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QUANTIFYING AND BENCHMARKING THE PROJECT DELIVERY PERFORMANCE OF PUBLIC-PRIVATE-PARTNERSHIP (PPP) TRANSPORTATION PROJECTS IN THE U.S.

Final Report

by

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DISCLAIMER

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EXCUTIVE SUMMARY

The use of public-private-partnerships (PPP) has increased in the U.S. since the early 1990s. Infrastructure design and construction projects have seen significant variations in costs and schedules under traditional project delivery systems, and therefore this report aims to quantify the cost and schedule performance of recently completed PPP projects in the U.S. transportation sector, and compare them to their non-PPP counterparts. The hypothesis of the study is that PPP projects will show superior performance, mainly due to the integration of major stakeholders and sharing of information throughout the project lifecycle.

The authors collected and verified data through professional datasets and structured interviews with key projects constituents. The report presents results stemming from 25 completed PPP transportation projects. All projects in the dataset were completed between 1995 and 2013 with project costs ranging from $18 million to $2.1 billion, and totaling about $14 billion. Results of the analysis show an average cost growth of 3.22% and an average schedule growth of 1.2%, which highlight superior performance when compared to traditional design-bid-build delivery. This research fills a gap of knowledge on PPP project performance in the U.S. transportation sector. It also compares the results to those of projects delivered using the traditional method and of previous research efforts studying the international PPP market.

1.0 INTRODUCTION

Transportation infrastructure is a key element in advancing the economic competiveness in various regions around the U.S. and the world. Since the early 1990s, public-private-partnerships (PPP or P3) have been one of the more prevalent alternative project delivery methods (APDM) used to supplement traditional delivery methods for transportation infrastructure projects. As of 2011, approximately 30 states have passed enabling PPP legislation that allows its use in the infrastructure development sector. Additionally, according to Public Works Financing (PWF), as of 2011 there have been at least 96 transportation projects completed in the U.S. that include publically funded design-build (DB) and design-build-operate-maintain (DBOM) projects as well as privately financed DBOMs and concessions as PPP options (Reinhardt 2011).

Recently, PWF sponsored a roundtable discussion on PPP research needs at the Transportation Research Board's (TRB) 2014 annual meeting in Washington D.C. (PWF 2014). Attending the meeting were 27 of the PPP industry's most influential leaders from academia, government and the private sector. During the meeting, participants discussed eight critical topic areas, three of which hold relevance to this research study: 1) the current body of PPP research, 2) the usefulness of the Value for Money (VfM) approach and 3) academia's role in future PPP research.

First, Garvin (PWF 2014) reported on the current state of PPP research. From his review of the literature, he found there are at least 50,000 unique articles on the topic of transportation PPPs in the global market. However, due to the breadth and depth of various PPP options, PPP research has become highly fragmented across several disciplines including economic finance, governance and policymaking.

Second, researchers from the University of Limerick in Ireland commented on the European market's "over-reliance" of the VfM approach in analyzing PPP financial efficiency. The most prevalent take away point from their discussion comes from the fact that typical VfM exercises are executed prior to the beginning of the procurement process of a project and tend to rely heavily on the estimation of future interest rates. This leads to highly scenario-driven calculations that can potentially overestimate or underestimate the actual economic benefits of a project, concluding that the usefulness of VfM remains unresolved. This dissolution of the VfM analysis method has the potential to fragment future PPP project assessment procedures.

Third, the discussion on the role of academia in future PPP research endeavors concluded that, in order for research to add value to the industry as a whole, the findings must present data that can be used to answer two basic fundamental questions: 1) why and 2) how benefits (cost, schedule, quality, etc.) are created through private participation. Additionally, industry constituents commented that the evolving market for new PPP transportation projects in 5 to 10 years will be very different than the current market, and that the U.S. market for PPP transportation projects seems to have increased significantly. Currently, there are at least 20 new U.S. PPP transportation infrastructure projects that will be completed in the next 5 to 7 years (PWF 2014).

A large portion of infrastructure design and construction projects have seen significant variations in costs and schedules. Based on the literature, construction projects have seen increases amounting to 25% and 33.5% of cost and schedule estimates, respectively. Therefore, in order to answer the need for new and relevant academic PPP research, this report provides a quantitative performance assessment of recently completed U.S. PPP transportation projects by studying actual cost and schedule performance.

2.0 LITERATURE REVIEW

The first step of this research consisted of a comprehensive literature review. First, the authors present the functional definition of PPP used to determine which projects are considered for this study. Second, previous studies on PPP project performance were reviewed and their findings are summarized. Last, previous studies regarding the performance of non-PPP projects, i.e. Design-Bid-Build (DBB) and Design-Build (DB) were reviewed and summarized in order to serve as a baseline for comparison.

2.1 PPP DEFINITION

Perhaps one of the more perplexing conundrums regarding PPPs is the plethora of definitions and contracting terminologies associated with them. Therefore, this study adopted the standard definition of PPP as the USDOT defines it:

A public-private partnership is a contractual agreement formed between public and private sector partners, which allows more private sector participation than is traditional. The agreements usually involve a government agency contracting with a private company to renovate, construct, operate, maintain, and/or manage a facility or system. While the public sector usually retains ownership in the facility or system, the private party will be given additional decision rights in determining how the project or task will be completed (U.S. DOT, 2007).

