short-term can be considered redundant. A large number of the STAs reported concerns regarding CEI consultants qualifications and
FIGURE 11 Advantages of CEI services as realized by STAs

- Is in keeping with state’s goal of increasing privatization
- Is more competitive
- Makes it easier to obtain equipment, office, etc.
- Provides special expertise not available in-house
- Provides flexibility to add or reduce staff more quickly
- Makes it easier to control in-house staff size
- Improves ability to handle peak work loads

FIGURE 12 Disadvantages of CEI services as realized by STAs.

- CEI consultants are more concerned with protecting themselves than the agency
- CEI consultants recruit DOT employees
- Control and responsiveness from construction contractors is lost
- Salary disparities between CEI consultants and in-house staff cause morale problems
- Training of CEI consultant personnel must be continual
- Training opportunities for in-house employees are lost
- CEI consultant forces may be poorly qualified
- Monitoring requires a duplication of effort, and increased paperwork
- Lack of familiarity with procedures
- Costs are higher compared to in-house staff.

cost effectiveness compared to in-house staff (usage score = 2.58). STAs also expressed concerns with maintaining the training and professional growth opportunities for in-house staff when CEI consultants are used as well as pay disparities between consultants and in-house staff, which can create low morale problems among in-house staff.
Changes of CEI Practices over the Years
This survey found significant changes have occurred in CEI practices over the years. A 1989 survey found that the portion of work load assigned to consultants varied from 1 to 52% with weighted average of 26%; however this survey found that range to exist between zero to 12.1% with weighted average of 1.05% (1). Even though the percent of CEI work volume decreased over the years, the number of CEI functional activities increased in significant number. Material testing, preparing progress estimates, preparing change orders, which were largely reserved by in-house staffing, is now widely performed by consultants. A 1999 survey by Witheford found the same and reported that half the states contracted out 50 percent or more of their preconstruction engineering compared to only one-fifth in ten years prior (4). Practices related to solicitation, selection, and negotiation of CEI consultant have not change much - the most common procedure is to develop a short list of firms qualified to perform the work- usually three-request proposals from these firms, evaluate the proposals, make a selection, and negotiate an agreement. For payment purpose, retainage was a common practice, however, that practice has almost been phased out according to this survey. The 1989 survey found training in STAs’ procedures was identified as the most urgent need for most consultant personnel, and this survey again found the need for training need CEI consultants to be a significant need. Even though the top three advantages of using consultants for CEI cited by agencies remained same, this survey found a significant shift in the disadvantages of using CEI consultants. The disadvantages most frequently cited is this survey are higher costs along with a lack of familiarity among CEI consultants with the agency methods, procedures, and requirements.

CONCLUSIONS
CEI consulting services serve as an effective strategy for STAs and private corporations when engineering expertise is needed or extra staffing is required. Consultant services can often provide project STAs with expertise for a wide array of projects that the STAs may not be able to complete with current staff. The national CEI survey provides a detailed mapping of various tools and practices for the management and oversight of CEI services. The survey found that a wide variety of tools and practices are used by STAs for defining the scope of work for CEI services to consultant selection and administration of CEI services contracts. STAs bring in consultants more frequently for large projects, and statements of work are the most common tool used to define services that CEI consultant can provide. Various procedures are used by STAs for selection of consultants; however, the use of advertisements to solicit CEI bids through media outlets and the direct request of proposals is the most frequent practice. STAs have developed and implemented many practices for the administration of CEI consultant contracts. The survey found the most frequently used tools/practices are:

- STAs preparation of a list of documents that the CEI consultants will manage, which later used as a closeout checklist for pre-construction;
- STAs internal review and approve changes to CEI consultant’s scope of work for contract clarification and modification;
- Verification that CEI consultant adequately review construction contractor’s application for payment for monitoring and inspection;
- Providing training to CEI consultant on agency processes and procedures for human resources; and
- Verification that CEI consultants have delivered all project documentation and records for closeout process.

An ANOVA analysis found that STAs use of tools/practices for CEI consultant services vary significantly, however, they are not significantly differ among Low, Medium, and High users.
One of the most important findings of this survey is the value of CEI consultant services as realized by the STAs. The survey found that the CEI consultant services provide STAs an improved ability to handle peak workloads, provide the flexibility of adding or reducing staff more quickly, and bring special expertise that may not be available in-house. Challenges, on the other hand, include developing CEI consultants’ familiarity with in-house processes and procedures, assuring that CEI consultants are well qualified to do their work, and price/cost disparities between the prices to pay CEI consultants to do the work versus the cost of in-house staff to do the same. Despite these disadvantages, the primary reason that STAs’ use CEI consultants has not changed compared to Newman’s 1989 study in that CEI consultants help alleviate staff shortages, particularly at times of peak workloads (1). This assertion is supported by the finding that currently CEI services are being used more on larger projects. Interestingly enough, the volume of CEI contracts based on both the number of contracts and the percentage of the overall dollar volume of contracts among STAs appears to have declined since Newman’s 1989 study. Certainly, the use of alternative delivery methods (e.g. Design-Build and PPP) have increased since then suggesting that STA’s are also examining other means besides CEI consultants to alleviate staff shortages. The use of CEI consultants is remarkably consistent across STAs. CEI consultants are used more frequently in project administration rather than in pre-construction or project closeout. Furthermore, CEI consultants are used primarily for on-site monitoring of contractor activities and scheduling, which does allow for more centralized activities of STA personnel.

REFERENCES


