



CCC 2018

Proceedings of the Creative Construction Conference (2018)
Edited by: Mirosław J. Skibniewski & Miklos Hajdu
DOI 10.3311/CCC2018-052

Creative Construction Conference 2018, CCC 2018, 30 June - 3 July 2018, Ljubljana, Slovenia

Correlation between Contract Type Selection and Cost Growth in U.S Army Corps Construction Projects

Kristina Williams^{a,b}, Anoop Sattineni^a, Robert A Bugg^a

^aAuburn University, 118 Miller Gorrie Center, Auburn, 36849, USA

^bUS. Army Corps of Engineers, 441 G Street NW, Washington DC, 20314, USA

Abstract

In United States federal construction projects, government contract managers seek to negotiate a contract type that will result in a reasonable level of contractor risk, as well as provide the contractor the greatest incentive for improved performance. The Federal Acquisition Regulation provides government contract managers a variety of contract types to choose from to provide flexibility in acquiring a wide range of required supplies and services. Contract types can be broadly group into two categories: fixed price and cost-reimbursement contracts. The aim of this research was to investigate the impact of contract type selection on cost growth in USACE construction projects. Based on the quantitative and qualitative analysis conducted, contract type selection does have an impact on construction cost growth. In addition, it can be concluded that negotiated non-competitive task orders and more specifically, those, which use RSMean and a contractor coefficient, are best at reducing construction cost growth in federal construction projects.

© 2018 The Authors. Published by Diamond Congress Ltd.

Peer-review under responsibility of the scientific committee of the Creative Construction Conference 2018.

Keywords: Cost Growth, Time Growth, Contract Type, Federal Acquisition Regulation

1. Introduction

Contract type selection is a key component in any successful construction project as contract risk is distributed between the contracting parties via the selection of contact type. In federal construction projects, government contract managers seek to negotiate a contract type that will result in a reasonable level of contractor risk, as well as provide the contractor the greatest incentive for improved performance.

A significant amount of research has been conducted on the impact delivery methods (i.e. design build, design bid build, CM at Risk, etc.) and acquisition methods (i.e. negotiated procurement, low bid, or sole source) have on cost growth for both public and private construction projects. However, there is limited research on how contract type affects contract cost growth, specifically in public projects. This research seeks to determine the correlation between contract type selection and construction cost growth in U.S. Army Corps of Engineer (USACE) projects.

1.1. Research Background

The Federal Acquisition Regulation (FAR) with its department and agency supplements is the primary regulatory guidance for all USACE acquisitions. In fiscal year 2016, USACE awarded over \$10 billion in construction contracts. Much of that being awarded on firm-fixed priced contracts based on the FAR's preference for firm-fixed price contracts for construction services.

Corresponding author: Author email: sattian@auburn.edu

For many years, the standard USACE practice was to award construction projects via sealed bid. This meant awarding firm-fixed price contracts to the lowest bidder with design-bid-build (DBB) as the prescribed delivery method. Although private sector construction projects had seen the benefits of utilizing design build (DB) delivery in certain projects, it was not until 1996 when the FAR was updated to allow for the use of DB in federal construction projects [1]. As building technologies continue to advance, construction projects become more complex with an increasing number of unknown challenges. These unknown factors make project cost estimating more difficult, resulting in project cost growth. Research has confirmed that the likelihood of cost overruns increase with contract size and complexity [2]. With so many unknowns associated with complex construction projects, USACE has moved from traditional low bidder awards to negotiated best value procurements. Based on research conducted on both private and public projects, negotiated best value procurements typically result in less cost growth when compared with lowest bid awards [3]. Even though several studies confirm these findings, none of these studies considered how contract type might affect costs. The aim of this research is to investigate the impact of contract type selection on cost growth in USACE construction projects. The researchers seek to expand the body of knowledge regarding contract type selection in USACE construction projects. This research is particularly relevant as Government projects continuously face shrinking budgets and limited numbers of qualified personnel capable of overseeing construction projects. The research scope is limited to USACE construction projects including interviews conducted with various USACE project and contract managers. Quantitative data is gathered from various construction projects from four different district offices in the southeast United States. Qualitative data comes from interviews with six district contracting chiefs, project managers, and legal counsel from each of the four district offices from which the quantitative data was collected.

