USC Keston Institute for Public Finance
and Infrastructure Policy

The Impacts of Design-Build on the Public Workforce

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Executive Summary

Design-Build is a method for obtaining construction services where a single organization is retained to provide architecture/engineering and construction services under one contract. This contrasts with the more traditional Design-Bid-Build approach where an architect or engineer is commissioned to prepare drawings and specifications, and the owner separately engages a contractor through a competitive bidding or negotiated process. Under certain circumstances, Design-Build contracting has resulted in reduced project delivery times and construction costs when compared with Design-Bid-Build procurement. At the present time, over half the states have some form of legislated design-build authority, although some states use the practice extensively and some not at all. California makes limited use of Design-Build and concerns have been raised that the design-build method of procuring infrastructure construction could result in major staff cutbacks within public agencies in California.

In order to evaluate this concern objectively, this study employed a combination of literature review, surveys of state departments of transportation, and content analysis of design-build requests for proposals to answer the following question:

> *What is the impact on the state department of transportation professional workforce when the state authorizes it to deliver infrastructure projects utilizing design-build project delivery?*

Figure E.1 below graphically illustrates the states covered by at least one of the three instruments employed to gather the data used in the study's analysis. Of the states not sampled in some fashion, only Delaware, Kansas, New Jersey, and the Virgin Islands had completed some form of design-build transportation project. Thus, the study is comprehensive in scope and its conclusions authoritatively reflect the design-build experience of state transportation agencies over a period of almost twenty years.

The study arrived at a number of conclusions with respect to the research question. These can be summarized as follows.

Implementing design-build contracting does not shift public professional engineering jobs from state agencies to the private sector.

> Of the states with design-build experience, all indicated that they did not reduce their professional engineering workforce as a result of implementing design-build. Eighty-six percent of the respondents reported that their professional workforce either remained the same or increased in size.

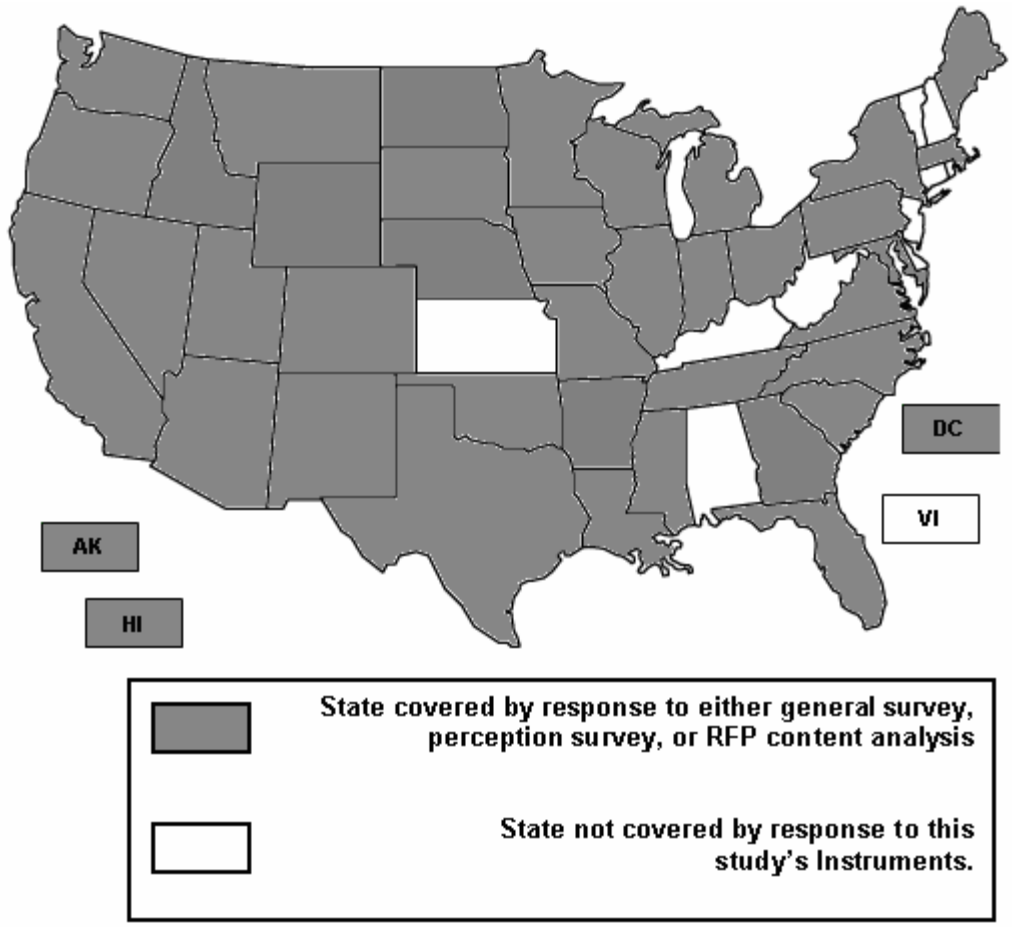

Figure E.1: Summary of Geographic Distribution of Study Instrument Coverage.

Utilizing design-build contracting does not significantly reduce the use of the traditional design-bid-build method.

> Ninety-three percent of the respondents indicated that design-build projects make up less than ten percent of their total number of construction projects of which eighty-nine percent indicated that design-build projects make up less than five percent. Thus, the traditional professional engineering workforce is required to deliver the remaining ninety percent of the projects using traditional contracting methods.

Implementing design-build requires a more competent and experienced workforce.

> Several states indicated that they purposely assign their most experienced engineers to administer design-build projects. State departments of transportation will need to maintain a robust traditional design-bid-build project delivery program to balance the workload between entry-level design and construction engineers and more experienced staff. Entry-level personnel will need to gain the experience and develop the professional

judgment necessary to allow them to become qualified to oversee design-build projects.

Implementing design-build does not compromise the time, cost and quality standards that define infrastructure project delivery success.

> A recent report to Congress by the Federal Highway Administration, which detailed the performance of nearly all (over three hundred) of the design-build projects that had been completed through 2004, summed the performance of design-build projects as follows:
>
> > On average, the managers of design-build projects surveyed in the study estimated that design-build project delivery reduced the overall duration of their projects by 14 percent, reduced the total cost of the projects by 3 percent, and maintained the same level of quality as compared to design-bid-build project delivery.

This study's summary conclusion is that

Implementing design-build contracting by a department of transportation that is new to the delivery method will not have a negative effect on its public engineering workforce.

> Implementing design-build will give the department one more tool to accelerate the delivery of critically needed transportation infrastructure projects and provide professional development opportunities to agency staff. When applied to the appropriate projects, design-build has the potential to be more efficient than the traditional design-bid-build method without negatively impacting the public workforce.

Design-build is a mature and proven tool throughout the U.S. to deliver highways and other infrastructure projects. The benefits of faster project delivery and increased cost certainty have been validated time and time again. The FHWA no longer considers design-build to be experimental and has provided a framework to ensure quality in federally-funded construction projects. Florida has been using design-build for almost 20 years and well over half the states now utilize design-build to some degree. Design-build is an option for project delivery that can help California meet its urgent infrastructure project delivery needs.

The Impacts of Design-Build on the Public Workforce[1]

Douglas D. Gransberg[2] and Keith R. Molenaar[3]

Introduction

The Design-Build Institute of America (DBIA) predicts that 50% of non-residential construction projects will be delivered using Design-Build (DB) in 2010.[4] This tracks well with a 2004 survey that found that construction companies expected 50% of their revenues to come from DB projects in 2006.[5] This same study reported that 80% of all design and construction firms surveyed in the US expect the percentage of their business derived from DB projects to increase over the next five years. Figure 1 shows that the percentage of non-residential construction projects being delivered by DB has increased steadily in the past twenty years from an estimated $18 billion in 1986 to over $250 billion in 2006.[6] This shift in project delivery culture first began in the 1960's in the private sector on commercial construction projects with strong revenue streams where the financial benefit of compressing the project delivery period outweighed the risk of starting construction before the design was totally complete.[7] In the 1980's, it spread to the public sector as a method for delivering revenue-producing projects such as toll roads and bridges as well as an effective means to expedite the procurement of emergency reconstruction after natural disasters such as the Interstate 10 bridges demolished by hurricanes in Florida. In 1996, the Federal Acquisition Reform Act was passed and specifically provided both regulation for the use of DB on federal projects and authority to utilize the delivery method without seeking special permission.[8]

Since its inception in 1993, the DBIA has tracked state and federal capital project and infrastructure procurement laws regarding DB. It has documented the trend of expanded legislative authority to public sector engineering and construction agencies to legally use

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[1] Study prepared with a grant from the Keston Institute for Public Finance and Infrastructure Policy, University of Southern California. The views expressed herein reflect those of the authors and do not necessarily reflect the views of the staff, officers, or Board of the Keston Institute for Public Finance and Infrastructure Policy.

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[4] Design-Build Institute of America (2005). "Non-Residential Construction in the United States," Unpublished presentation slides based on data from Lawson International Research and Engineering News Record.

[5] Zweig-White Research, (2004) *Is Design-Build Due for an Increase?*, The Zweig Letter, Issue 551, http://www.zweigwhite.com/trends/thezweigletter/index.asp (February 18, 2007).

[6] Design-Build Institute of America (2005). "Non-Residential Construction in the United States," Unpublished presentation slides based on data from Lawson International Research and Engineering News Record.

[7] Gransberg, D.D, J.E. Koch and K.R. Molenaar. (2006). *Preparing for Design-Build Projects: A Primer for Owners, Engineers, and Contractors*, ASCE Press, Reston, Virginia, pp.

[8] Ibid.

DB in all types of construction procurements. The building sector led the infrastructure sector in terms of embracing the use of DB. States like California and Oklahoma have

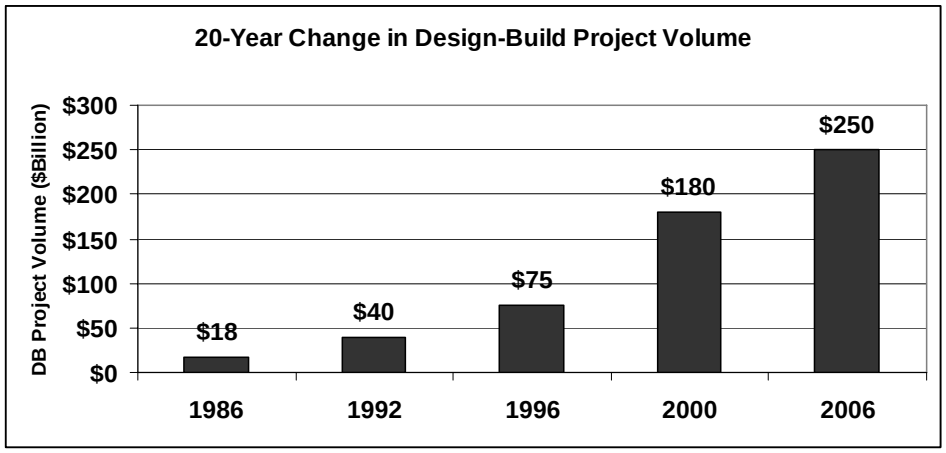

Figure 1: Design-build Growth in the United States.[9]

authorized its use on public buildings without extending broad DB authority to their departments of transportation. Nevertheless, in the past decade DB transportation projects have been constructed in over thirty-five states. Some are restricted to toll projects or mass transit projects where the revenue generation potential forms a convincing argument for achieving an early opening by compressing the traditional delivery period to the maximum extent possible. As a result, the use of DB project delivery in the transportation sector is growing across the country.

By 1994, the Federal Highway Administration (FHWA) had approved over 300 DB transportation projects in 32 states worth nearly $14 billion under the FHWA Special Experimental Projects program (SEP-14)[10]. In 2002, the Florida Department of Transportation (DOT) alone had awarded 49 DB projects for nearly $500 million worth of work and estimates that DB cuts 30% off the traditional project delivery period.[11] One study predicted that 27% of all transportation projects will be procured using DB by 2003[12]. There are also nearly $3 billion worth of water/wastewater projects either underway or in the planning and bidding process using DB[13]. When one adds the uncounted number of public building, utility, and other infrastructure DB projects completed by county and municipal public agencies as well as the Public-Private Partnerships (PPP) that deliver critical infrastructure such as toll roads, toll bridges, and

[9] Design-Build Institute of America (2005). "Non-Residential Construction in the United States," Unpublished presentation slides based on data from Lawson International Research and Engineering News Record.
[10] Federal Highway Administration (2006). "Design-Build Effectiveness Study," Final Report to Congress as Required by TEA-21, http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm (August 30, 2006).
[11] Mary Peters (2003). "An Important Project." Canal Road Intermodal Connector Meeting, Gulfport, Mississippi, http://www.fhwa.dot.gov/pressroom/re031021.htm [September 16, 2006].
[12] Design-Build Institute of America, (2000). "Market Trends, Water/Wastewater Outsourcing Revenues Jump in 1999," *Design-Build Institute of America Dateline April 2000*, Washington, D.C., p.13.
[13] Design-Build Institute of America, (2000b). "Market Trends, Water/Wastewater Outsourcing Revenues Jump in 1999," *Design-Build Institute of America Dateline May2000*, Washington, D.C., pp.1-2.

water/wastewater projects, the nationwide market for DB project delivery is truly staggering. To generate such meteoric growth in such a short period vividly confirms that DB must accrue tangible benefits to the public agencies that implement it. The FHWA recently completed a seminal report that eloquently articulates this when it states:

> *"The greatest motivation and realized benefit to a contracting agency of using design-build … is the ability to reduce the overall duration of the project development process by eliminating a second procurement process for the construction contract, reducing the potential for design errors and omissions, and allowing for more concurrent processing of design and construction activities..."*[14]

Timeliness is the paramount factor in transportation infrastructure projects and nowhere is it more critical than on congested California freeway projects. User costs of congestion due to delays, increased toxic emissions, and other factors on urban freeways can exceed $10,000 per lane-mile/day.[15] Thus, a typical eight-lane California urban freeway would feel a user cost of $80,000 per mile per day and a hypothetical five-mile urban freeway upgrade project would generate user costs on the order of $400,000/day. Taking the analogy one step further would lead one to determine that the 30-day period normally used to bid a traditional Design-Bid-Build (DBB) project costs the California commuters $12,000,000 on that 5-mile stretch of freeway, and generates a significant benefit by delivering a needed upgrade just one month earlier than it would have been delivered using traditional DBB.