This definition of PPP emphasizes the sharing of responsibility between the public and private sectors in order to deliver a project and/or its services. The increased private sector role is particularly important here; by expanding the responsibility of the private sector, the public sector is better able to utilize the technological, managerial and financial resources of the private sector to leverage often-scarce public funds and potentially expedite the delivery of a project. The financial resources as part of the above definition are particularly important.

Zhao et al. in 2011 developed a process framework to categorize different contracting methods used within PPP (Zhao et al. 2011). Within the report, they characterize the taxonomy of PPPs into two categories: a) by facility development stage, and b) by level and type of private involvement.

a) By Facility Development Stage: the facility development stages include construction, operation and maintenance (O&M), and expansion or rehabilitation. The development and construction of a new facility is often referred to as “greenfield” projects, while the operation and maintenance of an existing facility is typically referred to as a “brownfield” project.

b) By Level and Type of Private Involvement: the level of public-private involvement in infrastructure development projects varies along a spectrum. At one extreme is the traditional mode of project delivery, in which the private sector is typically involved in

the design and construction of the project. At the other extreme is full privatization, in which the private sector takes over complete risks and responsibilities for infrastructure development. Between these two extremes are various PPP options, which are categorized into two groups, public-financing PPP and private-financing PPP.

Similar to Zhao et al., the USDOT has developed a summary graphic, replicated below as Figure 1 (FHWA 2017), to characterize the various terminologies and contracting arrangements regarding PPPs in terms of facility development stage (i.e., new or existing facilities) and the level of private involvement.

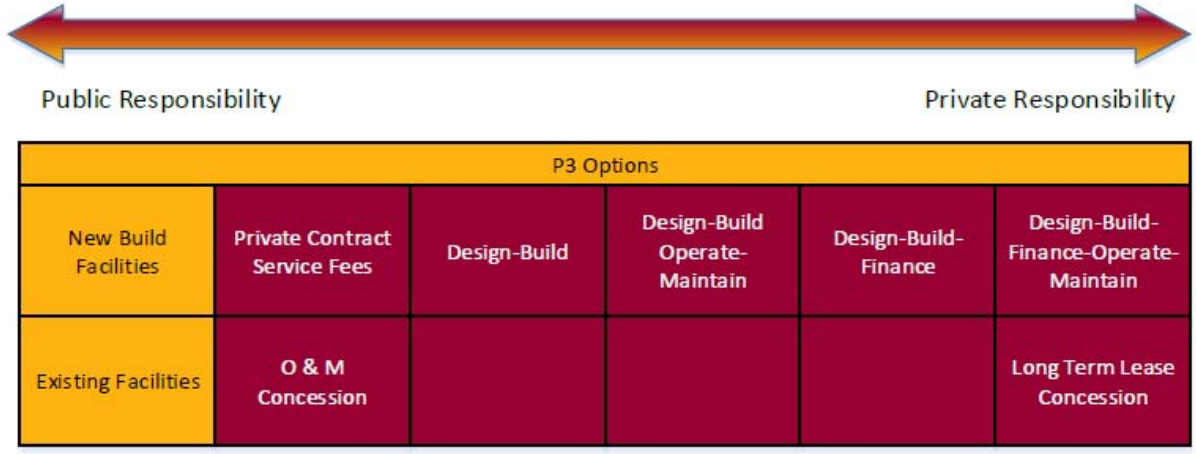

Figure 1: PPP spectrum according to FHWA

In accordance with the USDOT and the Federal Highway Administration (FHWA) definitions (FHWA 2017) of PPP, this report considers Design-Build (DB), Design-Build-Operate-Maintain (DBOM), Design-Build-Finance (DBF) and Design-Build-Finance-Operate-Maintain (DBFOM) contracts for new build facilities during the construction phase of development. Standardized definitions of these four contracting methods are provided below:

Design-Build (DB): DB combines the design and construction phases into a single contract. This is in contrast to the traditional DBB approach, in which the design and construction are awarded separately to different contractors. By combining the risk and responsibility of designing and building, DB has proven to save time and money over its traditional counterpart (Zhao et al. 2011; El Asmar et al 2010). Additionally, since DB private entities are only involved in the design and construction phases with no financial involvement beyond that, the authors agree with various definitions that state DB is not considered a type of PPP, and therefore this report will show the PPP performance results with and without DB projects considered, in order to be sensitive to the various existing definitions of PPP.

Design-Build-Finance (DBF): DBF can be seen as an extension of the DB method when the private sector also assumes additional financial responsibilities. The private contractor agrees to provide all or some of the construction financing and to be paid back either through milestone payments or completion payments made from public funds. These arrangements are typically short-term in nature, repaid at construction completion or extending only a few years later. They are most often used when there is a full funding grant agreement in place with funds flowing into

the project later than construction needs require, or in cases where the contractor will be repaid in one lump sum upon full completion, or in case of an emergency on the part of the public sponsor (Zhao et al. 2011).

Design-Build-Operate-Maintain (DBOM): DBOM is a combined delivery approach, in which a private contractor designs, constructs, operates, and maintains the facility for a specific period of time meeting specific performance requirements. The private contractor may be compensated in the form of availability payments, for example, depending on the number of days the facility is available to the public at a given performance level. Because initial private finance is not required, the public sector retains financial responsibility (Zhao et al. 2011).