2. Literature Review

The FAR provides government contract managers a variety of contract types to choose from to provide flexibility in acquiring a wide range of required supplies and services. Contract types can be broadly group into two categories: fixed price and cost-reimbursement contracts. The two main differences distinguishing these groups is degree and timing of risk assumed by the contractor for the costs of performance and the amount and nature of the profit incentive offered to the contractor for achieving or exceeding specified goals. Contract types can be arranged on a continuum with firm-fixed-price contracts on one end, in which the contractor bears all the risk for cost growth and the resulting profit or loss. On the other end a contract type of cost-plus-fixed-fee, in which the government bears all the risk for cost growth and the negotiated contractor fee is fixed. Selecting the appropriate contract type should result in a reasonable level of contractor risk, as well as provide the contractor the greatest incentive for improved performance.

When project requirements are well defined and the level of complexity reasonably low, using a firm fixed price contract is the best contract type to motivate contractor based on basic profits motives. As project size and level of complexity increases, other contract types should be considered and negotiations should be directed toward selecting a contract type that will appropriately tie profit to contractor performance. The FAR recommends that government contract managers consider several factors when selecting contract types to include: level of competition in the market, cost/price analysis, complexity of project, urgency of requirement, project duration, and acquisition history. It is relevant to understand the nuances of various contract types to explore cost growth trends between them.

2.1. Fixed Price Contract

Fixed price contracts establish a firm price for the completion of a project. Within the fixed price *category*, there is a *range* of contract types. Firm-fixed-price contracts are the most commonly used fixed price contract type. These contracts establish a price that is not subject to any adjustment based on the contractor's actual cost incurred during contract performance. This places maximum risk for all costs and resulting profit or loss on the contractor. This contractual relationship provides contractors with the maximum incentive to control costs. If performance uncertainties are low and costs can be reasonable estimated, contractors are willing to enter into firm-fixed price contracts; however, as uncertainties increase, use of firm-fixed price forces contractors to factor in the additional risk of these unknown unknowns in their prices. Thus, potentially leading to higher pricing.

2.2. Cost Reimbursement Contracts

When using cost-reimbursement contracts the FAR allows for the payment of all allowable and allocable costs incurred to the extent prescribed in the contract. These contracts establish a ceiling that cannot be exceeded without

agreement and approval of the government-contracting officer. Cost-reimbursement contracts place maximum risk on the government if the project cannot be completed within expected costs. With the high level of uncertainties involved in large and complex projects, contractor's may be unwilling to accept the risk of working under fixed-price contracts, which makes cost-reimbursement contracts necessary to transfer risk from the contractor to the government. When a decision to use a cost-reimbursement contract is selected, the Government not only accepts additional performance risk, but also accepts the burden of additional oversight and management requirements.

2.3. Incentive Contracts

In recent years, there has been a move toward the use of incentive contracts in public and private projects. The FAR states that incentive contracts are appropriate when services can be acquired at lower costs or with improved performance, by relating the amount of profit or fee payable under the contract to the contractor's performance. Per FAR 16.401, incentive contracts satisfy project objectives by establishing reasonable and attainable targets that are clearly communicated to the contractor and includes appropriate incentives designed to motive contractors to achieved these desired targets (i.e. discourage contractor inefficiency and waste). Incentive contracts work by establishing a predetermined formula, based on specified performance or delivery targets, in which profits or fees increase based on achieving targets or decrease when targets are not met.