While a number of DB toll roads, such as the $800 million Eastern Transportation Corridor toll project, have been completed in California, the state has lagged the rest of the nation in the implementation of legislatively authorized DB projects by the state DOT. One reason for this is concern that widespread implementation of design-build in California will adversely affect public employees. This concern however has not been addressed by any objective research study to date at a state or national level. Hence, the Keston Institute is pursuing this study: *to quantify the impact of DB on the state DOT professional engineering workforce.*

This research project sought to answer this question through a synthesis of literature review, structured interviews of senior managers in DOTs who have implemented DB project delivery, a national survey of DOT personnel, and a content analysis of a large sample of DB solicitation documents. It also looked to public agencies outside the transportation sector to gauge workforce impact in other sectors. In doing so, it formulated the study's specific research question.

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[14] Federal Highway Administration (2006). "Design-Build Effectiveness Study," Final Report to Congress as Required by TEA-21, http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm (August 30, 2006).

[15] Hicks, R. G. and Jon A. Epps (2000). "Life Cycle Cost Analysis of Asphalt-Rubber Paving Materials," Proceedings of Asphalt Rubber-2000, Rubber Pavements Association, pp 569-590.

The Research Question

The following is the formal research question around which the research methodology is organized and to which the output of this research is applied:

> *What is the impact on the state department of transportation professional workforce when the state authorizes it to deliver infrastructure projects utilizing design-build project delivery?*

To adequately answer this question, the research compared not only changes in the number of professional engineers in the experienced DOTs, but also the changes, if any, in the roles these engineers play in a DB project versus the traditional DBB delivery method. The study specifically looks at the public professional engineer's role in managing the design and construction quality of the delivery process, arguably the most important factor in an infrastructure project.

Design-Build Background: The National Context

The emergence of DB contracting on the national transportation scene has certainly been controversial. The emotions associated with the paradigm shift required to implement it have run high. When it emerged in the late 1980's, its detractors consisted primarily of the professional societies associated with the design industry who argued that the use of DB would inevitably degrade the ultimate quality of the constructed product by compromising the integrity of the design process. This fear was expressed in Position Statement #1726 by the National Society of Professional Engineers which said:

> *"Design decisions may be determined or inappropriately influenced by team members other than the designer. This is more likely to occur when a non-designer is the lead on the design-build team. The leader may pressure designers to reduce self-imposed quality criteria or design standards to minimum levels in order to maximize profit."*[16]

Another DB implementation issue deals with the appropriate distribution of responsibility for quality management in a DB highway project. In order to effectively transfer design liability to the design-builder, a DOT must also transfer many of the quality assurance (QA) responsibilities as well. This leads to a concern that the "fox may be guarding the hen house" that ties back to the NSPE statement above. A study by Ernzen and Feeney of the Arizona DOT's DB program (appropriately titled: **"**Contractor-Led Quality Control and Quality Assurance Plus Design-Build: Who Is Watching The Quality?") addressed this concern directly by comparing project QA test data on a DB project where the design-builder had been assigned the responsibility for QA with data from a similar project delivered by traditional means. It found the following:

> *"Analysis of the data shows that despite a highly compressed schedule, the quality of the material on the project exceeded the project specifications*

[16] National Society of Professional Engineers (1995). "Design/Build in the Public Sector," NSPE Board of Directors, Position Statement #1726, http://www.nspe.org/govrel/gr2-ps1726.asp (November 17, 2006).

and was similar to the quality of work completed for the state under traditional contracting methods with an Arizona DOT-operated quality assurance program."[17]

The Arizona DOT study and the numbers cited in the introduction of this Keston Study regarding the growth in DB across the nation effectively belie the theory that implementing DB project delivery will inherently result in decreased construction quality. It is impossible to believe that sophisticated public owners, such as state DOTs, would propagate the spread of a delivery method that consistently resulted in substandard or poor quality product regardless of its ability to expedite project delivery. The FHWA Design-Build Effectiveness Study reports actual results that conclusively confirm this belief as summarized in the following quotation:

"On average, the managers of design-build projects surveyed in the study estimated that design-build project delivery reduced the overall duration of their projects by 14 percent, reduced the total cost of the projects by 3 percent, and maintained the same level of quality as compared to design-bid-build project delivery."[18]

A 2003 study for the National Cooperative Highway Research Program (NCHRP) of the National Research Council's Transportation Research Board recorded the perceptions of state DOT upper managers regarding the benefits experienced from implementing DB:

"With respect to design-build projects, the conventional wisdom among those interviewed was that the dollar cost to the agency appeared to be about the same as conventional approaches, but that design-build projects opened to the public much sooner. Time, of course, is money and therefore this suggests that indeed there is a considerable saving to the public in the form of user cost benefits due to significant schedule accelerations resulting from this outsourcing method."[19]

The same NCHRP study goes on to cite the Maryland Sate Highway Administration's experience with its first ten DB projects where it "reduced the average time for design and construction by approximately one year, as compared to the traditional design-bid-build method. The program has also consistently produced final products with less than 1% in change orders – significantly less than the [DBB] program as a whole."[20] Thus, DB not only appears to improve project delivery time but it enhanced project cost certainty. This tracks with research conducted ten years ago that found that the top two reasons for

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[17] Ernzen, J. and T. Feeney, (2002) **"**Contractor-Led Quality Control and Quality Assurance Plus Design-Build: Who Is Watching The Quality?" Transportation Research Record 1813, Transportation Research Board, Washington, D.C. pp. 253-259.

[18] Federal Highway Administration (2006). "Design-build Effectiveness Study," Final Report to Congress as Required by TEA-21, http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm (August 30, 2006)

[19] Science Applications International Corporation (2003), Outsourcing of State DOT Capital Program Delivery Functions, NCHRP Web Document 59 (Project 20-24[18]): Contractor's Final Report pp. v.

[20] Ibid, p. 10.

public owners selecting DB project delivery were to compress the project schedule and to establish the project cost at an earlier point in time.[21]

Project cost certainty/early cost establishment is very important to public infrastructure projects as it effectively impacts the number of capital projects an agency can award in a given year within its established budget. For instance, an early study of the Florida DOT's first series of DB projects found that these projects were awarded at a 4.5% premium above low bid but only experienced 2% cost growth. Whereas, Florida DOT DBB projects experienced 8.5% cost growth from the low bid award price.[22] Thus, there was a marginal 2% cost savings on the DB projects. More importantly, however, is the effect on the Florida DOT's ability to manage its capital improvements budget. Under the traditional system, it would have to set aside 8.5% of each project's authorized budget to pay for cost growth due to quantity overruns and change orders. Its DB experience would require it to only set aside 2%. Thus, is could award a far greater percentage of its authorized budget which presumably would result in a larger number of total infrastructure projects being built in a given fiscal year and a more efficient use of available capital.[23]

In fact, there have been a number of factors that have driven the increased use of DB to deliver much-needed infrastructure projects. Hancher and Werkmeister cite the growth in U.S. population creating increased travel demand as the root cause for an increased requirement for construction of new infrastructure and reconstruction of aging infrastructure.[24] They go on to argue that the traveling public's demand for "better and quicker service" combined with the overall reduction in DOT workforces in the era of "reinventing government" has pushed public transportation agencies to explore alternatives, and DB is one way that can be accomplished.

The overwhelming momentum of successful applications of DB across the country has shown that detractors of the DB project delivery method for highway projects who voiced their opinions in the early 1990s were unduly pessimistic.. FHWA provided a lengthy and rigorous comment period on its Design-Build Rule Making for TEA-21.[25] The FHWA considered these comments and concerns and then published rules that allow, but do not require, all recipients in the Federal-aid highway program to use the design-build contracting method just as they would the traditional design-bid-build contracting method. The majority of states are now using DB. A number of states have developed large and successful programs, while others are still growing their programs. The

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[21] Songer, A.D. and Molenaar, K.R. (1996). "Selecting Design–Build: Private and Public Sector Owner Attitudes," ASCE Journal of Engineering Management, 12(6), pp. 47–53.

[22] Ellis, R. D., Herbsman, Z. and Kumar, A. (1991). " Evaluation of the FDOT Design/build Program." *Final Report*, Submitted to Florida Department of Transportation, State Project No. 99700-7543-010, Department of Civil Engineering, University of Florida, Gainesville, Florida.

[23] Gransberg, D.D., and M.E. Villarreal, (2002). "Construction Project Performance Metrics" *2002 Transactions*, AACE, International, Portland, Oregon, pp. CSC.02.01-CSC.02.05.

[24] Hancher, D. and Werkmeister, R. (2001). "Innovations in Private Involvement in Project Delivery: Outsourcing," NCHRP Web Document 39 (Project SP20-24[14]): Contractor's Final Report, p.9.

[25] FHWA (2002). FHWA Design-Build Rule, Published in the December 10, 2002 Federal Register, http://www.fhwa.dot.gov/programadmin/contracts/dbfinal.cfm (Viewed December 1, 2006)

benefits of faster delivery and greater cost certainty have been repeatedly validated, while the concerns of lowered quality are inconclusive at best. The next section addresses how the DOT workforce changes relate to DB delivery.

DOT Workforce Background: The National Context

The research literature contains virtually nothing specific regarding the impact of implementing DB on state DOT workforces, but there are several recent studies regarding DOT use of outsourcing. As DB requires some level of design outsourcing to achieve schedule reduction through concurrent design and construction processes, this body of literature can be used to derive some pertinent facts related to answering the research question. NCHRP published studies on this subject in 2001 and 2003. The earlier study outlined the following five benefits and five concerns with outsourcing:

> *"Potential Benefits of Outsourcing:*
> *1. DOTs can provide projects for general public within growing resource constraints.*
> *2. Costs are incurred only when services used.*
> *3. A smaller workforce would be required with peak demands handled by outsourcing.*
> *4. Potential for cost savings to DOT.*
> *5. Access to special private sector skills on as-needed basis.*
>
> *Potential Concerns of Outsourcing:*
> *1. DOTs may have less control on the quality, time and cost of its primary functions.*
> *2. DOTs may lose the skills and expertise to conduct essential functions in-house, or to effectively check, evaluate or approve the work of external sources.*
> *3. Conflict with DOT workforce and possible legal restrictions.*
> *4. DOTs would need new employees with different expertise and management skills.*
> *5. DOTs would have less capacity to serve a traditional role for hiring entry-level engineers to gain competent experience in the road building industry."* [26]

The potential benefits listed above have been confirmed by the literature reviewed for this project. Thus, a review of the literature to determine the validity of the potential concerns is in order. This review was accomplished by looking specifically at DB as the outsourcing mechanism of interest. The results of the FHWA DB effectiveness report contradict the first concern that outsourcing would cause DOTs to lose control over project quality, time and cost. The FHWA study quoted in the Executive Summary of this report showed that after looking at nearly every project that had been delivered using DB under SEP-14, the researchers found just the opposite— DB project delivery on

[26] Hancher, D and R. Werkmeister, (2001). "Innovations in Private Involvement in Project Delivery: Outsourcing," NCHRP Web Document 39 (Project SP20-24[14]): Contractor's Final Report, p.10.

average reduced project delivery time, controlled cost growth after award, and furnished a product of equal quality to projects delivered using traditional project delivery methods.

The remaining four concerns all deal with DOT workforce issues and hence deserve specific attention in this study. Concern 3, conflict with workforce and legal restriction, is the specific motivation for this study. As previously stated, there has been concern in California because DB it is viewed by some as a means to transfer jobs from the public to the private sector. Additionally, as the law currently stands in California, there is no broad legal authority for Caltrans to routinely utilize DB project delivery. The California Public Contract Code Section 10120 states "Before entering into any contract for a project, the department shall prepare full, complete, and accurate plans and specifications and estimates of cost, giving such directions as will enable any competent mechanic or other builder to carry them out." Thus, this concern is certainly valid in California, and as a result will be specifically addressed by this research.

