 

# Correlation between Cost Growth and Procurement Methods on USACE Construction Projects

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Procurement methods play a major role in the outcome of a construction project. This study focuses on the various procurement methods that are commonly used throughout United States Army Corps of Engineers (USACE) and analyzes each for construction cost growth. It also describes each method in detail. In order to determine which procurement method performs the best regarding construction cost growth the study used both quantitative and qualitative data. The quantitative data was taken from project data (procurement method, cost growth, time growth, etc.) from three different resident offices from two different districts. The qualitative data was developed from interviews of thirteen different resident engineers from nine different districts. The result of both types of data is that acquisition methods which award construction contracts considering other factors besides low cost, such as Best Value Tradeoff and Sole Source, perform significantly better when it comes to controlling cost growth. This study determined that taking into account factors such as past performance of contractors and best value were key in controlling cost growth on USACE construction projects, as opposed to awarding contracts to the lowest bidder.

**Key Words:** Government, Construction Management, Schedule Delays, USACE

## Introduction

The primary objective for an U.S. Army Corps of Engineers (USACE) construction management team is to deliver the project with high quality, ahead of schedule and within budget. One of the most difficult challenges to overcome during a construction project and a key issue especially if contingency funds are not readily available is cost growth. "*Over the time span between project initiation (concept development) and the completion of construction many factors may influence the final project costs*" (Shane et al., 2009). Once the construction contractor runs into a situation that causes the contract dollar amount to increase, the USACE construction management team has several decisions to make in order to avoid an Anti-deficiency Act (ADA) violation. Per the U.S. Government Accountability Office (GAO, n.d.), "*the Anti-deficiency Act prohibits federal employees from making or authorizing an expenditure from, or creating or authorizing an obligation under, any appropriation or fund in excess of the amount available in the appropriation or fund unless authorized by law*".

The ADA essentially prohibits a federal employee from entering into a contract obligation without the appropriate funds to meet that obligation. Therefore, the options when faced with such an issue are: (1) USACE construction management team has to find the appropriate funds, (2) USACE construction management team has to decrease part of the contract scope in order to pay for the contract increase, or (3) USACE construction management team has to put the construction contractor in suspense of work. Putting the contractor in work suspense can be the worst of the three choices since it will most likely lead to additional delay costs. This measure results in tying up public funds in an unusable and incomplete project. Differing site conditions, engineering or design changes and user changes are all common causes for a construction contract to grow in cost. How susceptible a construction project is to the various causes of cost growth will often depend on upon the acquisition method used to award the construction contract. The Federal Acquisitions Regulations (FAR) is the primary regulations, both uniform policies and procedures, for use by all Federal Executive agencies in their acquisition of supplies and services (U.S. Federal Government, 2017). The FAR governs all contracting actions and provides numerous contracting options that can be applied to a typical project conditions. The research on construction delivery methods shows studies that explore the nuances of delivery methods such as design-bid-build (DBB), design-build (DB) and construction management at risk (CMAR) (CMAA, 2012). The intent of this research is to analyze the various types of acquisition methods set by the USACE and determine which method(s) have correlation to restricting, or controlling, cost growth.

Jeffery and Menches (2008) note, "*the FAR supports the use of 16 different contract types, but the selection of a contract strategy is delegated to the agency contracting authority*". The scope of this study narrows the number of contract types to the most commonly represented six from the data collected: Performance Oriented Construction Activity (POCA), Single Award Task Order Contract (SATOC), Design-Build Multiple Award Task Order Contract (DB MATOC), Invitation for Bid (IFB), Two Step Design-Build (DB II Step), and Indefinite Delivery/Indefinite Quantity (IDIQ). The choice of which contract approach to employ in a given situation is not well defined, and usually there are complex interrelationships to be considered. In addition, different contract authority representatives may have differences of approach for the same set of conditions that in turn produce different results (Jeffery and Menches, 2008). The ultimate decision as to which contract strategy is most appropriate based on the information on hand is left up to the contracting officer. As this decision is often times required prior to the final settlement of the project scope, the contracting officer's goal is to select the contract type that assigns as much risk as possible on the construction contractor and provides the contractor with the highest performance incentive. The aim of this study is to determine if there is a direct correlation between procurement methods and cost growth in USACE construction projects. Since the construction schedule can be a key indicator of project delay and therefore cost escalation, schedule delays are also considered in the analysis of data.

## Literature Review

A brief discussion of the various acquisition methods used by USACE in awarding construction projects is appropriate for the reader to better understand the themes discussed in this research. Five acquisition methods were the subject of this study based on data obtained from USACE are listed in Table 1 below, along with the procurement process and typical contract amounts. USACE, as in the case of several federal agencies is separated into technical professionals represented by the 'Engineering Corps' and contracting professionals represented by the 'Contracting Corps'. The contracting corps group of professionals uses the procurement methods discussed in this research and is responsible for any changes to the terms to the contract, post award. However, professionals within the engineering corps have authority to approve contract modifications up to five hundred thousand dollars.