Design-Build-Finance-Operate-Maintain (DBFOM): DBFOM is an extension of DBOM in which the private sector also provides some or all of the project financing. This delivery approach increases incentives for overall value-for-money considerations because the private sector assumes a combined responsibility in finance, construction, operations and maintenance. The sponsoring government agency retains ownership of the facility (Zhao et al. 2011).

2.2 SELECTED STUDIES ON PPP TRANSPORTATION PROJECT PERFORMANCE

In 2007, AECOM/DMJM Harris published a research report for the USDOT regarding several project performance characteristics of eight completed and three ongoing PPP projects in the U.S. (U.S. DOT 2007). The authors performed a case study assessment on each project and measured cost and schedule performance metrics as well as procurement characteristics including partnering arrangements, project funding sources, PPP contract types, quality standards, and economic development benefits. Five of the eight completed projects were delivered within schedule and budget arrangements. For the other three, one project experienced -4% cost growth and -42% schedule growth (meaning the project was delivered under budget and ahead of the estimated time), while another experienced substantial schedule growth (+81%) while still being delivered within budget. The final project experienced a 12-year delay in project completion due to community lobbying over environmental concerns, protracted contractor negotiations and lawsuits. The project also experienced substantial cost growth due to the massively delayed schedule. Overall, based on the results presented in the analysis, it seems that PPP project performance is favorable over traditional procurement methods.

Bain in 2010 conducted a meta-analysis of 14 international studies regarding transportation and infrastructure PPP projects in Europe (Bain 2010). Bain compares the construction cost overruns in all 14 studies and reports on the range and variability of the results within each of the studies, while reporting cost overruns for both traditional procurement and PPP procurement methods. At 13%, the average PPP cost overrun was roughly half of what was calculated for traditional procurement (25%). The article indicates PPP as a superior method of project delivery in terms of cost growth for European infrastructure projects.

Chasey et al. (2012) conducted a research study regarding the project performance of 12 PPP transportation projects procured in North America, two of which are in the U.S. and ten located in Canada. The authors discuss cost and schedule overruns for these projects and compare these

numbers to previous work on traditional project delivery performance. From the results the authors calculated an average 0.81% cost overrun and -0.30% schedule overrun for the PPP projects included in the dataset. Overall, project delivery performance of PPPs was shown to be superior to traditional project delivery performance.

Also, Infrastructure Partnerships Australia (IPA) (2012) published a research report regarding project performance for 21 PPPs versus 33 traditionally procured projects in Australia. The project types in this report include social, transportation, information technology and water projects. In the report, the authors discuss cost and schedule overruns for these projects, and compare results for different stages in the procurement cycle. The PPP projects included in the dataset experienced an average cost overrun of 1.2% versus the 14.8% for traditionally procured projects. Likewise, PPP projects experienced an average schedule overrun of -3.4% with all 21 PPP projects delivered on time or earlier; while the average schedule overrun for traditionally procured projects was 23.5%. Overall, the report concludes Australian PPP projects demonstrate superior cost and schedule performance as compared to their traditional counterparts.

Garvin et al. (2011) performed a research study that provided state-of-the-practice descriptions of domestic and international practices for key performance indicators (KPIs) of PPP projects. The authors used a case study approach to document the success of eight PPP transportation projects located in Australia, British Columbia, the United Kingdom, and the U.S. A key finding from the report concluded that none of the agencies on the eight projects were able to realize performance measurement goals in relation to their specific KPIs. Moreover, the alignment of specific performance indicators did not match with the agencies intended project performance goals. Overall the authors suggested that PPP contracting methods, specifically in the U.S., should be more standardized than they currently are and that KPIs should evolve with the project's goals and not restrict project outcomes.

2.3 SELECTED STUDIES ON NON-PPP TRANSPORTATION PROJECT PERFORMANCE

Gransberg et al. (2000) conducted a research study of 21 DBB and 11 DB transportation projects in terms of cost and schedule growth. Cost growth for the DBB projects was 10.64% and schedule growth 33.5%. For the DB projects cost growth was -1.99% and schedule growth -35.7%. Overall, the results from this study clearly demonstrate the cost and schedule superiority of the DB project delivery system.

AECOM consultants (2006) prepared a research report for the FHWA on the effectiveness of the DB project delivery system. The authors studied 11 DBB and 11 DB transportation projects in terms of cost and schedule growth. Cost growth for the DBB projects was 3.6% and schedule growth was 4.8%. For the DB projects cost growth was 7.4% and schedule growth was -4.2%.

Shrestha (2007) conducted a research study comparing cost and schedule overruns for 4 DBB and 4 DB U.S. transportation projects. For the DBB projects cost growth was 12.71% and schedule growth was 4.34%. For the DB projects cost growth was 1.49% and schedule growth was 11.04%. On one hand DB produced superior cost performance over DBB, but on the other, DBB produced superior schedule performance over DB. Additionally, the results of the work

performed by Shrestha and the AECOM study seem to be contradicting, adding to the contention of the unpredictability and variability of cost and schedule performance on infrastructure projects.

Table 1: Selected studies on non-PPP transportation project performance

Research Study	Delivery Method	Cost Growth (%)	Schedule Growth (%)
Gransberg et al. (2000)	DBB (N=21)	10.64	33.5
	DB (N=11)	-1.99	-35.7
AECOM (2006)	DBB (N=11)	3.6	4.8
	DB (N=11)	7.4	-4.2
Shrestha (2007)	DBB (N=4)	12.71	4.34
	DB (N=4)	1.49	11.04

Table 1 shows an overall summary of the non-PPP research studies included in the literature review. As stated in the introduction, the studies presented in this literature review make up a small portion of the published research on PPPs and other delivery systems. Therefore, the authors selected some representative publications from the most recent relevant literature documenting cost and schedule overruns for transportation projects abroad and in the U.S.

