

# Engineering Design Costs: In-House versus Contracting-Out

---

An analysis of State Departments of Transportation in-house design  
costs versus engineering firm design costs  
August 31, 2016

Submitted to:



AMERICAN COUNCIL OF ENGINEERING COMPANIES

Prepared by:

**Professor F. H. (Bud) Griffis, PE, PhD**



With Graduate Research Assistants:

Giulia Luci  
Elena Pizzoli  
Nima Azad  
Shriti Pandey  
Bhavesh Rathore  
Isabella Geronzi  
Azzurra Pedrotti  
Zaira D'Angelo  
Ashkan Kangani  
Sarvenaz Entezarian

# **Table of Contents**

Part A. Executive Summary

Part B. Cost Elements and Methodologies

Part C. Additional Reasons for Contracting Out Design Engineering Services

Part D. Cost Comparisons By State

# Part A. Executive Summary

The purpose of this study -- which was performed by a faculty and student research team from New York University's Tandon School of Engineering under contract with the American Council of Engineering Companies, Washington, D.C. -- is to examine the true costs of performing engineering design services in-house by State Departments of Transportation (DOTs) versus contracting out to local firms. The study uses publicly available information to develop an average salary, cost of fringe benefits and a fully loaded overhead for each State DOT, and corresponding data from firms in each state.

First, it should be stated at the outset that simple cost comparisons are not the best way to measure *value* in delivering design services to the public. This view is embraced in federal law, and in the laws in most states, which require the use of the competitive Qualifications-Based Selection (QBS) procurement process for selecting architect and engineering (A/E) service providers. Under the QBS process, firms compete on the basis of the technical skills and experience of their respective design teams, with cost negotiations to follow, ensuring that public agencies receive design services best suited to individual project needs at a cost that meets the agency's budget.

The need for this study arises from the fact that State DOTs are at times criticized for contracting out services on the presumed basis that it's "cheaper" to perform the work in-house. Lawmakers at the state and federal level have also debated the relative merits of "insourcing" versus contracting out engineering services, where once again the most common metric cited is cost. It is hoped that this academic study will help to better inform policy makers and the public of how the true costs compare, with the goal of bringing the discussion back to the real value measures for strong partnership between public agencies and the nation's engineering industry, such as promoting innovation, efficient and timely project delivery, and project success (including cost).

In order to prepare a clear comparison of costs, NYU endeavored to identify and calculate State DOT costs -- labor, fringe benefits, and overhead costs -- in the same manner that private engineering firms treat their labor, fringe and overhead rates under Federal Acquisition Regulation (FAR) Part 31. Engineering firms must follow FAR Part 31 in accounting for and reporting costs for purposes of their contracting with State DOTs and other public agencies. Because State DOTs are not required to follow FAR Part 31 in accounting for their own costs, certain accounting practices followed by private engineering firms -- such as segregation of direct and indirect costs -- are not applied by the DOTs. As a result, it was necessary for the NYU team to apply certain assumptions and estimates to the State DOT cost information in order to develop estimated labor, fringe benefit, and overhead rates that are as consistent as possible with the methods used by private engineering firms in complying with government regulations.

Almost every state has one or more transparency web sites where the expenses of the state

government are available to be seen by the public. The variability among the states as to the level of detail of this data is considerable. Some states have expense records in the tens of thousands of line items while others have less than one thousand. Regardless, this project has attempted to use the same methodology in the calculation of the costs of every state.

## Key Findings

NYU examined cost data from a total of 28 State DOTs, as well as corresponding data from a sample of firms in each state. Researchers calculated totals for each of the major cost categories:

- **Direct Salary** -- the average direct salary of a member of the engineering staff is calculated as the weighted average of the professional positions in the agency. An average direct salary was computed for the firms in each state through a sample obtained through an electronic survey. Nationwide, the average direct salaries are approximately:
  - DOTs: \$69,262 with a coefficient of variation of 13%.
  - Firms: \$75,133 with a coefficient of variation of 9%.
  
- **Fringe Benefits** -- costs that fall under this heading include, but are not limited to, payroll taxes, health, dental, and life insurance, retirement, workman's compensation insurance, and other fringe benefits. Paid Time Off is excluded from the fringe benefits rate, and is instead included in the estimated indirect labor costs. Nationwide, the mean fringe rates (as a percentage of direct salaries) are as follows:
  - DOTs: 79% with a coefficient of variation of 23%.
  - Firms: 36% with a coefficient of variation of 16%.
  