2.4. Indefinite Delivery/Indefinite Quantity Contracts

USACE has seen a significant increase in the utilization of Indefinite Delivery/Indefinite Quantity (IDIQ) contracts for construction services because of the reduced procurement time and administrative burden they can provide (Stanford M. Scott et al., 2016). IDIQs are contractual relationships that allow the Government to place individual task-orders with contractors as projects become known, within stated limits, for a fixed period. While the IDIQ itself does not contain specific project performance specifications, the individual task orders do. When utilizing IDIQ contracts, the Government can award single award task order contracts (SATOC) or multiple award task order contracts (MATOC) in which each contractor within a pre-established pool must be given fair opportunity to compete for each task order. When issuing task orders against a non-competitive SATOC, some USACE offices utilize agreed upon unit prices guides like RSMeans and a contractor coefficient to determine the contract price.

Although there are many advantages of utilizing IDIQ contracts, critics point out that these contracts can limit competition to either a single contractor or small pool of contractors which could inadvertently lead to higher costs by limiting competition. Additionally, broad scopes of these IDIQs can limit small business participation [3]. The small business community has been critical of the increased use of IDIQ contracts due to being adversely impacted by contract bundling [4]. Thus, small business lobbying has resulted in changes to the Small Business Act, which make contract consolidation and bundling a much more difficult obstacle for Government contract managers to overcome.

2.5. Cost Growth

2.5.1. Identified Causes

A significant amount of research has been conducted studying the impact delivery methods (i.e. design build, design bid build, CM at Risk, etc.) and acquisition methods (i.e. negotiated procurement, low bid, or sole source) have on cost growth for both public and private construction projects [1, 2]. Cost growth has been attributed to unanticipated project schedule growth, the inability to accurately anticipate material or labor shortages, rework, unexpected site conditions, and owner requested changes. Multiple studies have suggested that the probability of cost overruns increases with the size, complexity, and number of change orders issued during project performance [5]. Unclear objectives, scope creep with no change control system, inappropriate procurement approach, poor leadership with unqualified staff, poor planning with unrealistic time scales, and overall poor contract management are seen as some of the factors leading to cost growth and potentially project failure [5].

2.5.2. Federal Requirements

Some researcher have found that public owners are exposed to additional risk due to additional requirements based on laws and regulations placed on federal construction projects[6]. The FAR, Buy American Act, Davis Bacon Act wage rates, and socio economic considerations all increase the cost of public sector construction projects [7]. Public projects seek to deliver best value to owners, but unlike private sector projects, public projects must do so while

maintaining the public's trust and fulfilling public policy objectives. In addition to providing assurances for fair and competitive source selections, the FAR requires that all public projects comply with all administrative, financial, labor, and environmental laws, which by their very nature result in increased project costs [8].

2.5.3. Small Business Considerations

With the passing of the Small Business Act in 1953, US Congress has decided that government should aid, counsel, assist, and protect, insofar as is possible, the interests of small business concerns in order to preserve free competitive enterprise. This will ensure that a fair proportion of the total purchases and contracts or subcontracts for property and services for the government will be placed with small business enterprises [4]. This congressional intent is further promulgated through FAR regulations stating that all federal acquisitions below \$150,000 be set aside exclusively for small business competition. Additionally, for acquisitions above \$150,000 in which market research determines that two or more small business will likely compete, these acquisitions must be set aside exclusively for small business competition. For construction projects over \$1.5 million that are not awarded to a small business, contractors must have small business subcontracting plans to the extent there are subcontracting opportunities. These plans establish subcontracting goals for various small businesses socio-economic categories i.e. women owned, HUB Zone and service-disabled veteran owned [9]. These socio-economic requirements tend to lead to increased project costs due the difficulty in finding and securing sub-contractors under each of the required socio-economic categories.

To help expand the industrial base and support small disadvantaged businesses, the U.S. Small Business Administration (SBA) created the "8(a) Business Development Program". This program allows Federal agencies to award sole-source contracts up to \$4 million to 8(a) firms. USACE has used this program extensively to award \$4 million SATOCs to 8(a) firms, which allows USACE to quickly issue task orders for smaller individual projects.

This literature review illustrates that there are several factors that lead to construction cost growth, many of which may be out of the control of the contracting parties. However, previous studies have shown that the chosen delivery method or acquisition strategy play a significant role in predicting the likelihood of construction cost growth. Further research is needed to determine how 'contract type selection' impacts cost growth, while taking into consideration the impacts of delivery method, acquisition strategy, and small business requirements.