3.0 PROBLEM STATEMENT & RESEARCH OBJECTIVES

3.1 PROBLEM STATEMENT

As shown in the literature review, scholars and practitioners have compared cost and schedule overruns of PPP projects against traditionally-procured projects in mature PPP markets such as Australia, Europe, and to some extent, North America. However, specific studies targeting the U.S. market only included a limited number of projects and have not been conducted recently. Therefore, owner organizations, private firms, banks, departments of transportation (DOTs), and construction companies might not be entirely cognizant of the cost and schedule variability linked to this particular procurement method. The goals of this research are to (1) examine the cost and schedule overruns of several recently completed PPP projects in the U.S and (2) compare these results to what has been reported for PPP in the international market, and for traditional delivery systems. It is the authors' hypothesis that PPP projects might help reduce cost and schedule variability when compared to traditional methods. Therefore, project cost growth and schedule growth were quantified in order to present a comprehensive quantitative assessment of PPP project delivery performance.

3.2 RESEARCH METHOD

In order to accomplish the research objectives, the methodology used for this study consisted of four steps: 1) literature review; 2) PPP project identification and data collection; 3) project data verification through structured interviews; and 4) data analysis. These steps are summarized below.

3.2.1 Literature Review

A comprehensive literature review was conducted in order to present a functional definition of PPP applicable to the projects in this study, and analyze previous PPP studies reporting cost and schedule performance. The literature review helped pave the way for the identification and collection of the appropriate cost and scheduling information in order to measure project cost and schedule performance.

3.2.2 PPP Project Identification and Data Collection

Various completed and ongoing PPP projects in the U.S. were identified through professional datasets available on the web and through publically available DOT websites. Specifically, three public information datasets provided a plethora of information regarding PPP projects in the U.S. First, the FHWA website on integrated project delivery lists and categorizes 54 U.S. PPP transportation projects (FHWA 2017). A majority of these projects are currently being

constructed. The authors used this source to gather initial data on PPP projects in the U.S. Second, Public Works Financing (PWF) has listed and categorized all projects (not just transportation projects) considered as PPP and any project that uses innovative financing methods since 1988 (PWF 2017). The authors utilized this dataset to collect data on various PPP transportation projects in the U.S. Third, the American Association of State Highway and Transportation Officials (AASHTO) lists several PPPs that are either fully operational or currently being constructed on their innovative financing website (AASHTO 2017). This dataset of projects was an excellent tertiary source of information when collecting project cost and scheduling data on recently completed PPP projects. Overall, the authors collected project data on 40 completed PPP projects constructed in the U.S. between the years of 1995 and 2013. Additionally, the authors collected data on 20 PPP projects currently ongoing in the U.S.

3.2.3 Project Data Verification through Structured Interviews

In order to verify the data collected on the various PPP projects, structured interviews with project constituents were setup through phone conversations and email communications. Project constituents consisted of facility managers, CEOs, Public Information Officers (PIO), P.E.s and Project Management Professionals (PMPs), to name a few. During each interview, project constituents were asked to verify cost and schedule information obtained from the various websites and datasets presented in the previous subsection. Constituents were asked to verify the same two pieces of project information as follows:

(1) Contract award value (estimated project cost) and final project cost (actual project cost)

(2) Estimated duration and final duration of the project

Definitions of the above terms were provided in order to clarify the information being requested. The definitions used for each of these four terms are discussed in the following section.

3.2.4 Data Analysis

This report studies PPP project performance in terms of cost and schedule growth.

Cost Growth

Cost growth is the percentage difference between the actual project cost and the estimated project cost. The estimated project cost is the contract value of the capital expenditure stipulated in the PPP contract at financial close. The actual project cost is the cumulative value of all payments made by the sponsor to the developer for the construction of the project. Equation 1 below displays how cost growth was calculated for all projects in the dataset.

$$Cost\ Growth\ (\%) = \frac{(actual\ project\ cost - estimated\ project\ cost) * 100}{estimated\ project\ cost} \quad (1)$$

Schedule Growth

Schedule growth is the percentage difference between the final construction duration (FCD) and the estimated construction duration (ECD). The ECD is the time allotted in the PPP contract for the construction of the project. The FCD is the actual time of the construction to the point of availability of use of the project. Equation 2 below displays how schedule growth was calculated for all projects included in the dataset.

$$Schedule\ Growth\ (\%) = \frac{(FCD - ECD) * 100}{ECD} \quad (2)$$

3.2.5 Data Characteristics

This section presents the characteristics of the dataset collected for this study. As shown in Table 2 the information presented in this section is as follows: project name, project location (state), project type, contracting method and year of financial close. A total of 25 (out of the 40) recently completed PPP projects in the U.S. are included in the dataset for this study. The authors verified cost and schedule information for these projects, which were completed between the years of 1995 and 2013 in the States of Alaska, Alabama, California, Colorado, Florida, Massachusetts, Montana, Nevada, New York, South Carolina, Texas and Virginia. Project cost ranges from $18 million to $2.1 billion, totaling approximately $14 billion in project expenditures. Moreover, project schedules ranged from 13 months to 66 months.