Concerns 2 and 4 revolve around what the literature terms "maintaining and retaining core competencies."[27] Core competencies are "the collective knowledge, skills, and abilities that set the organization apart from others and without which it cannot accomplish its primary mission or business and realize its desired outcomes."[28] The core competencies argument states that DOTs must be able to maintain and retain their core civil engineering competencies in order to adequately serve the mission for which they were established. A study done for the Kentucky Transportation Cabinet put it this way:

> "*If the core competency of an agency cannot be clearly identified and preserved, then the agency is not able to effectively meet the traveling public's needs.*"[29]

Core competencies go beyond merely being able to furnish technical design or construction engineering services with publicly employed professional engineers. It extends to ensuring that the agency has the foundation of professional experience upon which to base sound engineering judgment and be able to authoritatively review the work of outside professionals for technical adequacy. DOTs face two very real challenges in today's environment when it comes to core competency maintenance and retention. The first comes from the higher salaries that private industry offers both entry-level and mid-career professional engineers. The second is a function of an increased workload coupled with legislatively capped workforce strengths.

A bench-marking study on outsourcing done for the FHWA Federal Lands Highway Division surveyed a majority of state DOTs and found that competition with private

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[27] Transportation Research Board (2003). *Workforce Challenge: Recruiting, Training, and Retaining Qualified Workers for Transportation and Transit Agencies*, Special Report 273, Committee on Future Surface Transportation Agency Human Resource Needs, TRB, The National Academies. Washington, D.C., pp.98.

[28] Ibid.

[29] Hancher, D.E., A. Brenneman, R. Meagher, and P.M. Goodrum, (2005). "Outsourcing KyTC Project Delivery Functions," Report KTC-05-12/SPR-282-04-1F, Kentucky Transportation Center, Lexington, Kentucky, p.v.

industry for professional engineers was driving many decisions to contract for professional engineering services. [30] It found that the Arizona DOT was contracting out about thirty percent of its construction engineering and nearly ninety percent of its design work mainly due to a loss in staff to private industry. The Arizona respondent said:

> "*Employees view the level and extent of contracting out as a negative. However, some see contracting out as a place to go in the future. They can learn from the state to be marketable with a consultant. Consultants pay much higher salaries which lures employees away*."[31]

Colorado, Kentucky, Maryland, New Mexico and Tennessee DOTs reported similar issues of competition with industry for experienced engineering personnel. Colorado and Tennessee reported that this competition has become so fierce that in some areas the DOT is left with the least experienced personnel. Maryland reported that it was effectively unable to retain staff beyond five years and that they were losing their best employees to private consultants. It also reported that "85% of the consultants they [the Maryland State Highway Administration] hire have experience working in-house before becoming consultants."[32] More disturbingly, Nevada reported that "maintaining technical expertise [is] viewed as no longer possible" due to pay differences that reach as high as forty percent more that state salaries.[33]

When one combines this pressure with the pressure of the increased workload stimulated by first TEA-21[34] and recently its follow-on legislation SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)[35] DOTs are literally finding themselves having to do more professional engineering work with a less experienced workforce and the core competencies issue becomes even more critical.

At this point, it is important to summarize how DOTs have used the DB process to leverage the benefit and address the concerns of outsourcing. One state has initiated a program to directly address the issues. The Oregon DOT has set deliberate targets for in-house performance of design and construction engineering using traditional DBB project delivery. It also put limits on the number of DB projects it would award in order to maintain its core civil engineering competencies. A 2003 report synopsizes this decision as follows:

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[30] Calderon, E., R. West, T. Jurkofsky, H. Crockett, and D.S. Alexander (2000). "Contracting Out Bench Marking Study" Federal Lands Highway Division, Executive Quality Council Report, Washington, DC, pp 10.
[31] Ibid.
[32] Ibid, p. 66.
[33] Ibid p. 73.
[34] TR. Warne (2003). *State DOT Outsourcing and Private-Sector Utilization A Synthesis of Highway Practice* NCHRP Synthesis 313, Transportation Research Board, The National Academies. Washington, D.C. pp.1-3.
[35] Hanak, E. and K. Rueben, (2006). *Funding Innovations for California Infrastructure: Promises and Pitfalls,* The Keston Institute for Infrastructure Research Paper 06-01, March 20, 2006, University of Southern California, Los Angeles, California, p. 9.

> "*The target for ODOT's Technical Services and Construction Section is to be staffed at a capacity to deliver a $250 million program with 70% permanent staffing and 30% flexible services contracts. ODOT has a capacity to deliver up to 2 projects totaling $40 million per year with design-build contracts. Remaining projects must be delivered using outsourced DBB.*"[36]

South Carolina has initiated a "deliberate program of technology transfer from the design-build contracting teams to the permanent DOT staff…. as one of the requirements of the [DB] contract."[37] This program is designed to ensure that the necessary professional experience is institutionalized for future projects to furnish DOT contract managers with the necessary set of skills and knowledge to authoritatively administer DB projects.

The Washington State DOT states that "fluctuations in revenue streams (initiatives, referendums) have impacted WSDOT's ability to staff and deliver projects efficiently, requiring varying approaches to mitigate impacts,"[38] and an analysis of the North Dakota DOT workforce requirement concluded:

> *"In order to meet the future challenges of doing more with less, an enhanced workplace having individuals with greater technical and judgment skills will be required. Therefore, the level of education and training requirements for entry and advanced levels must be raised commensurate with these growing expectations*."[39]

Thus, it would seem that DOTs across the nation are not only recognizing the issues that have changed the requirements for the state workforce, but are using a multi-pronged approach to meeting these challenges. It can be concluded from the national literature review that DB furnishes both a means to overcome current workforce pressures and a project delivery method that not only saves time, but also preserves quality at a comparable cost to the traditional DBB project delivery method. It also should be noted that those DOTs that have implemented DB project delivery have not abandoned traditional DBB project delivery. Combining the above cited Oregon DOT example with the North Dakota DOT conclusion, to be successful in all venues the state professional engineering workforce must have a place where it can gain the experience necessary to

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[36] Rogge, D.F., T. Carbonell and R. Hinrichsen (2003) Evaluation of Oregon Department of Transportation Project Delivery- Outsourcing Project Delivery in State Departments of Transportation, Oregon Department of Transportation Research Report FHWA-OR-RD-04-07, Salem Oregon, p. 8.

[37] Science Applications International Corporation (2003), Outsourcing of State DOT Capital Program Delivery Functions, NCHRP Web Document 59 (Project 20-24[18]): Contractor's Final Report p. 15.

[38] MacDonald, D.B., P. Hammond, and J. Conrad (2005) WSDOT GMAP Report Highway Project Delivery, http://www.governor.wa.gov/gmap/forums/WSDOT_GMAP_Final_10-20-05.ppt (September16, 2006)

[39] Kalnbach L. (2004) *NDDOT Workforce Analysis: A Necessary Step in Creating An Effective Strategic Human Capital Plan, Research Report,* Upper Great Plains Transportation Institute, North Dakota State University, Fargo, North Dakota, pp. iii.

properly oversee project delivery and that place is through continued delivery of a portion of the capital improvement program using DBB.

Design-Build Background: The California Context

The attorney W. Samuel Niece presented a paper which elegantly sets the foundation for this discussion. In it, he states:

> "*California public contract law historically has been hostile to design-build. More than 100 years ago in Ertle v. Leary, 114 Cal. 238 (1896) (the Placer County jail case), the California Supreme Court rejected design-build.*"[40]

This environment has not improved much in the past century. Concern over the potential loss of public engineering jobs to private industry has retarded most efforts to authorize alternative project delivery methods for California infrastructure projects. One example of these restrictions was a State Court decision which limited Caltrans' outsourcing authority to only contracting out for engineering design services for environmental activities and specialty work such as seismic retrofit designs for bridges.[41]

In 2003, the Public Policy Institute of California published a report on the status of California's infrastructure construction and maintenance systems.[42] One of its conclusions dealt with the need to expedite project delivery in the state. It reported its finding as follows:

> *"Our review of the delivery of infrastructure capital projects turned up a number of problem areas and issues. In the case of transportation projects, Caltrans' process is cumbersome and time-consuming. …. In the case of Caltrans, there has been a reluctance to partner with the private sector. Unlike many other state departments of transportation, Caltrans has refused to contract out planning, design, and management work. As a result, projects take from 7 to 23 years to complete.*"[43]

The report goes on to quantify the need in the following terms:

> *"Between 1988 and 1998, VMT [vehicles miles traveled, i.e. traffic] increased by 21 percent overall and by 30 percent in urban areas. During the same period, however, California expanded its roadway system by less*

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[40] Niece, W.S. (2004). "Design-Build Contracts as an Alternative Method for Public Construction by California Cities."
http://www.constructionweblinks.com/Resources/Industry_Reports__Newsletters/Aug_30_2004/desi.html (November 26, 2006)

[41] Calderon, E., R. West, T. Jurkofsky, H. Crockett, and D.S. Alexander (2000). "Contracting Out Bench Marking Study" Federal Lands Highway Division, Executive Quality Council Report, Washington, DC, p.1.

[42] Dowall, D.E. and J. Whittington, (2003). Making Room for the Future : Rebuilding California's Infrastructure, Public Policy Institute of California, San Francisco, California, pp

[43] Ibid p. viii.

than 1 percent. Since 1990, the state has added only 70 new miles of highway, amounting to 1,300 lane miles of new capacity. The imbalance between the supply of and demand for roads has more than doubled the number of vehicle hours of delay on urban highways from 197,000 hours per day in 1988 to 418,000 hours in 1998. According to Caltrans, the economic costs of these delays are substantial—$7.8 million per day and $2.8 billion per year in lost time and added fuel costs".[44]

Thus, there is a well-documented need for providing Caltrans the project delivery tools that it needs to expedite transportation infrastructure projects of all types. An earlier report by the same institute reviewed California's experience with DB contracting in the building construction area by the Department of General Services and found that "[w]hen done properly, design-build reduces project costs and schedules by removing an entire bid cycle from the development process." [45]

Thus, California has found itself in need of means to expedite the delivery of much needed transportation infrastructure. In fact as previously stated, there have been successful examples of DB transportation project delivery in the state. Most notable perhaps is the Alameda Corridor project. A review by the Inspector General of the US Department of Transportation found that not only was this project proceeding on schedule but also that cost growth was only on the order of 3.7% and that "this large contract is likely to remain close to the awarded cost... This translates to an expectation that cost growth using design-build will be significantly less than using traditional contracting methods."[46]

Cost growth in California construction projects does not only occur during construction. A major issue was identified by the US General Accounting Office where its auditors found that "costs increase during the design process as preliminary design concepts are refined into detailed plans and specifications…. Projects may also be "stretched out" to accommodate federal and state funding cycles, thus increasing costs if for no other reason than the effects of inflation."[47] Thus, it is in the California taxpayers' best interest to establish the cost of design and construction as early as possible, and DB furnishes a mechanism where the cost risk for cost growth during design and for inflation of labor and material pricing is effectively transferred to the design-builder at a point before final design is complete.

As previously mentioned, the Alameda Corridor Project has shown that DB can be successfully used in California. Additionally, a $122 million project to upgrade the Los Angeles International Airport (LAX), called the Gateway LAX project also was

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[44] Ibid p. 129.
[45] Neuman, M.and J. Whittington, (2000). "Building California's Future: Current Conditions in Infrastructure Planning, Budgeting, and Financing," Public Policy Institute of California, San Francisco, California, p.85.
[46] Stefani, A.M. (2000). "Report on Review of the Alameda Corridor Project," US DOT Inspector General Report No. TR-2000-004, Washington, DC, p. iv.
[47] US General Accounting Office (1997). "*Transportation Infrastructure, Managing the Costs of Highway Projects*" GAO Report RCED-97-47, Washington DC, pp. 4-5.

undertaken in 1999 using DB.[48] Caltrans has been peripherally involved in a number of DB projects that it is supervising for various metropolitan transportation authorities. Three of the more recent projects are State Roads 22, 73 and 91. This exposure led Caltrans to seek training for its own employees in August of 2006 to prepare them to participate in a project to add a High Occupancy Vehicle lane on Interstate 405 in Los Angeles per California Senate Bill 1026.[49]

In light of the above discussion, the California context for this research can be simply stated. There are many good reasons to add DB to the project delivery toolbox for Caltrans and experience in California has shown that it can be implemented successfully. Therefore, the major barrier to widespread implementation of DB in California appears to be negative impacts on the public workforce through loss of jobs to the private sector.

The remainder of this report is directed to recording the impact to the professional engineering workforce in other states that have implemented DB project delivery as measured by the several research instruments used in this study.

Impact of Design-Build on State DOT Workforces (General Survey)

A questionnaire (see Appendix A) was developed and the response to the questionnaire in a variety of forms is presented in Table 1.