3. Research Methodology

A mixed method study involving qualitative data and quantitative data were used in the conduct of this research.

3.1. Quantitative Data

The quantitative data used for this research comes from completed construction projects awarded out of four USACE district contracting offices in the southeast United States. With the research aim to investigate the effect contract type selection has on cost growth in USACE construction projects, the chosen data set covers various delivery methods, acquisition methods, and most importantly a variety of contract types. All quantitative data was obtained via the USACE Electronic Data Warehouse (EDW) and validated by comparison to the Federal Procurement Data System - Next Generation (FPDS-NG) system. These two separate databases collect various data concerning USACE construction projects. Checking data in both sources ensured the accuracy of data considered for this research. Instead of using actual project names and contract numbers a generic project number usage to ensure anonymity. Cost growth is calculated as a percentage of final project cost versus awarded project contract cost. Time growth is also calculated as a percentage of extra days used to complete the project versus original days

3.2. Qualitative Data

The qualitative data used for this research comes for interviews of six government employees that are currently involved in awarding and administering construction projects on behalf of USACE. These individuals include professionals with titles contracting chiefs, project managers, and legal counsel from each of the four district offices from which the quantitative data was selected. USACE contracting chiefs are the highest ranking contracting official within their respective districts and are accountable and responsible for all contracts awarded within their offices. Each of these contracting chiefs hold unlimited contracting officer's warrants, which allow them to enter into contracts on behalf of the Government for any dollar amount. USACE project managers hold ultimate responsibility for the successful completion of a project under their watch.

Each interview be with questions related to their role within the organization and what types of construction projects they support. Then each interviewee is asked a series of questions related to acquisition method and contract type selection, and how these selections impact cost growth of a project. The overall intent of the interviews is to determine the types of contracts used by the interviewees, as well as determine their feelings on how contract type selection impacts project cost growth.

4. Results

The results for the research are organized by the type of data collected.

4.1. Quantitative Data

The quantitative data collected for this research came from 171 completed construction projects awarded out of four USACE district contracting offices in the southeast United States. The projects in the sample ranged in size from \$4,237 to \$16,231,843, with average size of \$946,372. The projects within the sample include work for mostly sustainment, restoration, and modernization (SRM) type work and small new construction of maintenance and storage facilities on military installations. These projects include construction of new facilities, mechanical-electrical-plumbing (MEP) repair/replacement projects, road and airfield pavement repairs, roof replacements, water/sewer system upgrades, and miscellaneous maintenance and restoration work on existing facilities. All projects within the sample were awarded and completed between October 2014 and September 2017. Contract type, cost growth, and time growth were determined for each construction project. Once collected, the data was sorted by contract type and analyzed for cost and time growth. Results of the analysis is presented in a tabular format, along with associated discussion.

Table 1: Summary of Contract Changes for Competitive Task Orders

Project Type	Number of Projects	Average Cost Growth	Average Time Growth	Projects with Cost Growth	Projects with Time Growth
MEP Repair/Replacement	13	4.43%	25.11%	11	10
Misc. Maintenance/Restoration	45	8.38%	29.53%	20	27
New Facilities	5	2.62%	18.08%	2	2
Paving	4	11.34%	51.88%	1	3
Roof Replacement	3	-25.33%	22.57%	0	2
Water/Sewer Upgrade	1	7.79%	64.00%	1	1
Summary	71	5.99%	29.36%	35	45

Table 1 presents the changes to contracts that were acquired using a competitive task order. Competitive task order project sample had an average of 6% cost growth and nearly 30% time growth. However, nearly 50% of projects had cost growth and 63% of projects had time growth.