- **Overhead Rates** -- for each state, the total overhead costs consist of non-labor overhead costs (such as facility costs) and indirect labor costs (such as administrative staff, non-project related time spent by project staff, and Paid Time Off). For comparison purposes, indirect labor costs are calculated as 40% of total DOT salaries and wages (consistent with industry averages). The nationwide calculated mean overhead rate based on direct labor cost exclusive of fringe is:
  - DOTs: 215% with a coefficient of variation of 22%.
  - Firms: 125% with a coefficient of variation of 10%.
  
- **Total Average Costs:**
  - **DOTs: \$272,684**
  - **Firms: \$217,020 (includes 10.5% average profit margin)**

## Additional Considerations for Policymakers

Beyond the question of cost, there are a number of additional factors for public agencies to

consider in making the decision to contract out work to the private sector:

- ✓ *Decision based on staffing capacity.* The public cannot afford to staff an agency to handle peak workloads. If the DOT staffed up to handle peak workloads, it is liable to pay those employees in lean times even if they have nothing to work on. If a project is contracted out, firm employees are only paid for the time they work on a project; they leave a project once it is over.
- ✓ *Decision based on schedule constraints.* This issue is based on capacity, expertise, and attitude and must be addressed to complete critical projects on time. Firms have more flexibility to meet fast-track deadlines than government agencies.
- ✓ *Decision based on lack of special expertise.* Often the DOT has no choice but to contract out the design if it lacks the required expertise in-house.
- ✓ *Decision based on the need for innovation.* The private sector has more means to encourage innovation than government agencies, including bonus programs and the sharing of intellectual properties. Most government agencies cannot by regulation provide these types of incentives.
- ✓ *Decision based on the better management of risks.* Contracting out is an effective risk management tool that enables agencies to shift risk to the firm and away from the taxpayer.
- ✓ *Decision based on improving quality.* Since firms compete against one another for work, they cannot submit a poor-quality design and expect to be selected again by the same agency. This is the core principle of the Qualifications-Based Selection (QBS) procurement process, which is used by federal and state agencies to acquire engineering services for public projects. Past performance and project success is a major gatekeeper in the selection of consultants.
- ✓ *Decision based on cost-effectiveness.* The cost savings demonstrated by this study when State DOTs contract out design services, coupled with the other factors referenced above that drive the decision-making to engage the private sector, builds a convincing narrative supporting a robust partnership between the DOTs and the nation's engineering industry.

## Part B. Cost Elements and Methodologies

As noted in Part A, the purpose of this project was to examine the true costs of performing engineering services in-house by State DOTs versus contracting out to local firms. To accomplish this objective, we first calculated the weighted average annual base salary for design professionals at individual State DOTs and a sample of firms in each state. We then added the estimated fringe, overhead and, for the private design professional, the estimated average profit. The resulting totals represent the total annual cost to employ a design professional in a State DOT as compared to a private engineering firm doing business in that state.

### Overall Approach

NYU's approach has been to identify and evaluate State DOT costs – labor, fringe benefits, and overhead costs – in the same manner that private engineering firms treat their labor, fringe and overhead rates under Federal Acquisition Regulation (FAR) Part 31. Engineering firms must follow FAR Part 31 in accounting for and reporting costs for purposes of their contracting with State DOTs and other public agencies. Because State DOTs are not required to follow FAR Part 31 in accounting for their own costs, certain accounting practices followed by private engineering firms – such as segregation of direct and indirect costs – are not applied by the DOTs. As a result, it was necessary for the NYU team to apply certain assumptions and estimates to the State DOT cost information in order to develop estimated labor, fringe benefit, and overhead rates that are as consistent as possible with the methods used by private engineering firms in complying with government regulations.