Figure 2 shows PPP projects targeted for data collection. Projects by state are highlighted in green. One interesting finding is that all of the central states save for Texas, Missouri and Minnesota, have not initiated a PPP project. Moreover, PPP projects seem to be heavily prevalent in the Southwest region except for Arizona, which has recently approved one. Furthermore, a PPP project has been initiated in nearly every state on the east coast except for Connecticut, Delaware, Maine, New Hampshire, and Vermont.

Table 2: PPP project characteristics

Project Number	Project Name	Project Location	Project Type	Private Risk	Financial Close	Project Cost ($ millions)
1	Dulles Greenway Toll Road	VA	Toll Motorway	DBFOM	1993	350
2	CPTC 91 Express Lanes	CA	Toll Motorway	DBFOM	1993	125.6
3	JFK Terminal 4	NY	Airport Terminal	DBFOM	1997	1400
4	Anton Anderson Tunnel	AK	Dual Mode Heavy Rail / Tunnel	DBOM	1998	59.6
5	Lake of the Ozarks Toll Bridge	MO	Toll Bridge	DBF	1998	18.2
6	Southern Connector	SC	Toll Highway	DBFOM	1998	240
7	Foley Beach Express	AL	Toll Bridge	DBFO	1999	44
8	Camino Colombia Bypass	TX	Toll Motorway	DBFOM	1999	90
9	Alameda Corridor	CA	Heavy Rail	DB	1999	712
10	Jamaica-JFK Airtrain	NY	Rail	DBOM	1999	1660
11	Route 3 North	MA	Motorway	DBF	2000	385
12	State Rt. 288	VA	Motorway	DBM	2000	236
13	E-470 Seg. 2&3	CO	Toll Highway	DB	2000	321.4
14	E-470 Seg. 4	CO	Toll Highway	DB	2000	233
15	Reno ReTRAC	NV	Freight Rail	DB	2002	264
16	T-Rex I-25 Road/Rail	CO	Motorway	DB	2003	1670
17	South Bay Expressway	CA	Toll Highway	DBFOM	2003	773
18	I-495 Capital Beltway HOT Lane	VA	Toll Motorway	DBFOM	2007	2006
19	IROX I-75	FL	Highway	DBF	2007	430.5
20	I-95 Widening/Pineda Causeway Interchange	FL	Motorway	DBF	2008	200
21	95 Express Lanes Phase 1A and 1B	FL	Tolled Highway	DBF	2008	139
22	US-1 Improvements	FL	Motorway	DBF	2008	111
23	Palmetto Expressway Widening	FL	Motorway	DBF	2008	190
24	SH 130 Segments 5-6	TX	Toll Highway	DBFOM	2008	1339
25	I-4 Connector	FL	Highway	DBF	2010	389.5

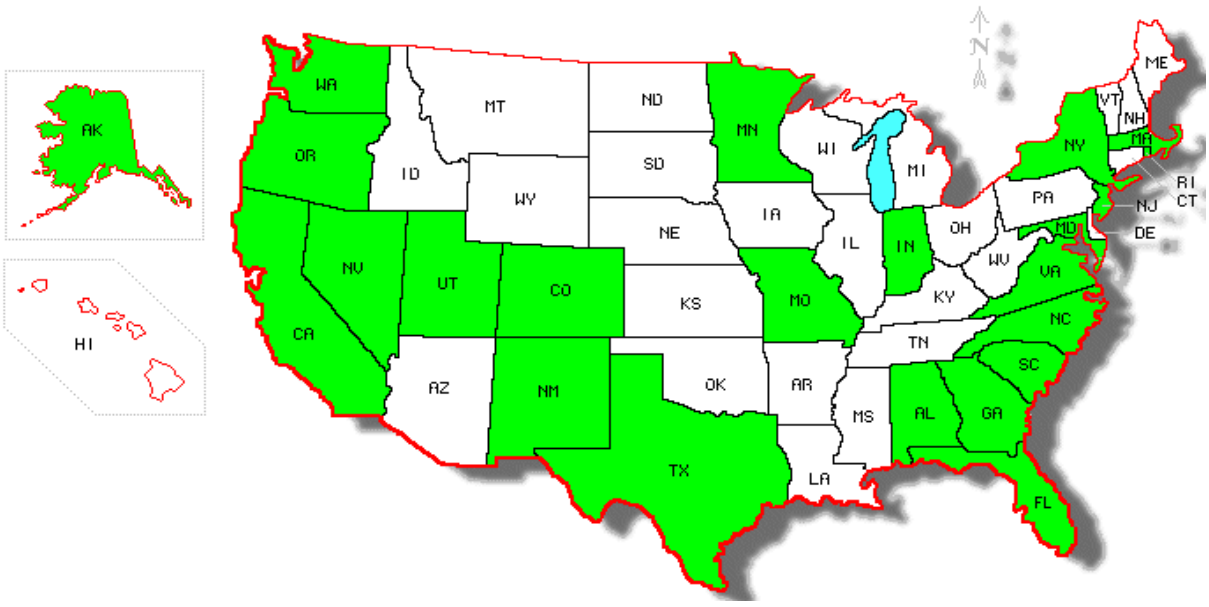

Figure 2: Geographical distribution of U.S. transportation PPP projects

4.0 RESULTS

The results presented in this section focus on the project performance metrics outlined in the research methodology. Cost and schedule growth of the 25 projects included in the dataset can be seen in Figure 3 and Figure 4, respectively. Figure 3 shows 13 of the 25 (52%) projects did not have any cost increase or decreases associated with the project. Of the 11 that did experience cost changes only one came in under budget with the other 10 coming in over budget. For the projects that came in over budget, these cost increases were associated with several variables including; increased scope of work during the contract term, change orders, unanticipated right of way expenses and litigation. Overall, the average cost growth associated with these 25 projects was 3.22%, as shown by the dotted line on Figure 3, with minimum cost growth being negative 4.36% and maximum cost growth being 16.43%.