Table 1. Summary of Questionnaire Responses

Data Type	Number
SEP 14 DB Agencies	34
Total General Survey & Interview Responses	34
Structured Interviews: Agencies with DB Experience	9
General Survey Response: Agencies with DB Experience	16
General Survey Response: Agencies without DB Experience	9
Non-responding Agencies with DB Experience	9
Non-responding Agencies without DB Experience	9
Perceptions Survey Response States (23 total responses)	15
Agencies covered by DB RFP Content Analysis	23
Total Agencies Covered by Data (50 states + DC & Virgin Islands)	41 of 52 = 79%
Total Agencies with DB Experience Covered by Data	30 of 34 = 88%

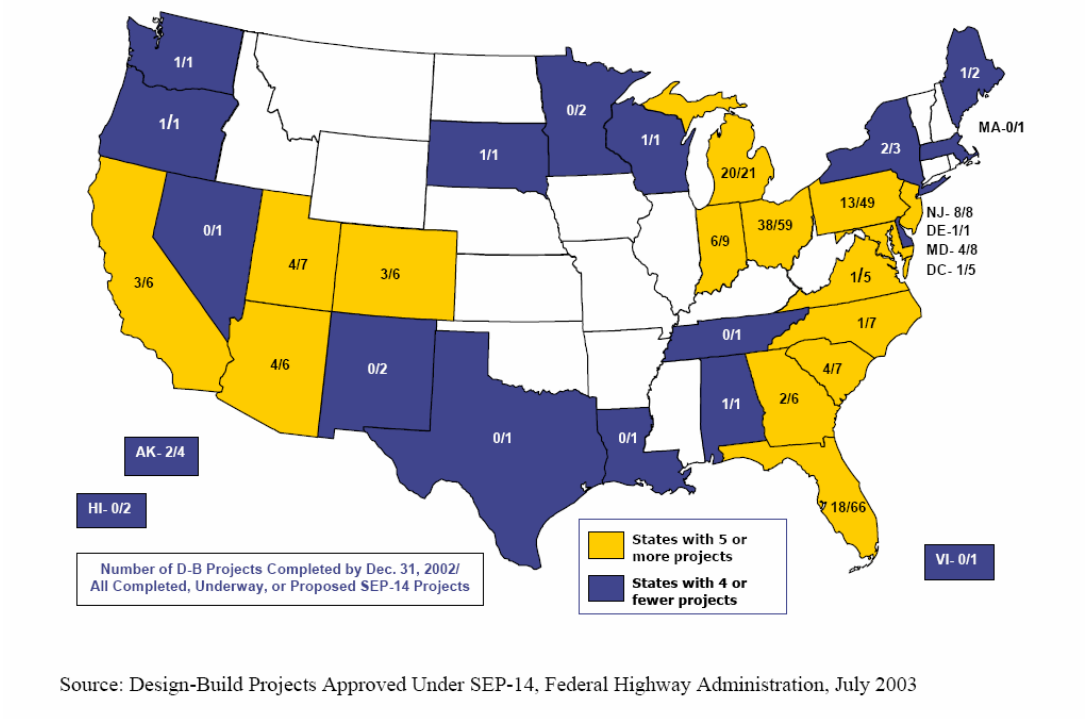
NOTE: See Appendix C for summary of details on data in this table.

Structured telephone interviews were conducted with upper management DOT officials in Florida, Maryland, Minnesota, North Carolina, Ohio, Oregon, Utah, and Virginia. These states were selected because each had significant experience with DB project

[48] Moore, A.T., G.F. Segal, and J. McCormally (2000). "Infrastructure Outsourcing: Leveraging Concrete, Steel, and Asphalt with Public-Private Partnerships," Policy Study No. 272, Reason Public Policy Institute, Los Angeles, California, p. 8

[49] State of California (2006). Senate Bill 1026, An act to add and repeal Article 6.9 (commencing with Section 20209.20) of Chapter 1 of Part 3 of Division 2 of the Public Contract Code, pp, 1-8.

delivery. Montana was also interviewed to capture the experience of a state that had implemented DB after the SEP-14 program was over and determine if there were any differences between states that were new to DB and those that had a mature DB program. Additionally, the same questionnaire was uploaded on a commercial Internet survey website and emails were sent to the thirty-two states shown in Figure 2 that had DB projects approved under SEP-14 as well as to other states that the authors believed to have implemented DB since the FHWA study had been completed. A total of twenty-eight responses were received including those states that completed the survey via the structured interview. Three of the responses indicated that the state did not have sufficient experience to complete the survey.[50] It should also be noted that the response from California was from a toll road authority and the response from Mississippi is from the federal agency that is responsible for transportation projects on federal lands. Also two responses were received from Maine of which one was a toll road authority and the other was the DOT. The response from Nevada referred to an ongoing project that will be awarded in 2007. Finally, seventeen state DOTs have not implemented DB.[51]



Source: Design-Build Projects Approved Under SEP-14, Federal Highway Administration, July 2003

Figure 2: SEP-14 DB Project Approvals Across the United States.[52]

[50] New York's SEP-14 projects were not completed by the New York State DOT. The New York City DOT was the sponsor that applied for SEP-14 authority. The Tennessee SEP-14 project also was not delivered by the state DOT. It was an Intelligent Transportation System project built for the Nashville and Davidson County Metropolitan Transportation Authority. Finally, Oklahoma clarified a misconception that the emergency reconstruction of the Arkansas River Bridge on I-40 in 2004 was not delivered using DB.

[51] Alabama, Arkansas, Connecticut, Idaho, Illinois, Iowa, Mississippi, Nebraska, New Hampshire, New York, North Dakota, Oklahoma, Rhode Island, Tennessee, Vermont, West Virginia, and Wyoming.

[52] Federal Highway Administration (2006). "Design-build Effectiveness Study," Final Report to Congress as Required by TEA-21, http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm (August 30, 2006).

Figure 3 shows the geographic distribution of responses received and the amount of DB experience each state DOT has. It can be seen that not only are the responses well-distributed across the nation, but all the West Coast states are represented. Additionally, seven states indicated that they have completed more than 10 DB projects, which allows us to better determine the impact on the workforce over time. Of those, Florida has included DB project delivery in its program since 1989 and the states of Maine, Michigan, Minnesota, South Carolina, and Utah, as well as the toll road respondent in California, have over 10 years of experience with the project delivery method and therefore presumably can furnish a reliable picture of the long-term changes to an agency's workforce when it implements DB contracting. Adding the twenty-four responses (note Maine had two responses) from states with DB experience to the seventeen states that did not respond but have no DB experience accounts for forty-one of the fifty states, and certainly makes the findings of this study, and the conclusions drawn from them, representative of the national trend.

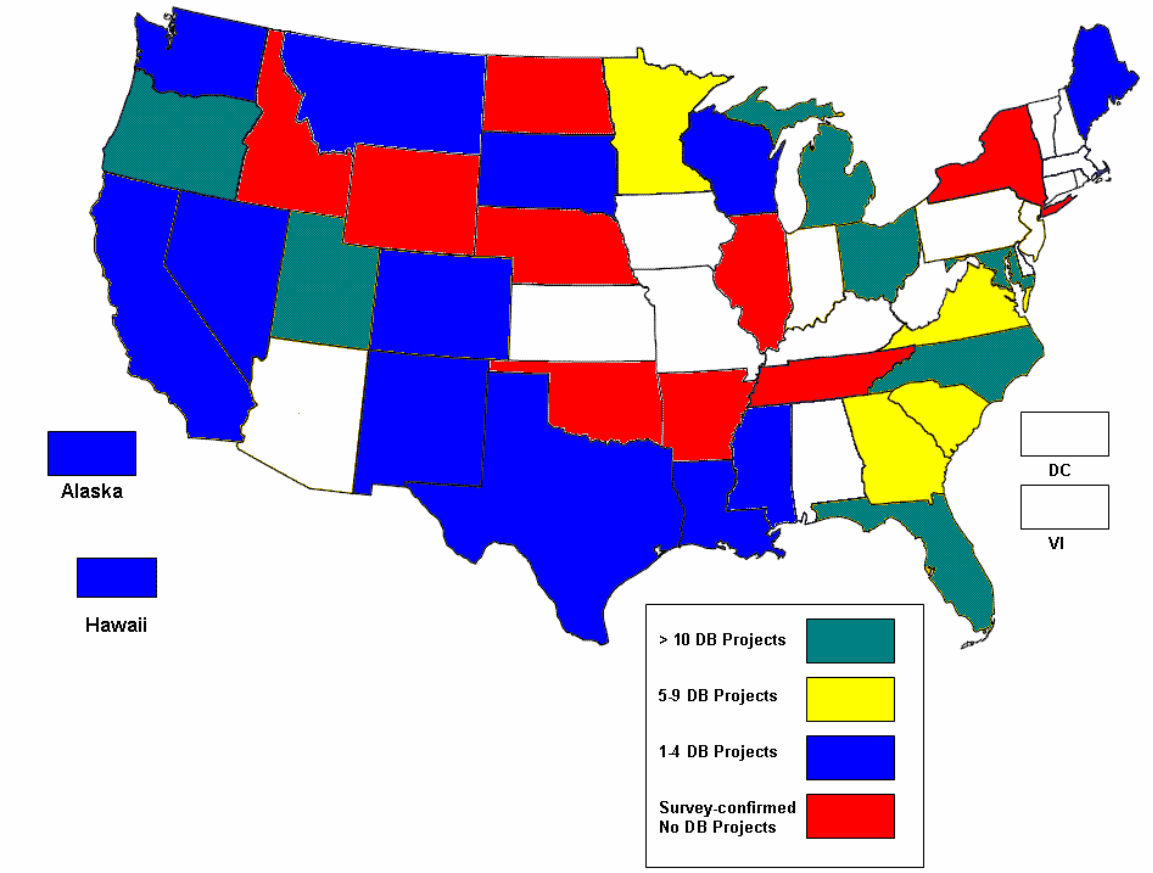


Figure 3: Geographic Distribution of General Survey Responses.

Based on the information contained in the questionnaire, the analysis of trends focused on three specific areas. First, the responses regarding the proportion of DB projects to the agencies total construction program will be addressed. Next, the changes in the numbers of professional engineers on an agency's staff will be analyzed. Finally, the changes in the roles that the professional engineers on an agency's staff will be discussed.

Changes to DOT Construction Programs After Implementing Design-Build

The questionnaire and interview asked the respondents to gauge the impact of implementing DB on their overall program of design and construction. The question was asked in two ways. First, they were asked to select a percentage range on a basis of the total number of projects awarded each year. Next, they were asked the same question but as a percentage of their total construction budget each year. This differentiation was deliberate and is used as a means to identify if an agency has awarded a DB mega-project but done very little else in the way of implementing DB. The other purpose of the two questions was to see if DOTs who implement DB essentially stop using or trend towards using less DBB project delivery. *This question, i.e. the concern that DB will become the dominant project delivery method, appears to be unfounded as ninety-three percent of respondents reported that DB projects make up less than ten percent of their total program*. Additionally, ninety-two percent also indicated that DB projects constituted less than twenty-five percent of their construction budget. In fact, seventy-three percent reported that their DB program was less than ten percent of their total construction budget. Only two respondents, the Alameda Corridor in California and the E-470 Toll Road Agency in Colorado, indicated that DB projects made up more than fifty percent of their budget and this makes sense as both toll agencies were created to furnish transportation projects via DB contracting.

Changes to DOT Professional Engineering Workforce Size After Implementing Design-Build

There were a series of questions that explored workforce changes related to implementing DB project delivery and the reasons for those changes. Agencies were asked to cite the number of professional engineers in their workforce before implementing DB and currently. Five states indicated that their professional engineering workforce had increased since implementing DB. Those states were Maryland, Michigan, Texas, Utah, and Virginia. Texas which has a construction program and population that is comparable to California added 178 new engineers since implementing DB in 2002. Virginia nearly tripled its professional engineering workforce from 100 to 271 since it implemented DB in 1998. Maryland, Michigan and Utah increased their professional engineering workforces by more than ten percent. Three states, Florida, Hawaii, and Wisconsin reported a drop in their workforce. Florida cited a change in legislative authorization (i.e. the "reinventing governments" initiative) that forced them to reduce the size of their workforce. Hawaii cited that their drop was due to engineers leaving state government for industry and the DOT being unable to fill vacant authorized positions, and Wisconsin cited an agency budget decrease as the reason for the change in strength. All other respondents reported no change. *Therefore, eighty-six percent of the respondents report that their professional workforce either remained same or increased in size.*

Two of the structured interviewees indicated that their agency had converted a number of non-professional technician spaces to professional engineer spaces because they felt that DB project delivery required a more highly-qualified agency oversight person to deal with the types of problems that occurred on the compressed timelines of DB projects. The Utah respondent stated that DB project administration was more complicated and required his personnel to "use more engineering judgment." North Carolina created a

special section to manage DB projects, and Montana hired an engineer with DB experience to lead their pilot program. Virginia stated that they assigned their "most competent staff" to DB project administration duties.

Next, the respondents were specifically asked if they had reduced the number of professional engineers in their workforce as a result of implementing DB. *All answered "No" to that question.* The respondents were also asked if their agency used DB as a means to augment its existing workforce, one of the benefits touted in the literature. Only five answered this question in the affirmative. The data from this report show that DB is not causing agencies to reduce their workforce.