### Cost Elements/Methodologies

The report includes the following cost elements which were used to develop an estimated average total cost of a design professional in State DOTs and private engineering firms: average salary cost, direct labor, fringe benefits, overhead, and profit (for private firms). These costs were developed as described below:

- **Average Salary Cost.** The average salary cost, labeled as Direct Salary in the Cost Comparisons by State tables, represents the average annual salary of a design professional in a State DOT or private firm. The State DOT average salary was determined based on a review of actual salary information for design staff on the applicable State DOT transparency websites. The average includes licensed professional engineers and unlicensed design staff. For private firms, the average was developed based on survey responses from private firms doing business in each state.
- **Direct Labor.** Private engineering firms must segregate their labor costs (salaries and wages) between those costs that are incurred working on projects (direct labor costs) and those not related to specific projects (indirect labor costs). A/E industry financial

performance surveys report information on labor utilization, calculated as direct labor cost as a percentage of total labor cost. Two leading surveys (the PSMJ A/E Financial Performance Survey and the Deltek Clarity Architecture and Engineering Industry Study) reported an industry average utilization rate of approximately 60% for 2014, the year for which costs were evaluated in the NYU study. The NYU team has applied this 60% utilization rate to each State DOT's total labor costs to estimate direct labor costs, with the remaining 40% of labor costs treated as indirect labor. The estimated 40% indirect labor costs include vacation, sick leave, holiday pay, and any labor hours incurred by employees when they are not directly working on projects.

- **Fringe Benefits.** The NYU team gathered information on State DOT fringe benefits from state transparency websites, and initially provided that data on the basis of total salaries and wages. The fringe benefit costs include health, dental and life insurance, pension and retirement costs, workers' compensation, and payroll taxes. Leave time is not included in the fringe rate. For State DOTs evaluated in the study, fringe benefits averaged approximately 45% of total labor costs. Because engineering firms must calculate their fringe rates and overhead rates on the basis of direct labor costs, it was necessary to convert the State DOT fringe benefit rates to a direct labor cost basis. When expressed as a percentage of direct labor costs, State DOT fringe benefit rates averaged approximately 75% of direct labor.
- **Overhead Costs.** The NYU team examined cost information provided on State DOT transparency websites in order to compile data on state DOT overhead costs. They made the best possible effort with the information available to present the State DOT data on the same basis that private engineering firms use to account for and report overhead costs. For example, State DOT construction and engineering projects were excluded from the overhead costs, as were the costs related to State DOT roadway maintenance, debt service, and transfers of funds to other governmental agencies. The NYU team was tasked with evaluating State DOT cost information that varied in level of detail from as few as 50-100 line items to over 90,000 line items of cost detail. In evaluating costs, the NYU team applied the same approach and assumptions to each State DOT to help ensure consistency. For each state, the total overhead costs consist of non-labor overhead costs and indirect labor costs. Indirect labor costs are calculated as 40% of total DOT salaries and wages, as described in the Direct Labor section above.
- **Profit.** The Profit Amount calculated as a component of the total cost for private firms is based on the average profit rate reported by private firms in the survey responses. The profit rate is expressed as a percentage of the sum of direct salary plus fringe plus overhead, which is the standard method used by private firms in developing cost proposals for state DOT contracts. The Profit Amount is not applicable to the calculation of total State DOT costs.

# Part C. Additional Reasons for Contracting Out Design Engineering Services

## Introduction

While this study focused on a pure cost comparison of DOT and private sector engineering services, in reality there are a number of more important factors that drive State DOTs to partner with engineering firms in delivering projects to the public. DOTs cannot efficiently staff up every time there is a substantive increase in project workload, nor are they in a position to easily ramp down staffing during periods of reduced funding. In addition, State DOTs benefit from the outside specialized expertise and innovation that firms bring to the table, as well as the ability to address unique technical challenges or to manage risks and improve project quality. Contracting out provides DOTs with access to design capabilities when they need it, without the costs associated with maintaining such capabilities when they're not needed.<sup>i</sup>

### ✓ *Decision Based on Staffing Capacity*

Transportation infrastructure funding is never constant. It varies from year to year and depends on many factors. When project funding is high, it is often impossible for the DOT to perform the necessary design and inspection services in-house. On the other hand, if the DOT were to staff to a level capable of performing its highest workload, they would in turn be paying idle staff during the lean years when funding is flat or reduced (as has been the case in recent years). Unique or highly skilled staff members accentuate the problem. Once hired, a DOT employee can remain a DOT employee for his or her entire career, receiving salary and benefits (including long-term retirement benefits) regardless of the agency's needs or level of effort. If the projects are contracted out, the consultant employee is charged only for the time he or she works on the project and leaves the project when the project is over.