Table 2: Summary of Contract Changes for Firm Fixed Price Projects

Project Type	Number of Projects	Average Cost Growth	Average Time Growth	Projects with Cost Growth	Projects with Time Growth
MEP Repair/Replacement	2	9.40%	14.40%	1	2
Misc. Maintenance/Restoration	6	3.06%	19.57%	4	6
New Facilities	7	5.87%	14.26%	2	4
Paving	3	20.70%	7.13%	2	1
Water/Sewer Upgrade	1	21.05%	59.10%	1	1
Summary	19	8.50%	17.18%	10	14

Firm fixed price (FFP) acquisition method type contract changes are presented in Table 2. FFP acquired projects had an 8.5% cost growth and 17.18% time growth. More than 50% of the projects had cost growth and 73% of them had time growth.

Table 3: Summary of Contract Changes for Non-Competitive Task Orders

Project Type	Number of Projects	Average Cost Growth	Average Time Growth	Projects with Cost Growth	Projects with Time Growth
MEP Repair/Replacement	2	0.00%	4.60%	0	1
Misc. Maintenance/Restoration	72	1.35%	13.10%	11	18
Paving	5	3.41%	17.04%	1	2
Roof Replacement	2	3.72%	16.40%	1	2
Summary	81	1.50%	13.21%	13	23

Table 3 shows contract change data for projects acquired using non-competitive task order acquisition method. The data shows an average cost growth of 1.5% and time growth of 13.21%. Only 16% of projects has cost growth and 28% of the projects had time growth.

Table 4: Comparison of cost growth by contract type

	Competitive Task Order	Firm Fixed Price Projects	Non-Competitive Task Oder	Total Projects
Mean	5.99%	8.50%	1.50%	4.14%
Standard Deviation	23.88%	15.63%	5.40%	16.76%

Table 4 illustrates the average cost growth and standard deviation for each of the contract types used in the sample. The average percentage cost growth for projects within the sample was 4.14%. When comparing the different contract types, non-competitive task orders outperform competitive task orders and firm-fixed price standalone contracts when it comes to percentage of average cost growth. The average percentage cost growth for non-competitive task orders was a very low 1.50%, with competitive task orders and firm-fixed price standalone coming in at 5.99% and 8.50% respectively. Although competitive task orders have lower average cost growth than firm-fixed price standalone, the firm-fixed price standalone had a lower standard deviation meaning there is less variability in cost for firm-fixed price standalone when compared the competitive task orders. Not only did the non-competitive task orders outperform the other contract types, but with a standard deviation of 5.40%, there is significantly less variability in cost growth for non-competitive task orders when compared to the other contract types. This low average cost growth and standard deviation, could be because many of these non-competitive task orders were awarded based on agreed upon unit prices guides like RSMMeans and a contractor coefficient to determine the contract price. This requires that the contractor has a very clear understanding of the project requirements as the only item truly being negotiated is level of effort for labor rates.

Table 5: Comparison of time growth by contract type

	Competitive Task Order	Firm Fixed Price Projects	Non-Competitive Task Oder	Total Projects
Mean	29.36%	17.18%	13.21%	20.36%
Standard Deviation	34.52%	17.75%	27.36%	30.59%

Table 5 illustrates average time growth percentages and standard deviation for each of the contract types used in the sample. The average time growth for all the projects within the sample was 20.36% with a standard deviation of 30.59%. This high standard deviation is indicative of the high degree of variability of time growth within the sample. When comparing the different contract types, again the non-competitive task orders outperform the other contract types with average time growth at 13.21%. Unlike average cost growth, firm-fixed price standalone contracts outperform competitive task orders in terms of average time growth. With an average percentage time growth of 17.18%, firm-fixed price standalone contracts experience less average time growth than competitive task orders and based on standard deviation, have less variability than both competitive and non-competitive task orders.

4.2. Qualitative Data

The qualitative data collected for this research came from interviews of six government employees that are currently involved in awarding and administering construction projects on behalf of USACE. These individuals include contracting chiefs, project managers and legal counsel from each of the four district offices from which the quantitative data was selected. The data was analyzed using thematic analysis techniques and presented under the headings of the major themes uncovered in the analysis.