Furthermore, if the five strictly DB projects contained within the dataset were excluded from the calculations, the average cost growth of the 20 remaining PPP projects would be 2.81%, even lower than the 3.22% value.

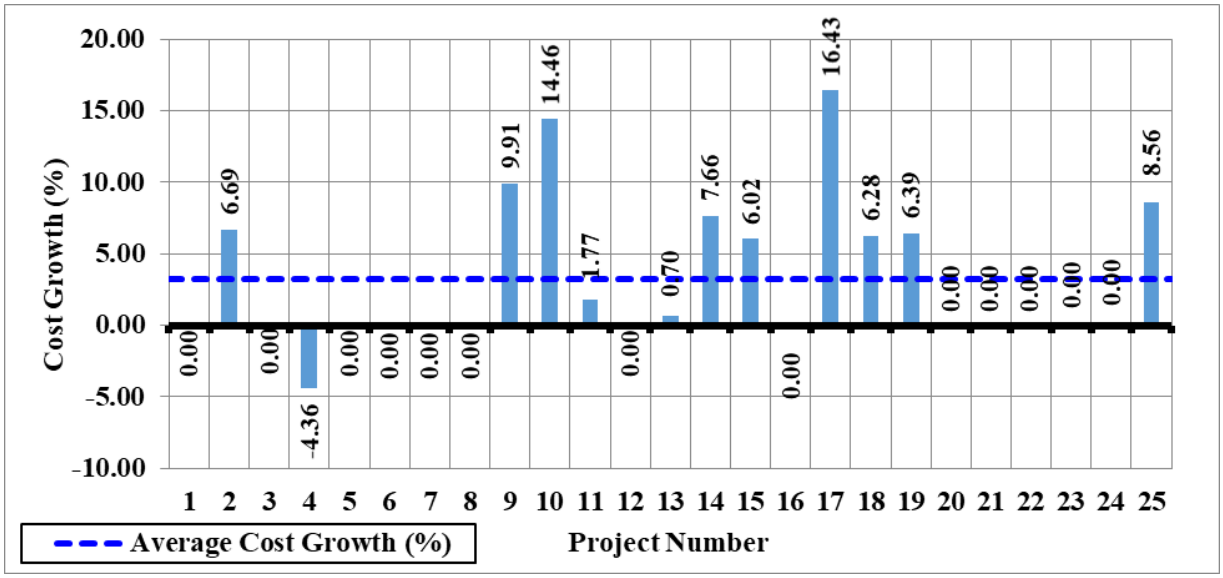

Figure 3: PPP projects cost growth

Figure 4 shows 14 of the 25 projects (56%) did not have any schedule increase or decreases associated with the project and were completed within the contract term. Eight projects were delivered ahead of schedule, while the remaining three projects were delivered extremely late and outside of the contract terms. Project #11, Route 3 North experienced massive delays due to misinterpretation of the contract requirements between the public sponsor and the private developer. Additionally, conflicts regarding the budget, schedule and scope of work also caused substantial delays with the completion of the project but only resulted in a cost growth of 1.77%. The cost growth associated with the delay in this project was not as substantial due to the

liquidated damages for delay being capped at 1% of the project's budget (U.S. DOT 2007). Project #10, the Jamaica-JFK Airtrain experienced project delays due to a catastrophic operational failure of a test run of the facility prior to final acceptance. This event ended up delaying the completion of the project by more than one year and was accompanied by a 14% increase in cost. Project #17, the South Bay Expressway experienced big delays due to substantial contractor claims regarding the scope of work involved in the project. Similarly to Project #10, this caused the project to be delayed by approximately one year and have an associated cost increase of 16.43%. Overall, average schedule growth was 1.2% (shown as the dashed line on Figure 4) with a minimum schedule growth of -18.08% and a maximum schedule growth of 35.56%. Moreover, once again, if the five strictly DB projects contained within the dataset were excluded from the calculations, the average schedule growth for the remaining 20 projects would be 2.58%.