In one survey of state DOTs, variations in workload was cited as a very important factor in agency decisions to retain consultants.<sup>ii</sup>

### ✓ *Decision Based on Schedule Constraints*

Meeting challenging delivery schedules is frequently cited by State DOTs as one of the key drivers in choosing to contract with local engineering firms.<sup>iii</sup> This issue is related to capacity, expertise and attitude. Generally speaking, consultants have more flexibility to meet deadlines than in-house design staff. From a strictly administrative viewpoint, a consultant can bring a sub-consultant onto a job much faster than a government agency can negotiate a contract or hire more staff. In addition, consultants are more focused to meeting deadlines. They have to satisfy the agency if they want to continue to receive work. If a particular project requires specific expertise, a consultant can get the expertise much faster than a government agency. A



World Bank study of infrastructure projects found that outsourced projects are 60 percent more likely to be fully completed, take an average of 9 months less to complete, and are more than four times as likely to be rated successful by project managers and financiers.<sup>iv</sup>

### ✓ *Decision Based on Lack of Special Expertise*

There are instances when the DOT has a requirement to deliver products and services for which they are not equipped. They may be unable to accommodate networking, modeling, or database activities for a project requirement, or they may lack sufficient experience in seismic design (for example) for a critical transportation structure. Contracting out allows the DOT to avail itself of the expertise it needs when it needs it. This view has been supported by a U.S. Government Accountability Office (GAO) report in 2008, which noted that state DOTs rely on firms to supplement staff and provide access to technical expertise or specialized services or equipment.<sup>v</sup> An earlier cooperative study supported by the State DOTs, the Transportation Research Board of the National Research Council, and the Federal Highway Administration (FHWA) also highlighted the need to access specialty skills and technology as one of the principle drivers in contracting out with the private sector.<sup>vi</sup>

### ✓ *Decision Based on the Need for Innovation*

State DOTs pay close attention to the threats and challenges facing critical assets under their charge, but they don't always understand the range of cutting edge, innovative design solutions that may be available in replacing or restoring those facilities. Bringing forward innovative solutions and techniques that help agency clients to achieve project objectives has been cited in multiple government studies as key factors driving State DOT decisions to retain engineering firms.<sup>vii</sup>

The private sector also has a greater ability to encourage innovation from within -- through bonus programs, the sharing of intellectual properties, and other mechanisms -- than government agencies. Most government agencies cannot by tradition and regulation provide those types of incentives.

### ✓ *Decision Based on Better Management of Risks*

Contracting out is an effective mechanism for public agencies to control risk and increase accountability and efficiency. If a project is performed in-house, the risk is assumed by the agency. Should there be design flaws caused by errors or omissions by the in-house design team, the cost will ultimately be borne by the agency and the taxpayer.

By contrast, contracting out shifts the risk from the agency to the firm, since the firm now has responsibility and control over the design. In order to protect themselves, firms either self-insure or carry insurance for the purpose of covering added costs due to errors and omissions. Their insurers require, by controlling the cost of their premiums, that firms maintain a quality

assurance program to protect the insurer. This need to control insurance costs by minimizing design errors becomes yet another strong incentive for the firm to deliver quality design services to the agency.

### ✓ *Decision Based on Improving Quality*<sup>viii</sup>

Design quality is enhanced by the special expertise engineering firms bring to the table, as well as the motivations of firms to reduce risk by minimizing design errors. However, the goal of achieving quality and successful project outcomes is built into the very competitive procurement process used by public agencies to acquire design services. As noted earlier in the study, the federal government and most state governments use Qualifications-Based Selection (QBS) for the procurement of professional engineering services, where the principle metric for evaluating competing firms is the qualifications and experience of the design team.<sup>ix</sup> The value proposition of QBS is simple: The design costs of new construction, rehabilitation or maintenance of capital projects represent a tiny fraction of the overall life cycle cost of these projects. According to the General Accounting Office the cost of design typically represents 1% or less of the project's overall life cycle costs. A well-developed design can keep a project on time and on budget, while a substandard design can result in schedule and cost overruns that greatly exceed the cost of the design. For this reason, the American Public Works Association (APWA) recommends that design professional services should always be obtained through the QBS procurement process.<sup>x</sup>

With transportation projects, QBS procurements most often involve the use of selection boards within State DOTs that evaluate proposals from firms, select short lists, and recommend the most technically qualified firm for further discussion on the scope of work and the negotiation of price. If the DOT and the firm can negotiate a fair and reasonable price, the award of a design contract follows. Selection boards have long memories.