Changes to DOT Professional Engineering Workforce Roles After Implementing Design-Build

The final portion of the questionnaire sought to identify any changes in the roles agency professional engineers play as a result of implementing DB. Obviously the first issue must deal with design responsibilities. Theoretically, a state could contract one hundred percent of the design effort out to the design-builder with a well-articulated set of performance specifications. However, that doesn't occur because state DOTs normally have to advance the design to the point where right-of-way requirements are identified and environmental clearances can be obtained to avoid a potential delay in the DB contract due to these causes. Since 2003, the FHWA's Design-Build Contracting Final Rule stipulates that the NEPA environmental clearance process be completed before the release of the final DB RFP.[53] Thus, the agency must necessarily be involved with a substantial amount of pre-advertising design and engineering effort even if it is using DB project delivery. In fact a recent study at the University of Colorado found that public agencies were investing in the development of a large amount of detailed design and design criteria as a means to reduce the performance risk on large DB projects.[54]

The questionnaire sought to verify this fact by asking the level of design development that was portrayed in the DB procurement documents (RFQ and RFP). Eighty-eight percent of the respondents indicated that they advanced the design to a range of ten to thirty percent and an additional eight percent carried it to a level between thirty-one and fifty percent. Only one response indicated a level of less than ten percent design development. These findings track well with the FHWA DB Effectiveness study which reported an average design development level of thirty-seven percent for over three hundred DB projects in that study.[55]

The questionnaire then asked who performed the preliminary design that was used to develop the DB solicitation documents. In most cases, it was a combination of agency design engineers and engineering consultants. It would be logical for agencies that are new to DB to hire experienced consultants to assist them in the process. Thus, the next

[53] Federal Highway Administration (2002). "Design-Build Contracting: Final Rule," Federal Register, December 10, 2002, Volume 67, No. 237, pages 75902 – 75935.
[54] Molenaar, K.R., (2005). "Programmatic Cost Risk Analysis for Highway Megaprojects," Journal of Construction Engineering and Management, ASCE Vol. 131(3), pp 343-353.
[55] Federal Highway Administration (2006). "Design-build Effectiveness Study," Final Report, http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm (August 30, 2006). p. viii.

question asked if the consultants were hired specifically for DB projects, and none of the respondents answered "Yes" to that question. In clarification discussions during the structured interviews, every interviewee indicated that the consultants that were used to help prepare DB project procurement documents were the same ones that the agency used to complete design for traditional DBB projects. *Thus, it can be inferred that implementing DB had no effect on these agencies' level of outsourcing for design services.*

The next series of questions sought to determine what roles were retained by the agency during DB project execution. Ninety-two percent of the respondents utilized agency design engineers to review and approve the design-builders' design deliverables. They were often assisted by agency construction engineers and general engineering consultants. All of the responses indicated that some or all aspects of construction inspection (e.g., quality control inspection, quality assurance inspection, acceptance inspection, and independent quality assurance inspection) were retained and conducted by agency construction engineers who were assisted by agency design engineers and general engineering consultants. Finally, ninety-six percent of the respondents indicated that agency construction engineers were responsible for quality assurance activities assisted by agency design engineers and general engineering consultants as required. *Thus, by and large, the traditional design and construction engineering tasks performed by public agency professional engineers were carried over into the DB project.*

The final section of the questionnaire specifically asked the respondents to identify the changes that resulted from implementing DB project delivery. Over sixty per cent of the respondents indicated that both the design staff and construction staff shifted from full-time traditional tasks to oversight of the design-builders' design and construction tasks. In most cases the workload stayed roughly the same or increased. This differs from the expectation reported in the literature that DB will ultimately reduce the workload for the owner's staff. Finally, when asked to select from a list of statements that summarized DB's overall impact on the agency's professional engineering workforce, the most popular response indicated that "DB changed the roles agency engineers play without changing their workload." The next most popular response was that "DB changed the roles and increased the workload."

Perceptions of the Impact of Design-Build on State DOT Workforces

In public policy, perceptions are often of equal importance to facts. Legislative action is heavily influenced by perceptions, and as previously discussed implementation of DB for public infrastructure projects has had to overcome the perceptions that DB project delivery would result in an inherently poor quality and possibly unsafe final product because the designer's fiduciary loyalty has been moved to the builder's team. One report on DB implementation classifies perceptions as "barriers to broad acceptance."[56] An interesting discussion of the issue of perceptions creating a barrier to implementing

[56] Byrd, L. G. and A.A. Grant, (1993). "Prerequisites for a Successful Design/Build/Warranty Highway Construction Contract," A Report to the U.S. Department of Transportation, Federal Highway Administration, Washington, D. C. http://www.fhwa.dot.gov/programadmin/contracts/byrd.cfm (February 4, 2007).

DB was published in 2005. While it is specifically directed at architectural projects, its content applies directly to infrastructure. The article states that "architects have groomed a cultural perception that builders can't be trusted" and as a result participating in a DB project must be unethical. The author goes on to state: "That perception [that DB is unethical] subsequently contributed to many bidding and contracting laws that made design-build cumbersome or impossible in the U.S."[57] This perception is contradicted by the legislation that specifically authorizes the use of DB on all types of projects across the country. Nevertheless, the perception is stubbornly persistent. Thus, this research study has measured the perception of DB's impact on the public professional engineering workforce and compared it to the facts obtained in the general survey. In this manner, the potential divisive influence of persistent anti-DB perceptions can be potentially identified.

To accomplish this purpose, a short survey (See Appendix B for details) was distributed to the Transportation Research Board's Design-Build Task Force at its 2007 meeting in Washington DC. The task force is made up of both public agency and private industry professionals with an interest in the subject. Not all have DB experience. Many choose to join the task force for its value as a training and informational resource for DOT members who anticipate using DB in the future. Additionally, the meetings are open to the public and are well attended by non-members with similar interests. The meetings are lively and decidedly open to opinions from all sides of the DB issue. Thus, it is excellent forum to capture the perceptional input that this study requires. Thirty-two surveys were issued and twenty-three responses were received for a seventy-two percent response rate. The responses come from individuals working for both private and public organizations in seventeen states. Figure 4 shows the distribution of those responses and highlights those that are from states that also returned general surveys. When one correlates these responses with the SEP-14 data, it is found that only three responses are from states with no DB experience: Iowa, Illinois, and Oklahoma.

When asked for their perception of whether DB caused the public agency in its state to reduce the number of professional engineers on its staff, two responded in the affirmative and interestingly, one of those two was a public employee in Colorado, a state that answered negatively to the same question in the general survey that was sent to the targeted population with DB experience. Next, the question was rephrased to specifically ask whether the respondent felt that implementing DB "should" change the requirement for professional engineers in an agency's workforce. This elicited a very interesting set of perceptions. The most popular answer (43.5%) was that there would be no change. However, the next most popular answer was that the requirement would be reduced (34.8%). The remaining respondents felt that the agency would need to increase the number of professional engineers on their staff to implement DB. When only the public employee responses are considered, the population is split evenly between needing fewer professional engineers and no change in the requirement. Thus, it becomes very clear that

[57] Nicholson, T. (2005). "AIA Teaching Architects to Lead Design-Build Teams," Design-Build Magazine, McGraw-Hill Construction, http://designbuild.construction.com/features/archive/2005/0506_feature2.asp (February 4, 2007).

there is definitely a disconnect between the perception of the requirement and the factual data reported by public transportation agencies with DB experience.

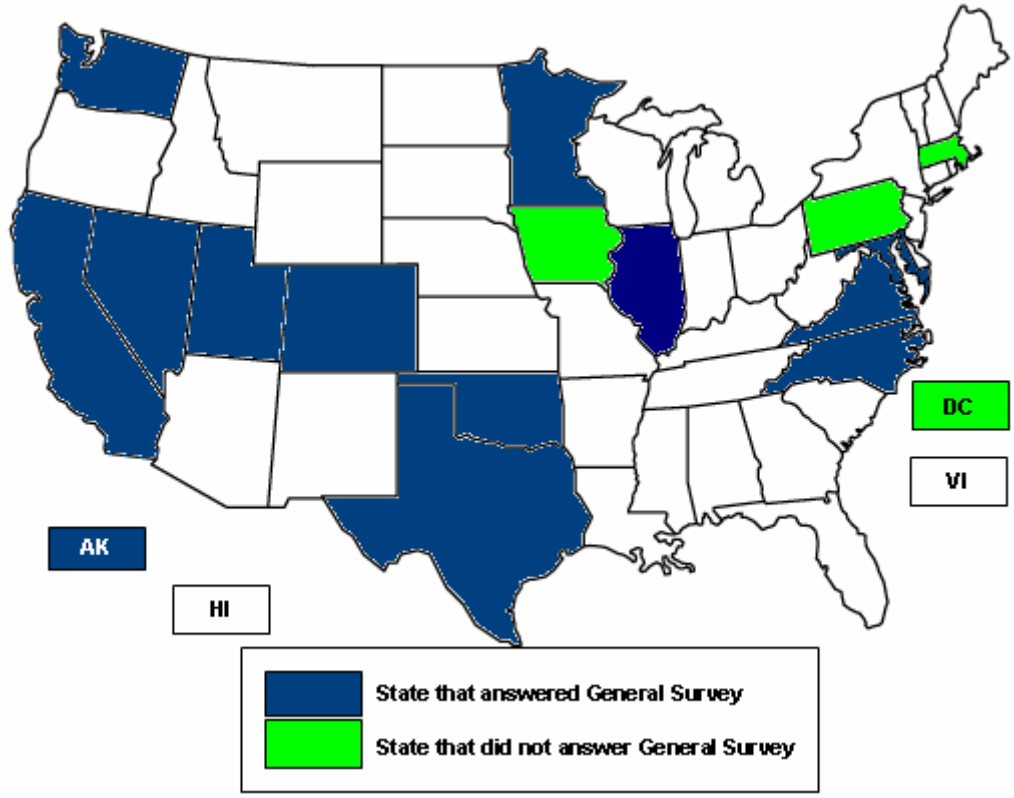


Figure 4: Geographic Distribution of Perception Survey Responses.

None of the public employees thought that agencies would see the increase in its professional engineering workforce that was reported by twenty percent of the general survey respondents. Additionally, sixty-five percent of the general survey respondents reported no change in their workforce after implementing DB. *Thus, the perceptional concern that DB will shift jobs from the public to the private sector is validated by the perceptions survey but refuted by the general survey of actual experience.* From this the inference can be made that the perception that DB will create public sector engineering job loss is indeed a barrier to implementation.

The next perception issue addressed in this survey dealt with the expectations for change in the roles of agency professional engineers. Only twenty percent of the respondents expected no change. Nearly two-thirds indicated that they thought that agency design engineers would do less traditional design work and that agency construction engineers would do less traditional construction engineering tasks. These would be replaced by oversight of the design-builders' workforce. When the responses were broken out by group, a great disparity between the perceptions of the private industry respondents and the public agency respondents was observed. The majority (70%) of private practitioners expected that the roles of public engineers would change as described in the question. Whereas, the public respondents where equally divided with the same number expecting a role change as the number that did not expect a change in engineering roles. This

indicates confusion among the public employees versus a pretty clear set of expectations among the private practitioners. This disparity indicates that the perception that the public engineering workforce will undergo a change in its traditional role and contributes to the concern that the ultimate impact of implementing DB will be detrimental to the public professional engineering workforce.

The final two questions of the survey addressed the issue of DB quality discussed in the opening paragraph of this section. These were designed to assess the perception regarding quality: the concern that the change in the designer's role from working for the owner to working for the builder would degrade the ultimate quality of the constructed project. The fourth survey question asked the respondents to reveal their impression of the impact of DB project delivery on project quality. Interestingly, over seventy percent indicated that DB quality was either better or equal to the quality of traditionally delivered projects. Only one respondent indicated that the quality would be worse, and four had no opinion. Breaking out the responses by group, the public employees were evenly divided between better, no change and don't know. The eighty-five percent of private practitioners indicated it was better or equal. Again, there is a disparity between the two groups with the public employees showing no trend and the private practitioners indicating substantial confidence in the delivery method.

The final question asked who should be assigned the majority of the responsibility for quality assurance (QA) in a DB project. The results showed that nearly half the respondents felt that this essential task should be shared between the agency and its design-builder. The trend remained the same when the results were split out between the two groups. Obviously, the public agency engineers in this sample understood the dynamics of DB QA in the same manner as their private industry counterparts.

Given the above discussion, it can be concluded that perceptions will probably remain a barrier to DB implementation. Public agency engineers believe that their roles will change and are unsure of the impact on the quality of their most important deliverable: the constructed infrastructure project. Some see implementing DB as potentially reducing the need for public agency professional engineers. So given this issue, it leads us to the final component of the research, analyzing what public agencies tell us about the impact to their professional engineering workforce through the division of responsibilities articulated in their DB procurement documents.