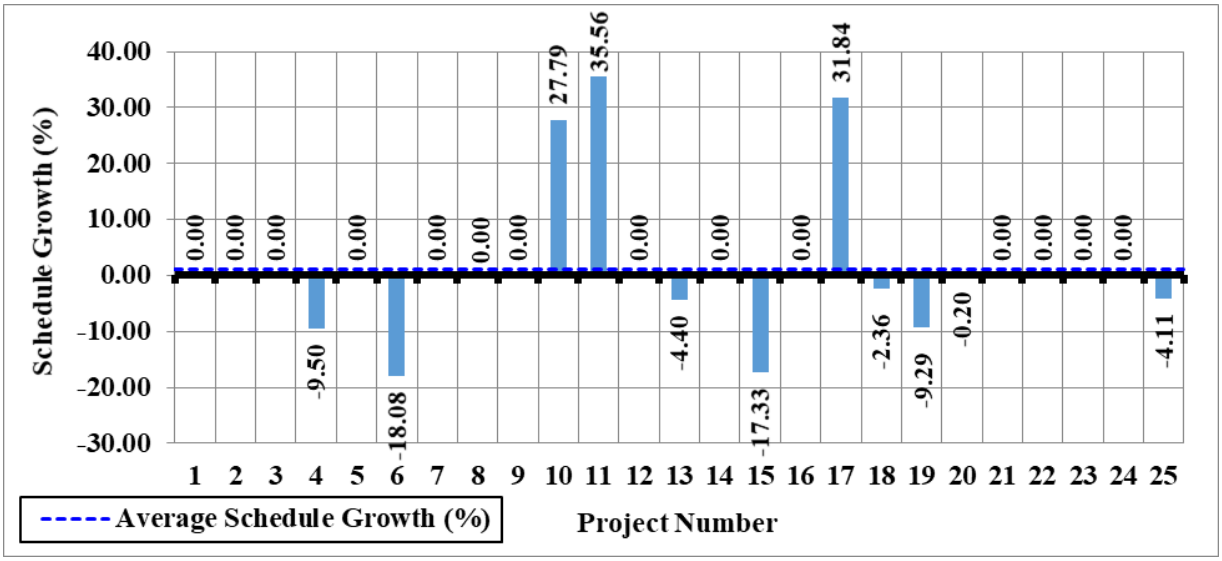

Figure 4: PPP projects schedule growth

The second research objective of this study includes comparing the cost and schedule growth results with that of previous studies targeting the international PPP market. Figure 5 shows the average cost and schedule growth results of the Bain (2010) report for European transportation and infrastructure PPP projects; Chasey et al. (2012); the AUS IPA report (2013); and this study. The average cost overrun for the Bain study was 13%. The average cost overrun for the projects studied by Chasey et al. (2012) was 0.81%. The average cost overrun for the AUS IPA (2013) study was 1.2%. For this study, the average cost overrun was 3.22%. Based on these results, three out of four cost growth findings are around the 1 to 3% range. Figure 5 also presents average schedule overruns for the studies available in the literature. Twenty-two of the 25 (88%) projects included in this study's dataset were delivered on time or earlier, with only three delayed projects driving the average up to 1.20%. If these projects were not considered as part of the average, then the average schedule overrun would decrease to -2.97%, in line with what was reported for the AUS IPA study.

Also included in the second research objective is to compare the cost and schedule overruns with that of previous studies on traditional project delivery performance. Several studies regarding

traditional project performance were reviewed and their results are shown in Figure 6. With regards to cost performance, four of the five studies experienced a cost growth greater than 10%, with only one study, AECOM (2006) showing cost growth below 5%. Schedule performance in two of the five studies showed schedule growth well above 10%, with two studies having schedule growth below 5% and one study, Bain (2010) not reporting schedule changes for the projects included in their dataset. Overall, the DBB cost growth ranges for these studies was from 3.6% to 25% and the schedule growth ranges from 4.34% to 33.5%. These rather large ranges seem to indicate high variability in project performance of traditionally procured projects. Moreover, for the PPP studies project cost growth ranges from 0.81% to 13% and schedule growth ranges from -3.4% to 1.2%. With this much tighter range of cost and schedule performance on PPP projects the argument can then be made for the superiority of PPP projects over traditionally procured projects in terms of cost and schedule certainty. Overall, the results presented in this study provide an initial assessment of PPP project performance in terms of cost and schedule growth for the U.S. transportation sector.