4.2.1. Acquisition Method

The offices from which the quantitative data was collected use a wide variety of acquisition methods for the procurement of construction services. These include sole source negotiated procurements, as well as competitive negotiated procurements utilizing best value trade-off and lowest price technically acceptable selection criteria. In rare instances, these offices utilized sealed bidding procedures which award projects to the lowest priced bidder without evaluating technical capability. Either best value trade-off or lowest price technically acceptable selection criteria is used when issuing competitive task orders.

Based on the interview responses, consensus within a project delivery team typically determine which acquisition method is used for any projects. A variety of factors are used when determining which acquisition method is most appropriate for a project. This decision is usually based on the type of work to be performed, the complexity of the project, the estimated dollar value of that project, the amount of time needed based on the project plan, and the availability of existing contract tools such as existing IDIQ contracts. Most of the interviewees felt that acquisition method directly impacts cost growth and the ability to control cost growth on a project. Unsurprising, negotiated procurements were seen as being better at controlling cost growth because of their ability to ensure that contractors had a clearer understanding of all project requirements.

4.2.2. Contract Type

As expected, based on the quantitative analysis conducted, the contract types utilized by the interviewees were the same as those within the quantitative data sample. The interviewees discussed several factors considered when making a contract type selection decision such as complexity of project, whether the project was within scope of an existing IDIQ, and how quickly the contract needed to be awarded. One interviewee mentioned the need to consider if project items and quantities be could be reasonably estimated and the need to be able to account for that, as well the need to incentivize contractor cost controls. Typically, the contract type selection decision is made concurrently with the acquisition method selection decision. Both of which are made by consensus within the project delivery team.

None of the interviewees had experience using other than firm-fixed price standalone or task orders for awarding or administering construction projects. Several of the interviewees were familiar with the theory behind incentive contracts such as fixed-price incentive firm target and believed there could be value in their utilization. However, the consensus was that government personnel don't have the skills and/or resources necessary to administer complex contract types. Project delivery teams are hesitant to serve as pilot projects for a non-traditional contract type utilization and most project delivery teams do not consider the possible benefits worth the risk in trying non-traditional contract types. In general, the interviewees felt that firm-fixed price were adequate in handling changes and controlling cost growth during a construction project. One interviewee specifically stated that least cost growth comes from projects awarded using non-competitive task orders with price being determined by RSMMeans and a contractor coefficient. This was validated by the quantitative analysis conducted.

4.2.3. Other Common Themes

Along with acquisition method and contract type selection impacting cost growth, other themes were mentioned as potential cost growth factors. One of the most frequently mentioned was that the quality of the project drawings and specifications were seen as a significant contributor to project cost growth. Unclear requirements lead to excessive requests for information, contract modifications and project delays, all of which are known project cost drivers. Another common theme was the impact of fiscal restraints caused by the utilization of federally appropriated dollars. Many times, contractor proposal come in above program amounts which adds additional risk to the project, as all funds must be available at time of award to prevent an Anti-Deficiency Act violation. Federal dollars have finite obligation periods which means if contracts are not awarded before funds expire, the funds will be lost and not be available for obligation. This leads to the extensive use of options as incrementally funding firm-fixed price contracts is typically not allowable by the FAR.

5. Conclusions

The aim of this research was to investigate the impact of contract type selection on cost growth in USACE construction projects. With this aim, a literature review was conducted to investigate various causes for cost growth as well as understand the various contract types allowed by the FAR. Based on the quantitative and qualitative analysis conducted, contract type selection does have an impact on construction cost growth. It can be concluded that negotiated non-competitive task orders and more specifically, those which use RSMMeans and a contractor coefficient are best at reducing construction cost growth. In addition, the quantitative analysis showed that the type of work (i.e. MEP repair/replacement, paving, water/sewer upgrade, etc.) impacts the likelihood of project cost growth. Although small business utilization has been seen as a potential cost driver, USACE's utilization of the SBA's 8(a) Business Development Program, has resulted in projects that have less cost growth than other projects.

Based on the interviews it seems that all three contract types within the sample are adequate at handling changes and motivating contractor performance. Although there may be benefits from the use of non-traditional contract types, consensus from the interviewees was that government personnel currently do not have the skills to administer non-traditional contract types, project delivery teams are hesitant to serve as pilot projects for a non-traditional contract type utilization, and organizational cultural does not consider the possible benefits worth the risk in trying non-traditional contract types.