Design-Build Request for Proposal Content Analysis

DB RFPs articulate their owners' intentions for how a DB project will be administered. Obviously, the average DOT can choose to either outsource all the project administration, retain all the project administration, or allocate those responsibilities between itself and the design-builder. To the discerning reader, a DB RFP's content furnishes a means to determine the level of effort required by a DOT's workforce. The value of this content analysis approach has been proven by previous DB research[58] and that approach was replicated for this study.

[58] Gransberg, D.D. and K.R. Molenaar,(2004). "Analysis of Owner's Design and Construction Quality

Nowhere is the requirement for professional engineering workforce involvement more clearly identified than in the DB project's contract clauses on quality management. Quality management, a totality of quality control (QC) and QA requirements, is the mechanism through which the public infrastructure owner interfaces with its design-builder and assesses the success or failure of the project's constructed product. It is in this system where the need for an experienced professional engineering workforce is probably most critical. Therefore, this study chose to conduct a formal content analysis as described by Neuendorf [59] on 60 typical transportation DB RFPs from twenty-three states. Sixteen were road projects, twenty-two were bridge projects, thirteen were combined road and bridge projects and the remainder were projects, like tunnels, rest areas, etc. The RFPs were published in the period 1991 to 2006 with the majority being for projects awarded in 2000 or later. Thus, the sample is both well-rounded with regard to project type and timely, illustrating current DB practice.

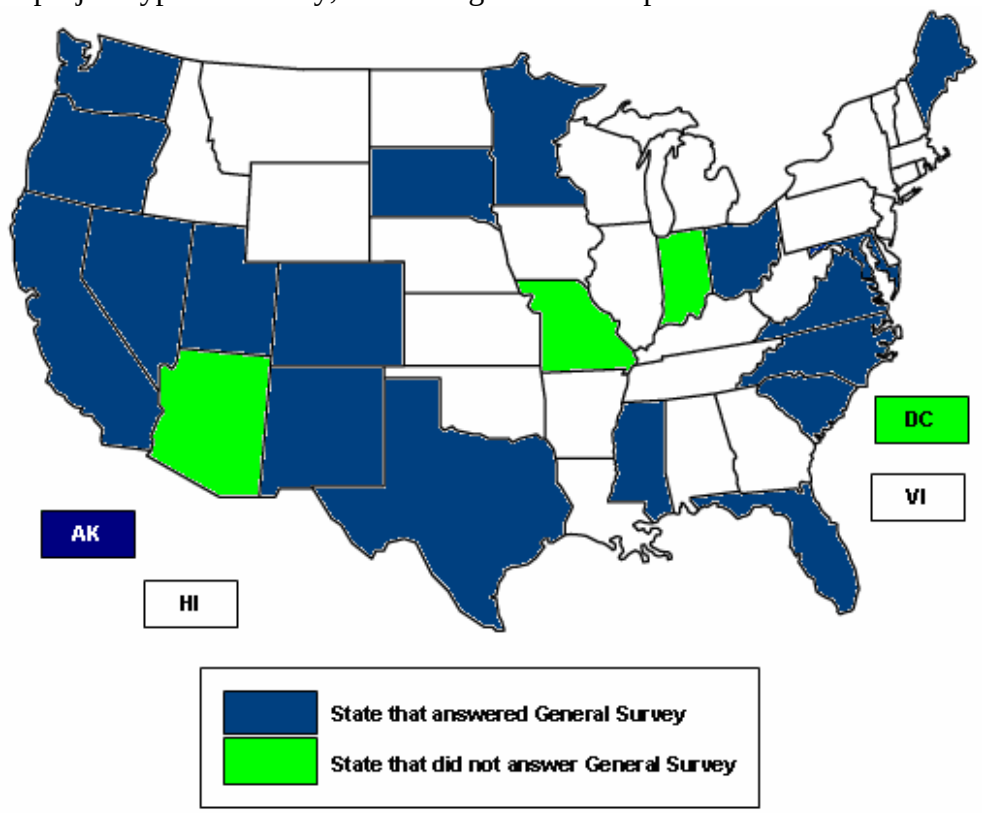


Figure 5: Geographic Distribution of Design-build Requests for Proposals Analyzed in this Study.

Figure 5 shows the geographic distribution of the states that published the RFPs in the sample population. It also shows a direct comparison between RFPs and responses to the general survey. In doing so, one can assess what the survey respondents believe is happening in their state with regard to quality management against what they are

Management Approaches in Design-Build Projects" *Journal of Management in Engineering*, ASCE, Vol. 20 (4), pp. 162-169.

[59] Neuendorf, K.A. (2002). The Content Analysis Guidebook, Sage Publications, Thousand Oaks.

contractually mandating through their RFP language. The sample population of RFPs correlates very closely to the responses received in the general survey. Only five RFPs came from states that did not respond to the survey. Therefore the output of this analysis is very authoritative.

The previously cited DB RFP research developed six general approaches to articulating the owner's DB quality requirements. Building on this foundation, the content analysis first sought to categorize each RFP within that framework. The DB quality approaches are listed below with their definitions:

- *"Quality by Qualifications*: The RFP was either vague or silent on specific requirements for a DB quality management program. However, it contained language in the requirements for past performance and/or personnel qualifications that indicated that the owner was concerned about the qualifications of the DB team. As it is incomprehensible that any owner would award a multimillion-dollar project without a concern for its quality, it was concluded that the owner believed that awarding to a highly qualified and experienced team would ensure the project's quality requirements.
- *Quality by Evaluated Program*: The RFP required the Design-builder to submit its proposed quality management program in the proposal and the owner would then evaluate and rate it. The submitted quality management program was not restricted in any way.
- *Quality by Specified Program*: The RFP required the Design-builder to submit a proposed quality management program in the proposal that complied with an owner-specified program. The owner would then check the proposed quality management program and determine if it was responsive to the specified program.
- *Quality by Performance Criteria*: The RFP required the Design-builder to submit proposed technical solutions that were responsive to owner-furnished technical performance criteria. The owner would then evaluate each proposed solution and rate it. The performance criteria were open-ended and permitted more than one possible alternative to satisfy a given criterion.
- *Quality by Specification*: The RFP required the Design-builder to submit proposed technical solutions that were responsive to the owner's prescriptive technical specifications. The owner would then check the proposed solutions and determine if they were responsive to the specifications. The specifications were generally closed and permitted only one possible alternative to satisfy a given specification.
- *Quality by Warranty*: This category was for those RFPs in which the issue of quality was not addressed in any specific form but that had a requirement for some type of performance warranty or maintenance bond. One of these projects required the Design-builder to operate and maintain the facility for a specified period after construction was complete."[60]

[60] Ibid.

Table 2 shows the results of the first content analysis. One can see that the large majority selected the "Quality by Qualifications" approach to articulating the requirement for quality management. This could be interpreted in two ways. First, it might indicate that public infrastructure owners see the prequalification process that is inherent to DB contracting as a risk management tool that significantly reduces the potential that an incompetent design-build team will be awarded a DB contract. Thus, by awarding to a highly qualified DB team, the owner believes that the quality will be brought to the project's design and construction deliverables without the need to specify a given quality management program. On the other hand, it could indicate that the owners in this sample are confused by the relatively new procurement process and as a result, have not had the series of experiences that would cause them to place constraints and restrictions on the DB quality management system on their projects. When one compares Figure 5 with Figure 3, thirty-seven out of the sixty RFPs came from states with more than five projects and twenty-three RFPs came from states with more that ten previous DB projects. In fact, North Carolina is the only state with more than ten projects worth of experience that did not use quality by qualifications in its RFPs. So that would serve to reject the second explanation of confusion due to lack of experience. This in fact is something of an endorsement for the faith that experienced DOTs are able to place in the process by which they select their design-builders.

Table 2: DB RFP Content Analysis Quality Approach Category Results.

Quality Approach Category	**Number of RFPs**
Quality by Qualifications	33
Quality by Specified Program	14
Quality by Evaluated Program	8
Quality by Performance Criteria	3
Quality by Specification	1
Quality by Warranty	1

The second most prevalent approach was "Quality by Specified Program." This was the approach used in North Carolina and eight of the fourteen RFPs that used this approach came from that state. It was interesting that only one RFP used "Quality by Specification." This approach would typically demonstrate an owner that is unwilling to give up control over the details of design to the design-builder. Finally, only one RFP used "Quality by Warranty," which is arguably the most comprehensive approach in that it extends the quality management process beyond construction completion.

The second portion of the RFP content analysis was to review the details of the RFP and determine the public professional design and construction engineering workforce requirements by determining the allocation of responsibility for QA and QC tasks. Specifically it looked for the assignment of verification and acceptance testing tasks. In this analysis, there were three possible entities that could be involved in the process: the DOTs professional engineering workforce, the design-builder's personnel, and a third party such as a general engineering consultant or independent quality control firm hired by either the DOT or the design-builder. Table 3 displays that in over half the cases, the DOT retained the responsibility for design and construction QA and QC. Additionally, it was impossible to discern the allocation of these responsibilities in twenty-three out of sixty RFPs. Thus, in only three RFPs did the DOT choose to outsource the quality management tasks. *Therefore, it can be inferred from this analysis that it is highly unlikely that implementing DB will create an environment where a public transportation agency would become so comfortable with the DB process that it would not need to retain its qualified and technically competent professional engineering workforce to perform the quality management tasks.* This finding tracks with both the responses to the general survey that found implementing DB requires a more qualified and experienced workforce than the traditional process and also the perceptions survey that found that quality management responsibilities should be shared between the design-builder and the owner.

Table 3: Design-Build RFP Quality Management Responsibilities

Responsible Party	**Number of RFPs**
DOT only	31
Design-builder only	2
DOT and 3rd party	2
DOT and Design-builder	1
Design-builder and 3rd party	1
Could not tell from the RFP	23

Conclusions

With the DB experience of forty-one of fifty states plus the District of Columbia and the U.S. Virgin Islands accounted for in this study, a number of authoritative conclusions can be drawn. These are listed as follows:

1. Design-build is a tried and tested project delivery tool at the national level for highways and infrastructure. The benefits of faster project delivery, increased cost certainty and comparable quality have been validated time and time again.

The FHWA no longer considers DB to be experimental and has provided a framework of Federal rules to ensure quality in the constructed project. Florida has been using design-build for almost 20 years and well over half the states now have some level of a DB program. DB is a well-accepted and proven project delivery option that can help a state meet its urgent infrastructure project delivery needs.

2. The concern that implementing DB project delivery will eliminate jobs for public agency professional engineers appears to be unfounded. While this perception has been shared by many engineers around the country, the hard data collected in this study supports the opposite conclusion. None of the agencies that responded to the questionnaire had reduced their professional engineering staff because they had implemented DB.
3. Implementing DB does not mean that public transportation agencies will stop using the traditional method. None of the respondents reported switching completely to DB. Over two-thirds reported that DB projects made up less than ten percent of their total construction program. Thus, authorizing a public transportation agency to utilize DB project delivery will probably not eliminate the need for any of its current professional engineering staff.
4. It seems to be apparent that implementing DB requires a well-qualified technically competent staff at the agency to achieve success. Several respondents indicated that they assigned their best engineers to DB projects and that implementing DB required them to exercise a great deal more engineering judgment. Since experienced agencies agree that DB projects require the most experienced agency engineers, there will always be a need to maintain a robust DBB project delivery program to train entry level engineers and build core competencies.
5. The shift to DB entails a change in the roles agency professional engineers play from traditional design and construction engineering tasks to one of overseeing, reviewing, and approving the accomplishment of those tasks by the design-builders' personnel. Contrary to popular belief, this study has shown that implementing DB does not reduce the workload of the agency's engineering staff.
6. Comparing the results of the perceptions survey to the general survey output illustrates the reason why DB remains controversial even after nearly two decades of DOT experience. The public employees that answered the perceptions survey demonstrated a lack of awareness of the actual impact of the delivery method on their role in the infrastructure construction process with an even split between all possible responses regarding role changes. Thus, absent training and outreach to improve awareness, the perception that DB will change the roles of the public engineering workforce will continue to act as a significant barrier to implementation in those states without DB experience.
7. The DB RFP content analysis shows that states with significant DB experience appear to use the "Quality by Qualifications" approach to articulating the requirement for quality management in their DB RFPs. This evaluation process is likely used as a risk management tool for delivering quality products. This would also support the argument that DOTs that implement DB need a well-trained and

experienced professional engineering workforce to enable them to oversee design-builder design and construction quality management processes.

8. The content analysis also showed that in half the sample DB RFPs, DOTs are retaining their traditional authority for design and construction QA and QC tasks. Only four of the sixty RFPs clearly indicated that the DOTs were willing to delegate the authority for those professional design and construction engineering tasks. This effectively belies the perception that a DOT implementing DB will need fewer professional engineers as a result of shifting public design and construction engineering tasks to private firms.