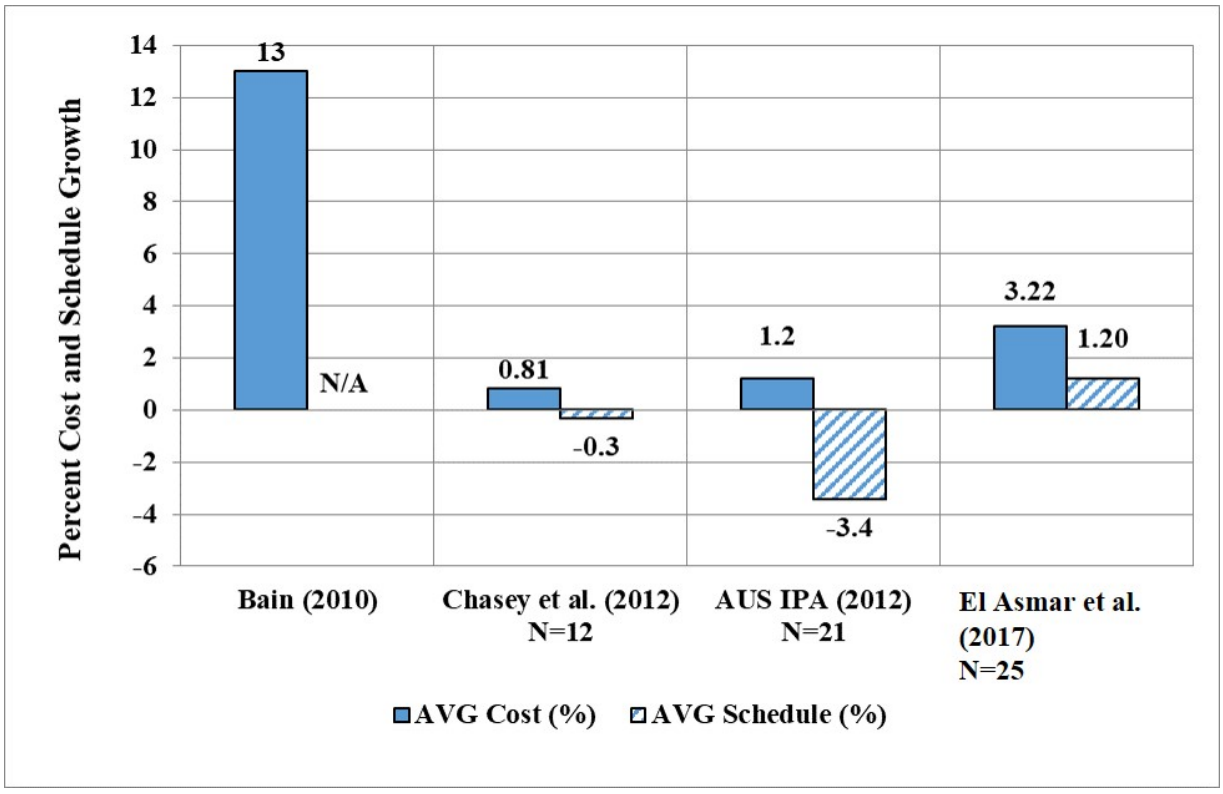

Figure 5: PPP projects cost and schedule growth: U.S. transportation results vs. PPP literature

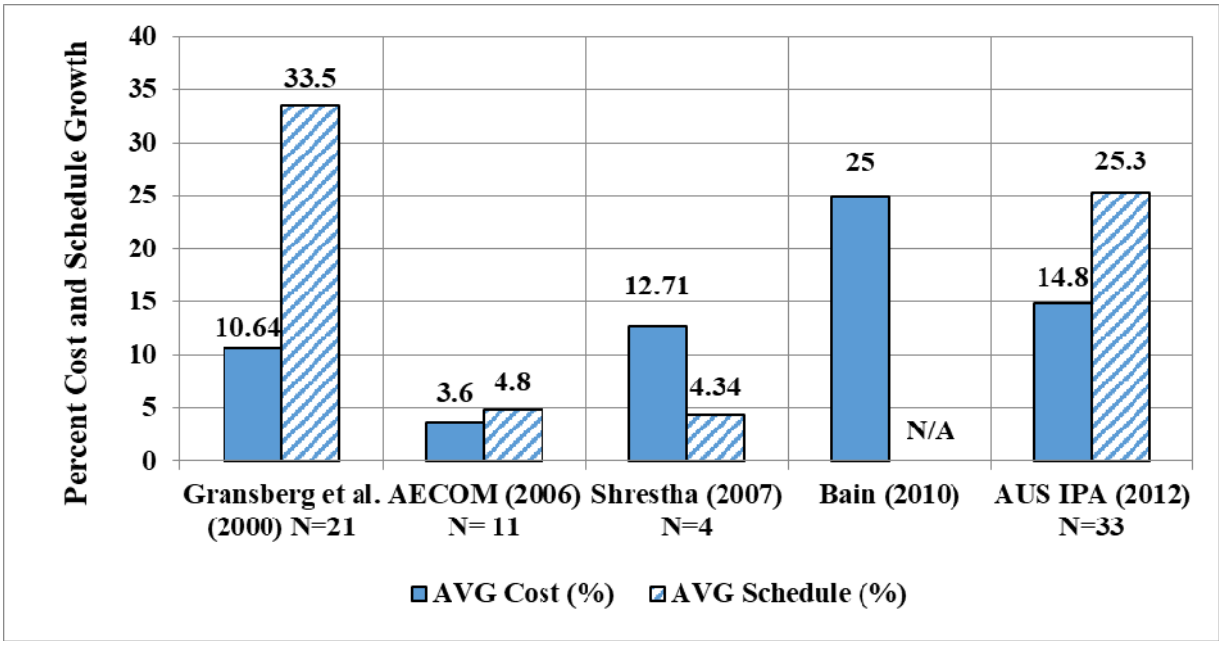

Figure 6: Cost and schedule growth of DBB projects: a comparison baseline

5.0 CONCLUSIONS

Performance research has been conducted on PPPs for international markets in Europe, Australia, and to some extent North America. Well-documented project performance evidence for U.S. transportation PPP projects has been lacking. This study started filling this gap by comparing the cost and schedule overruns of several recently completed PPP projects in the U.S. to that of PPP projects on the international market as well as non-PPP U.S. projects. Overall, this study presents an initial benchmark of PPP cost and schedule performance for the U.S. transportation sector. Public owners and private entities can use this requisite knowledge about PPP to inform their decisions on whether to embark on future PPP projects, and what to expect in terms of cost and schedule growth. The main limitation of this study is the sample size of 25 projects. Future efforts will increase the sample size to include all U.S. PPP projects. Additionally, many cost and schedule overruns are absorbed within the project team and cannot be measured readily. The work presented in this report is a first significant step to provide a comprehensive quantitative performance benchmark of cost and schedule growth for PPP transportation projects in the U.S. Future work on this topic includes increasing the dataset of projects to target all completed U.S. PPP projects and comparing the results to those of the international market to help the industry improve PPP project practices.

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