5.1. Research Limitations

Potential limitations of this study include the limited number of projects contained within the sample, as a larger sample size with a broader geographical foot print could potentially impact conclusions found. Additionally, the projects within this sample did not contain large new vertical construction projects. A more in-depth look into the individual cost growth drivers for each of the projects within the sample would provide more detailed analysis than original versus final project costs alone.

5.2. Recommendations

Although competition is known to lead to lower initial pricing, competition in and of itself does not necessarily limit construction cost growth. Working with known contractors to award contracts based upon agreed upon rates and engaging in discussion to truly ensure understanding of project requirements leads to significantly less project cost growth. Based on the quantitative analysis showing that the type of work impacts the likelihood of cost growth, project managers should use this information to mitigate these cost growth risks when possible. Additionally, the 8(a) Business Development Program easily lends itself to establishing relationships with known contractors and awarding sole source contracts under \$4 million. Expanding the utilization of RSMMeans and a contractor coefficient to larger projects could lead to less cost growth in future projects. Recommendations for further research include a study that looks specifically at contracts that utilize price guide pricing (i.e. RSMMeans), the selection criteria used to select these contractors and the amount of actual negotiations that take place prior to award of a contract. This would help highlight possible reason why some contract types are better at controlling costs than others.

References

- [1] Yu Tao, Shen Geoffrey Qiping, Shi Qian, 2017. Comparing the Performance Quality of Design-Bid-Build and Design-Build Delivery Methods. *J. Constr. Eng. Manag.* 143, 04016111. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0001262](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001262)
- [2] Love Peter E. D., Wang Xiangyu, Sing Chun-pong, Tiong Robert L. K., 2013. Determining the Probability of Project Cost Overruns. *J. Constr. Eng. Manag.* 139, 321–330. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000575](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000575)
- [3] Stanford M. Scott, Molenaar Keith R., Sheeran Kelly M., 2016. Application of Indefinite Delivery–Indefinite Quantity Construction Strategies at the Federal Level. *J. Manag. Eng.* 32, 04016011. [https://doi.org/10.1061/\(ASCE\)ME.1943-5479.0000437](https://doi.org/10.1061/(ASCE)ME.1943-5479.0000437)
- [4] Clark III, M., Moutray, C., 2004. The Future of Small Business in the U.S. Federal Government Marketplace. *J. Public Procure.* 4, 450–470.
- [5] Ren Z., Shen G. Q., Xue X. L., 2013. Failure Caused by Inappropriate Construction Methods: An Expensive Lesson. *J. Manag. Eng.* 29, 25–34. [https://doi.org/10.1061/\(ASCE\)ME.1943-5479.0000117](https://doi.org/10.1061/(ASCE)ME.1943-5479.0000117)
- [6] Crowley Larry G., Hancher Donn E., 1995. Risk Assessment of Competitive Procurement. *J. Constr. Eng. Manag.* 121, 230–237. [https://doi.org/10.1061/\(ASCE\)0733-9364\(1995\)121:2\(230\)](https://doi.org/10.1061/(ASCE)0733-9364(1995)121:2(230))
- [7] Blomberg Daniel, Cotelleso Paul, Sitzabee William, Thal Alfred E., 2014. Discovery of Internal and External Factors Causing Military Construction Cost Premiums. *J. Constr. Eng. Manag.* 140, 04013060. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000810](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000810)

- [8] Johnson Travis R., Feng Peter, Sitzabee William, Jernigan Mark, 2013. Federal Acquisition Regulation Applied to Alliancing Contract Practices. *J. Constr. Eng. Manag.* 139, 480–487. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000592](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000592)
- [9] Small Business Set Asides [WWW Document], 2017. . Small Bus. Set US Small Bus. Adm. SBAgov. URL <https://www.sba.gov/contracting/government-contracting-programs/what-small-business-set-aside> (accessed 8.31.17).