Summary

Mary Peters, the Federal Highway Administrator, summed up the content of this interim report, when she said:

> "*Our transportation system is indispensable to our quality of life and to our economy. There are tremendous benefits from getting projects completed quickly, once they have all the necessary approvals.*"[61]

The FHWA, in a report to the U.S. Congress on the effectiveness of DB under the SEP-14 program found that in three hundred-plus projects in thirty-two states, the District of Columbia and the U.S. Virgin Islands, DB project delivery "reduced the overall duration of their projects by fourteen percent, reduced the total cost of the projects by three percent, and maintained the same level of quality as compared to design-bid-build project delivery." [62] The survey of twenty-five agencies with DB experience carried out for this study demonstrates that implementing DB has not threatened the public professional engineering workforce. In fact, it seems that to implement DB successfully demands a public professional engineering workforce with elevated technical competence and professional experience. DB contracting is unlikely to supplant the traditional DBB project delivery process, and thus, DB contracting should take its place along side DBB as merely another tool available to the public transportation agency to deliver much needed infrastructure projects.

[61] Mary Peters (2003). "An Important Project." Canal Road Intermodal Connector Meeting, Gulfport, Mississippi, http://www.fhwa.dot.gov/pressroom/re031021.htm [September16, 2006]

[62] Federal Highway Administration (2006). "Design-build Effectiveness Study," Final Report, http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm (August 30, 2006), p. v.

Appendix A: General Survey Questionnaire

PURPOSE: The purpose of this survey is to collect information on the changes to the professional engineering workforce, if any, that have occurred at public transportation agencies that have implemented design-build project delivery procedures.

BACKGROUND: The Federal Highway Administration initiated Special Experimental Project 14 (SEP-14) which gave state transportation agencies the ability to experiment with the use of design-build project delivery. Thirty-two states applied for SEP-14 approval to complete construction projects using design-build. Design-build inherently creates a situation where some or all of the detailed engineering design effort is now being completed by a private engineering firm engaged as a member of the winning design-build team. Thus, the level of state professional engineering design effort will change. Perceptions of the actual impact of that change range between two extremes. One extreme believes that implementing design-build will lead to massive layoffs of public sector professional engineers as their jobs are outsourced to private industry. The other extreme sees the need for increasing currently strained agency engineering expertise from traditional levels to complete a new task of review and oversight of contractor-produced design products and construction deliverables.

This study seeks to measure the actual impact on the public workforce by surveying public agencies that have experienced the effects of implementing design-build project delivery. In doing so, the study intends to quantify those impacts in a manner that resolves the perceptions current in the public sector.

DEFINITIONS: The following are terms that must be carefully understood to properly complete this survey.

Design-build (DB): A project delivery method where both the design and the construction of the project are simultaneously awarded to a single entity.

Design-bid-build (DBB): A project delivery method where the design is completed either by in-house professional engineering staff or a design consultant before the construction contract is advertised.

Design deliverable: A product produced by the design-builder's design team that is submitted to the agency for review. (i.e. design packages, construction documents, etc.)

Construction deliverable: A product produced by the design-builder's construction team that is submitted to the agency for review. (shop drawings, product submittals, final constructed products/work features, etc.)

Quality Assurance: Those activities performed by the owner during both design and construction to assure that the project will meet published requirements.

General Information:

1. US state in which the respondent is employed:

2. Has your agency awarded a DB project? ☐ Yes ☐ No*
   *(if No, please stop and submit the questionnaire.)

3. In what year did your agency award its first DB project?

4. How many DB projects has your agency awarded since then?

   ☐ 1-5; ☐ 5-10; ☐ Greater than 10

5. About what percentage of your agency's <u>total number</u> of projects do DB projects make up? ☐ less than 1% ☐ 2% to 5% ☐ 6% to 10% ☐ 11% to 25% ☐ 26% to 50% ☐ Greater than 50%

6. About what percentage of your agency's <u>total construction budget</u> do DB projects make up? ☐ less than 1% ☐ 2% to 5% ☐ 6% to 10% ☐ 11% to 25% ☐ 26% to 50% ☐ Greater than 50%

7. How many professional engineers were on your agency's payroll in the year of your first DB project award?

8. How many professional engineers were on your agency's payroll in the most recent year award?

9. If you do not know the numbers for questions 7 and 8 above, how did the number change over that period? ☐ More ☐ Less ☐ No change

10. If the answer to question 8 is less than the answer to question 7 or the answer to question 9 is "Less," what was the reason for the drop?
    ☐ Agency budget decreased ☐ Legislative authorization decreased
    ☐ Engineers left the agency to work in private industry
    ☐ The agency was unable to fill open positions.
    ☐ Implementing DB allowed us to deliberately reduce our workforce.
    ☐ Other Please explain:

11. Has your agency reduced the number of professional engineers it employs as a direct result of implementing DB project delivery? ☐ Yes ☐ No

12. Did your agency implement DB project delivery as a result of a direct need to augment its existing workforce? ☐ Yes ☐ No ☐ Not applicable/don't know

Design-Build Policy Information:

13. Who prepares the preliminary design upon which the DB Request for Proposals is based?
☐ Agency engineers ☐ Engineering consultants ☐ Other Please specify:

14. If the agency employs consultants to prepare preliminary design for DB Request for Proposals, are these consultants unique to DB project delivery?
☐ Yes, these design consultants are unique to DB
☐ No, these design consultants are also employed to complete DBB design
☐ Not applicable/don't know

15. To what level of design development is the preliminary design advanced for DB Requests for Proposals?
☐ less than 10 % ☐ 10% to 30% ☐ 31% to 50% ☐ Greater than 50%

16. On DB projects, who reviews the design-builder's design deliverables? (Check all that apply)
☐ Agency design engineers ☐ Agency construction engineers
☐ General engineering consultant ☐ Other Please specify:

17. On DB projects, who reviews the design-builder's construction deliverables? (Check all that apply)
☐ Agency design engineers ☐ Agency construction engineers
☐ General engineering consultant ☐ Other Please specify:

18. Who performs quality assurance activities on your agency's DB projects? (Check all that apply)
☐ Agency design engineers ☐ Agency construction engineers
☐ General engineering consultant ☐ Other Please specify:

19. What changes occurred in the utilization of your in-house engineering workforce to accommodate DB projects? (Check all that apply)
☐ Design staff workload decreased
☐ Design staff workload increased
☐ Design staff workload shifted from fundamental design tasks to review and oversight of design-builder design tasks.
☐ Construction staff workload decreased
☐ Construction staff workload increased
☐ Construction staff workload shifted from fundamental construction inspection tasks to review and oversight of design-builder construction QC tasks.
☐ Other: Please specify:

20. What one statement best describes the impact of design-build contracting on your agency's professional engineering workforce?

☐ Implementing design-build had no impact.

☐ Implementing design-build changed the roles in-house engineers play but it did not appreciably change the amount of work that was required of them.

☐ Implementing design-build changed the roles in-house engineers play and also increased the amount of work that was required of them.

☐ Implementing design-build changed the roles in-house engineers play and also decreased the amount of work that was required of them.

☐ Implementing design-build did not change the roles in-house engineers play; however, it increased the amount of work that was required of them.

☐ Implementing design-build did not change the roles in-house engineers play; however, it decreased the amount of work that was required of them.

☐ No opinion

Please add any written comments that you believe would be helpful to this study:

Appendix B: Perceptions Survey Questionnaire

Objective: The objective of this survey is to measure the perceived impact of implementing design-build contracting on Quality Assurance activities performed by the public workforce. The results will be compared with measured impacts gained from another survey of state DOTs that have implemented design-build contracting. Perceptions are important in public procurement policy implementation as they often form a motivation for implementation or a major barrier to change.

Please answer the following questions based on how you perceive the impact of implementing design-build project delivery has impacted project quality.

In what US state are you employed? _____

What is your job? ☐ Public employee ☐ Private industry (If responding from the private industry perspective, please answer the following questions based on your perception of what is happening to a typical public agency with which you are familiar.)

1. Did implementing design-build cause your agency to reduce the number of professional engineers employed by your agency? ☐ Yes ☐ No ☐ Not applicable

2. Do you feel that implementing design-build project delivery would cause your agency to change the number of professional engineers it requires?
   ☐ Yes, we will need more; ☐ Yes, we will need less; ☐ No change is expected

3. Do you feel that implementing design-build project delivery will change the roles that professional engineers employed by your agency would play? Check all that apply.
   ☐ Yes, we will do less in-house design and more design review
   ☐ Yes, we will do less construction inspection and more construction oversight
   ☐ No change is expected; ☐ No opinion

4. Do you believe that design-build project delivery furnishes impacts the quality of project? ☐ Yes, its better; ☐ Yes, its worse; ☐ No change ☐ Don't know

5. Who should have the majority of the responsibility for quality assurance in a design-build project?
   ☐ The public agency; ☐ The design-builder; ☐ No opinion
   ☐ It should be shared by the agency and the design-builder;
6. Please write any comments that you feel would be helpful to this research?

Appendix C: Research Instrument Coverage Summary

Table C.1 is a summary of the state by state coverage of the research instruments used in this study. There were fifty-two total agencies that reside in fifty US states plus the District of Columbia and the U.S. Virgin Islands. Not all the agencies were state Departments of Transportation. Those that were either toll or federal agencies are noted in the table. The results of the structured telephone interviews in nine states were incorporated into the general survey response population.

Table C.1: Research survey Instrument Coverage.

State	SEP 14 DB State	Structured Interview	General Survey	Perception Survey	Content Analysis	Notes
AK	✓		✓	✓	✓	
AL	✓					
AR			✓			
AZ	✓				✓	
CA	✓		✓	✓	✓	Toll authority response
CO	✓		✓	✓	✓	Toll authority response
CT						
DC	✓			✓	✓	
DE	✓					
FL	✓	✓	✓		✓	
GA	✓		✓			
HI	✓		✓			
IA				✓		
ID			✓			
IL			✓	✓		
IN	✓				✓	
KS						
KY						
LA	✓		✓			
MA	✓					
MD	✓	✓	✓		✓	
ME	✓		✓		✓	DOT & Maine Toll Authority
MI	✓		✓			
MN	✓	✓	✓	✓	✓	
MO					✓	
MS			✓		✓	EFLHD not DOT
MT		✓	✓			
NC	✓	✓	✓		✓	
ND			✓			
NE			✓			

State	SEP 14 DB State	Structured Interview	General Survey	Perception Survey	Content Analysis	Notes
NH						
NJ	✓					
NM	✓		✓		✓	
NV	✓		✓	✓	✓	
NY	✓		✓			NYSDOT No complete DB project to date
OH	✓	✓	✓		✓	
OK			✓	✓		No DB projects to date
OR	✓	✓	✓		✓	
PA	✓			✓		
RI						
SC	✓		✓		✓	
SD	✓		✓		✓	
TN	✓		✓			Not complete DB project to date
TX	✓		✓	✓	✓	
UT	✓	✓	✓	✓	✓	
VA	✓	✓	✓		✓	
VI	✓					
VT						
WA	✓		✓	✓	✓	
WI	✓		✓			
WV						
WY			✓			
Total	34	9	34	13	23	

Appendix D: Detailed Survey Data Summary

This appendix contains the reduced data from the structured interviews, general survey and the perceptions survey in tabular form. As the structured interview consisted of asking the same questions to the interviewees that were asked in the on-line version of the general survey, those results have been consolidated with the general survey results. Finally, specific comments that were offered by both the interviewees and the on-line questionnaire respondents are listed at the end of this appendix in appropriate order.

General Survey (including structured interview responses)

1. Statement of Consent to Take Survey: 34/100%

2. US State in which respondent is employed:	3. Has your agency awarded a DB project? *(if No, please stop and submit the questionnaire.)	4. In what year did your agency award its first DB project?
Alaska	Yes	1996
California	Yes	1991
Colorado	Yes	1996
Florida	Yes	1989
Georgia	Yes	1999
Hawaii	Yes	2000
Idaho	No	-
Illinois	No	-
Louisiana	Yes	2006
Maine	Yes	1995
Maine Toll	Yes	?
Maryland	Yes	1998
Michigan	Yes	1995
Minnesota	Yes	1996
Mississippi	Yes	2001
Montana	Yes	2004
Nebraska	No	-
Nevada	No	Will in 2007
New Mexico	Yes	2002
New York State DOT	No	-
North Carolina	Yes	2001
North Dakota	No	-
Ohio	Yes	2000
Oklahoma	No	-
Oregon	Yes	2002
South Carolina	Yes	1997
South Dakota	Yes	2000
Tennessee	No	-
Texas	Yes	2002
Utah	Yes	1997
Virginia	Yes	1998
Washington	Yes	2002
Wisconsin	Yes	2000
Wyoming	No	-

5. How many DB projects has your agency awarded since then?

Answer	# Responses	Percentage
1 to 4	13	54%
5-9	4	17%
Greater than 10	7	29%
Total	24	100%

6. About what percentage of your agency's total number of construction projects do DB projects make up?

Answer	# Responses	Percentage
less than 1%	14	54%
2% to 5%	9	35%
6% to 10%	1	4%
11% to 25%	1	4%
26% to 50%	1	4%
Greater than 50%	0	0%
Total	26	100%

7. About what percentage of your agency's total construction budget do DB projects make up?

Answer	# Responses	Percentage
less than 1%	8	31%
2% to 5%	5	19%
6% to 10%	6	23%
11% to 25%	5	19%
26% to 50%	0	0%
Greater than 50%	2	8%
Total	26	100%

Questions 8 and 9.