When it comes to comparing the quality of design between contracted out and in-house designs, there have been no competent studies made. However, when one considers incentives and other factors for producing a quality design, it points towards contracting out:

1. The QBS procurement process ensures that the most capable and experienced firms are hired to deliver projects to the public, whereas no comparable evaluation is done when the decision is made to do the design work in-house. Using in-house staff is essentially sole source contracting, with the pitfalls of awarding work without competition;
2. The ability of the firm to win *future* work with the DOT is conditioned by the quality and success of the previous services provided to the agency;
3. The firm has a DOT project manager providing oversight and adding to its internal management;
4. The firm can hire (and fire) employees far easier than a government agency.

## ✓ *Decision Based on Cost Effectiveness*

The study illustrates, through a comparison of the basic cost elements that are relevant to the delivery of design services to the public, that engaging the private sector is less expensive than doing the engineering design in-house. In addition, the various elements discussed above that drive the decision-making whether to engage engineering firms – staffing capacity and capabilities, scheduling constraints, innovation, risk management, and project quality – also directly impact both project costs in the near-term and agency budgets over the long-term. Taken together, a comprehensive narrative emerges that should inform lawmakers at the federal and state levels, as well as public agency leaders, of the very strong and convincing arguments in favor of a robust partnership between State DOTs and the nation’s engineering industry.

---

<sup>i</sup> Tom Warne and Associates, LLC (2003). *NCHRP SYNTHESIS 313: State DOT Outsourcing and Private-Sector Utilization*.

<sup>ii</sup> GAO, 2008. *Federal-Aid Highways: Increased Reliance on Contractors Can Pose Oversight Challenges for Federal and State Officials*

<sup>iii</sup> CTC & Associates, *Balancing Workload and Resources in Capital Programs: A Survey of Practices in Caltrans and Selected State Departments of Transportation* (April 10, 2013); p. 39.

<sup>iv</sup> F. Humplick and T.O. Nasser, *An Econometric Assessment of the Impact of Service Contracting on Infrastructure Provision*, World Bank Research Project No. 687-64, cited in Frannie A. Leautier, “Private Partnerships and Delegated Management”, in *Business Briefing: World Urban Economic Development in 2000* (London: World Markets Research Centre, 2000), p. 47 and further cited in Moore, A.T., G.F. Segal, and J. McCormally, “Infrastructure Outsourcing: Leveraging Concrete, Steel, and Asphalt with Public-Private Partnerships”, Policy Study No. 272, Reason Policy Institute, September 2000.

<sup>v</sup> GAO, 2008. *Federal-Aid Highways: Increased Reliance on Contractors Can Pose Oversight Challenges for Federal and State Officials*

<sup>vi</sup> Tom Warne and Associates, LLC (2003). *NCHRP SYNTHESIS 313: State DOT Outsourcing and Private-Sector Utilization*.

<sup>vii</sup> CTC & Associates, *Balancing Workload and Resources in Capital Programs: A Survey of Practices in Caltrans and Selected State Departments of Transportation* (April 10, 2013); GAO, 2008. *Federal-Aid Highways: Increased Reliance on Contractors Can Pose Oversight Challenges for Federal and State Officials*

<sup>viii</sup> Christodoulou, C., Griffis, F.H. (Bud), Barrett, L., & Okungbowa, M. (2003). *Qualifications-Based Selection For the Procurement of Professional Architectural-Engineering Services*. Brooklyn, New York: Polytechnic University.

<sup>ix</sup> The Brooks Act: How to use Qualifications Based Selection. (n.d.). Retrieved from <http://www.acec.org/advocacy/brooks2.cfm>

<sup>x</sup> American Public Works Association *Red Book on Qualifications-Based Selection Guidelines*