State	8. How many professional engineers were on your agency's payroll in the year of your first DB project award?	9. How many professional engineers were on your agency's payroll in the most recent year award?
Maryland	15	32
California	6	4
Minnesota	678	674
Utah	200	221
Virginia	100	271
Maine Toll	14	14
Michigan	270	300
Texas	955	1133
Colorado Toll	5	4
Maine DOT	153	153

10. If you do not know the numbers for questions 8 and 9 above, how did the number change over that period?

Answer	# Responses	Percentage
More	4	18%
Less	3	14%
No change	15	68%
Total	22	100%

11. If the answer to question 9 is less than the answer to question 8 or the answer to question 10 is "Less," what was the reason for the drop?

Answer	# Responses	Percentage
Agency budget decreased	3	43%
Legislative authorization decreased	1	14%
Engineers left the agency to work in private industry	1	14%
The agency was unable to fill open positions.	1	14%
Implementing DB allowed us to deliberately reduce our workforce.	0	0%
Other	1	14%
Total	7	100%

Other Response:
1. No change

12. Has your agency reduced the number of professional engineers it employs as a direct result of implementing DB project delivery?

Answer	# Responses	Percentage
Yes	0	0%
No	26	100%
Total	26	100%

13. Did your agency implement DB project delivery as a result of a direct need to augment its existing workforce?

Answer	# Responses	Percentage
Yes	5	19%
No	20	77%
Not applicable/don't Know	1	4%
Total	26	100%

14. Who prepares the preliminary design upon which the DB Request for Proposals is based? (Check all that apply)

Answer	# Responses	Percentage
Agency engineers	19	73%
Engineering consultants	19	73%
Other	3	12%

Other Responses:

1. **Hawaii:** Both Agency engineers and Engineering consultants.
2. **Washington:** Combination. Decision is based on resources available.
3. **Georgia:** Early DB projects Agency, last two - 15% by Agency and 80% by consultant.

15. If the agency employs consultants to prepare preliminary design for DB Request for Proposals, are these consultants unique to DB project delivery?

Answer	# Responses	Percentage
Yes, these design consultants are unique to DB	0	0%
No, these design consultants are also employed to complete DBB design	21	84%
Not applicable/don't know	4	16%
Total	25	100%

16. To what level of design development is the preliminary design advanced for DB Requests for Proposals?

Answer	# Responses	Percentage
less than 10%	1	4%
10% to 30%	22	88%
31% to 50%	2	8%
Greater than 50%	0	0%
Total	25	100%

17. On DB projects, who reviews the design-builder's design deliverables? (Check all that apply)

Answer	# Responses	Percentage
Agency design engineers	24	92%
Agency construction engineers	20	77%
General engineering consultant	16	62%
Other	3	12%

Other Responses:

1. **California:** Agency Environmental Staff, DOT, Local Agencies
2. **Louisiana:** A program administrator/consultant.
3. **Washington:** Reviewers very based upon availability. [sic]

18. On DB projects, who reviews the design-builder's construction deliverables? (Check all that apply)

Answer	# Responses	Percentage
Agency design engineers	14	58%
Agency construction engineers	23	96%
General engineering consultant	13	54%
Other	2	8%

Other Responses:

1. **California:** Agency Environmental Staff, DOT, Local Agencies
2. **Louisiana:** A program administrator/consultant.

19. Who performs quality assurance activities on your agency's DB projects? (Check all that apply)

Answer	# Responses	Percentage
Agency design engineers	15	58%
Agency construction engineers	22	85%
General engineering consultant	10	38%
Other	4	15%

Other Responses:

1. **California:** DB Contractor
2. **Louisiana:** A program administrator/consultant.
3. **Michigan:** Quality Assurance Staff also review design plans
4. **Texas:** See 22 below.

20. What changes occurred in the utilization of your in-house engineering workforce to accommodate DB projects? (Check all that apply)

Answer	# Responses	Percentage
Design staff workload decreased	2	8%
Design staff workload increased	6	25%
Design staff workload shifted from fundamental design tasks to review and oversight of design-builder design tasks	15	62%
Construction staff workload decreased	2	8%
Construction staff workload increased	6	25%
Construction staff workload shifted from fundamental construction inspection tasks to review and oversight of design-builder construction QC tasks.	16	67%
Other	6	25%

Other Responses:

1. **Ohio:** No change
2. **Louisiana:** None
3. **Washington:** DB projects generally beyond agency capacity
4. **North Carolina:** Special unit created to handle DB projects
5. **Texas:** See 22 below
6. **Maine:** No Change 2 DB Projects Done to Fast Track Process

21. What one statement best describes the impact of design-build contracting on your agency's professional engineering workforce?

Answer	# Responses	Percentage
Implementing design-build had no impact.	3	12%
Implementing design-build changed the roles in-house engineers play but it did not appreciably change the amount of work that was required of them.	10	40%
Implementing design-build changed the roles in-house engineers play and also increased the amount of work that was required of them.	5	20%
Implementing design-build changed the roles in-house engineers play and also decreased the amount of work that was required of them.	2	8%
Implementing design-build did not change the roles in-house engineers play; however, it increased the amount of work that was required of them.	4	16%
Implementing design-build did not change the roles in-house engineers play; however, it decreased the amount of work that was required of them.	0	0%
No opinion	1	4%
Total	25	100%

22. Please add any written comments that you believe would be helpful to this study:

1. **Oregon:** Need to quantify level of outside factors needed in DB projects.
2. **Florida:** DB allowed the FDOT to pickup additional work as it came without having to increase its staffing. Deliver the project quicker.
3. **Maryland:** Some of design work shift to post-award activities during 1st year of contract.
4. **Minnesota:** Our state has implemented design-build to accommodate large increases in funding appropriated by the legislature. These dollars were above and beyond our original program and the only way to deliver projects with these funds was the use design-build. On some projects, Mn/DOT used consultants as support staff to review contractor plans and perform construction oversight. On other projects, Mn/DOT used internal staff to review plans and perform construction oversight. The use of consultants depended on the availability of staff within the Mn/DOT district at the time of the project. As a follow-up to questions 19 and 20, the roles and amount of work significantly changed to Mn/DOT staff on the design-build projects, but it did not change the roles and responsibilities of our engineers or staff on design-bid-build projects.
5. **Montana:** Main impact was increased demand on the agency engineering staff. Mainly due to contractual review period being accelerated for design and submittal. Pilot program was a success and will see increased usage in the future upon legislative general authorization
6. **Ohio:** The Ohio DOT uses D/B on a few projects per year at the Districts discretion as part of other Innovative Contacting Methods. The D/B note is only used to expedite project, no changes in ODOT personnel have been realized, or

expected in the future. The work is more complicated and had to use more engineering judgment instead of cookbook.

7. **Utah:** The work is more complicated and had to use more engineering judgment instead of cookbook. Impact of DB is on a segment of the workforce in a different way where a project team gets pulled in a different times……different work flow. DB doesn't fit neatly into the project development model.
8. **Virginia:** Need our most competent staff in DB because of timing. DB has to hire an independent QA for construction. Pricing is similar to DOT estimates.
9. **Louisiana:** To date we have only awarded one design build project. Project is a part of a special program which we have hired under contract a program manager. Special legislation was required for this single project. Do not know at this time if LaDOTD will be allowed to do more DB projects.
10. **Michigan:** Many of the Design Build projects were selected to deliver projects initiated due to an increase in state and federal funds. It was a method to quickly deliver projects especially for a significantly increased bridge program. MDOT has not let any Design-Build projects since 2000
11. **Hawaii:** The Hawaii DOT is currently establishing a Design-Build Program. The Hawaii DOT is contacting other states to obtain information on Design-Build to help establish the program.
12. **Oklahoma:** Prohibited by law
13. **North Carolina:** Workforce requirements changed, cultural attitudes altered, did not change numbers of employees – but long term it could.
14. **Texas:** Question 19 - The DB Developer is responsible for the project QC/QA program with TxDOT providing independent assurance and owner verification testing. Question 20 - Hired additional consultant staff to assist in owner verification testing. (design and construction) Response to Question 15 is - Varies depending on the project. We have 8 comprehensive development agreements in the works right now that vary from a preliminary schematic (10%) to almost complete PS&E - Greater than 50% Question 20 should be qualified for concession projects (Public/Private Partnerships), the upfront effort is greatly increased, but long term should pace more responsibility on the developers resulting in a decreased effort by in-house staff in the long run.
15. **Colorado:** One of the main reasons we chose design build is because we are a toll road and we needed to guarantee a fixed price and completion date so that we could sell bonds and investors would have confidence we could meet schedule and budget. We supplement our staff with consultant help because we have such a small engineering staff. Design build changes our roles on projects - as compared to conventional design bid build - but staffing levels have not been affected by the delivery system per se.
16. **Mississippi:** My agency is a federal agency EFLHD not a DOT
17. **Wisconsin**: Wisconsin DOT has awarded only 1 DB project as part of the local program in partnership with the City of Milwaukee. WisDOT has not awarded another DB project nor pursued legislative changes to allow use of DB. Answers to some of the questions are based upon how WisDOT envisions how they would do DB projects should they undertake one.

18. **South Dakota:** South Dakota is not a good representative to answer this survey, but I did anyway.
19. **Georgia:** My perspective - Implemented GDOT first 6 DB projects from 7-1999 to 7-2002. Most were interstate widenings, bridge jackings, bridge widenings with little needed innovation. The last three D-B projects GDOT has pursued have included a unique bridge in downtown Atlanta, a lane widening on an interstate, and 10 miles of roadway (interchange and frontage road) to serve a new automotive plant in West Point, GA. To my knowledge, this is the first D-B GDOT has pursued since 2002. I do not have any detail on the bridge in Atlanta. The lane widening was advertised and since only two D-B team submitted, the project was re-advertised. Still only two submitted. GDOT will pursue one final time. They are progessing the plan in the event the project doesn't get the required 3rd proponent. Finally, the D-B project for West Point, GA will have 80% plans. The project was driven be an environmental deliverable and GDOT chose to further develop the plans since they had the time and hoped to reduce the risk. They are allowing alternative designs that meet or are betterment to what is presented in the costing plans. The D-B contractor cannot adversely affect the schedule. With regards to Agency oversight, GDOT will most like employ a consultant to review the submissions (and there are plenty) from the Contractor. The office that is home of the project has minimal staff (and they are also tasked with current PPI proposals that seem to be thing in GA at this time).

Perceptions Survey

The responses to the perceptions survey that were collected at the 2007 TRB Design-build Task Force meeting are shown in the following table. They are broken out in three groups: responses from the total population, responses from the public agency members, and responses from the private practitioners. The total population included twenty-three responses from fifteen different states. There were six public agency members from five states: Colorado, District of Columbia, Illinois, North Carolina, and Virginia. There were thirteen private practitioners from ten states: California, Massachusetts, Maryland, Nevada, North Carolina, Pennsylvania, Texas, Utah, Virginia, and Washington. There were also three academics at the meeting that responded, but those responses were not considered significant enough to break out as a fourth group.

Survey Question -- Possible Answer	**Total Population Responses**		**Public Agency Responses**		**Private Practitioner Responses**	
	#	%	#	%	#	%
1. Did implementing design-build cause your agency to reduce the number of professional engineers employed by your agency?						
Yes	2	8.7%	1	16.7%	1	7.7%
No	15	65.2%	2	33.3%	10	76.9%
Not Applicable	6	26.1%	3	50.0%	2	15.4%
2. Do you feel that implementing design-build project delivery would cause your agency to change the number of professional engineers it requires?						
Yes more	5	21.7%	0	0.0%	4	30.8%
Yes less	7	30.4%	3	50.0%	4	30.8%
No change	10	43.5%	3	50.0%	5	38.5%

Survey Question -- Possible Answer	Total Population Responses		Public Agency Responses		Private Practitioner Responses	
	#	%	#	%	#	%
3. Do you feel that implementing design-build project delivery will change the roles that professional engineers employed by your agency would play? Check all that apply.						
Yes, we will do less in-house design and more design review	14	60.9%	2	33.3%	9	69.2%
Yes, we will do less construction inspection and more construction oversight	14	60.9%	2	33.3%	9	69.2%
No change is expected	6	26.1%	2	33.3%	3	23.1%
No opinion	1	4.3%	1	16.7%	0	0.0%
4. Do you believe that design-build project delivery impacts the quality of a project?						
Yes, its better;	11	47.8%	2	33.3%	8	61.5%
Yes, its worse;	1	4.3%	0	0.0%	1	7.7%
No change	7	30.4%	2	33.3%	3	23.1%
Don't know	4	17.4%	2	33.3%	1	7.7%
5. Who should have the majority of the responsibility for quality assurance in a design-build project?						
The public agency	5	21.7%	2	33.3%	2	15.4%
The design-builder	7	30.4%	1	16.7%	5	38.5%
shared	11	47.8%	3	50.0%	6	46.2%
No opinion	0	0.0%	0	0.0%	0	0.0%