Table 1. *Construction Procurement Methods in USACE*

| Name | Acronym | Procurement Process | Contract Amounts |
|---|---|---|---|
| Performance Oriented Construction Activity | POCA | Negotiations | < $4 Million |
| Best Value Tradeoff | BVTO | Negotiations | < $30 Million |
| Design-Build Multiple Award Task Order Contract | DB MATOC | Competitive | Unlimited |
| Invitation for Bid | IFB | Competitive | Unlimited |
| Indefinite Delivery / Indefinite Quantity | IDIQ | Competitive / Negotiations | < $30 Million |

The 'Performance Oriented Construction Activity' (POCA) contract is a sole source construction contract that is given to small disadvantaged businesses. The contract is awarded by negotiations and can be used for general construction or a specific discipline (i.e. electrical, mechanical, etc.). The typical maximum amount that is awarded against a POCA is $4M. The 'Design-Build Multiple Award Task Order Contract' (DB MATOC) contract is awarded through a two-step process. The first step is to short-list a group of contractors down to four to six through proposal evaluation. The second step is each task order within the DB MATOC contract is awarded through competition of the short-listed contractors using two common methods namely 'Best Value Tradeoff' (BVTO) or 'Lowest Price Technically Acceptable' (LPTA). The BVTO method will award the contract to the overall best value to the government and not necessarily the lowest price. The LPTA method will award the contract to the lowest price of all the proposals deemed technically acceptable (i.e. meet all of the requirements of the selection criteria/contract).

The 'Invitation for Bid' (IFB) contract is the traditional construction contract acquisition method that awards to the lowest responsive bidder. IFB uses 100% design and in construction terms is commonly known as 'Design-Bid-Build'. A contract that is referred to as an IDIQ in the USACE toolbox, it refers to a specific type of work (e.g. Paving IDIQ, Painting IDIQ, Roofing IDIQ, etc.). The IDIQ base contract is awarded through proposal evaluation using BVTO. The IDIQ contract includes pre-priced line items such as square yards of 3" asphalt or square feet of 4-ply built roofing system, etc. and then the contracts for the pre-priced scopes are issued as task orders during a fixed period of time. It must be noted, the contracting officer must indicate the procurement methods clearly in the invitation process. If a bid is expected to use competitive processes, the contracting officer may not use any other methods to evaluate proposals.

However, if a negotiated process is used, the contracting officer may also use additional means such as past performance of the contractor to evaluate proposals.

The primary role of the USACE construction office is to manage the construction contract from notice to proceed (NTP) through contract closeout and to provide construction quality assurance for a customer who owns the property. Example customers include Department of the Air Force, Department of Veteran Affairs, apart from the Department of the US Army. Therefore, the research will be based on the owner's point of view. The procurement method would have an influence on the amount of money that an uncontrolled event such as differing site condition, market conditions, etc. would cost, but it would not be able to prevent an uncontrolled event from occurring. With this in mind, the research will focus on factors which can be controlled. Both engineering skills (e.g. project development, design and cost estimating) and soft skills (e.g. collaboration, communication, and partnering) have a large impact in preventing cost growth, but the procurement method will have also have an impact on soft skills since the engineering skills are usually set ahead of time via the design/request for proposal (RFP). The research on the causes of cost growth in construction projects has been narrowed down to include literature that analyzes factors after contract award, are government driven, are controlled and are based on soft skills.

## *Cost Growth Causes – Post Contract Award*

There is a significant amount of literature that considers the entire process from project development to project completion when evaluating causes of cost growth in construction projects. Rosenfeld (2013) started with 146 potential cost growth causes and concluded that there are fifteen universal root causes. Shane et al., (2009) determined that from an industry standpoint, the causes of cost growth could be broken into eighteen factors. A common cause throughout the research is scope creep or changes in the project definition. Creedy et al., (2010) looked at 37 cost growth causes and determined that changes in project designs and scope changes during project development are of particular concern. For a design–bid-build project, this concern addresses the issue of keeping the contract amount close to the project estimate, but does not address cost growth during construction. For a design build project however, this can be a major concern during the design portion of the project. Changes, errors, and omissions contained in contract documents have been repeatedly identified as key contributors to cost overruns where research revealed a mean cost overrun of 13.55% (Love et al., 2015). So in the process of trying to determine the causes of cost growth, the causes of the changes during construction have to be identified. Of the most commonly accepted cost growth causes as determined by the literature review, six have the potential to cause contract changes during construction: project schedule changes, scope changes, faulty execution, ambiguous contract provisions, contract document conflicts and unforeseen conditions. Within the USACE Resident Management System (RMS), cost growth is categorized as user changes, engineering changes, construction changes and other changes. RMS serves as the data repository for all contracts under each resident office. USACE is broken up into thirty-six districts worldwide with anywhere from two to ten resident offices per district. A limitation of the RMS database is it does not currently provide the ability to extract and categorize the data of the 'Other Changes' category further for analysis.

## *Cost Growth Causes – Soft Skills*

Several recent studies have focused on conflict as a reason for construction cost growth. For the construction industry, studies suggest that construction owners and contractors ranked conflict among construction project participants as the highest factor affecting project cost (Brockman, 2014). The problem of cost overrun, especially in the construction industry, is a worldwide phenomenon. Its effects are normally a source of friction between owners (especially government owners), project managers, and contractors in terms of project cost variation (Creedy, et al., 2010). This leads one to believe that a primary goal of a procurement method should be to build a team between the owner and the contractor so that communication occurs often and effectively, and so that trust can be developed between the two parties. Trust has been determined by many studies as an excellent determinant to successful projects and crucial to build integrated project teams (Gad and Shane, 2014). There are three essential types of conflict between the owners and contractors in construction projects: (1) relationship-related conflict, (2) process-related conflict, and (3) task-related conflict (Chen, et el., 2014). Chen, et el., (2014) suggest task-related conflict is good, to a point, and relationship conflict between owners and contracts should be avoided regarding project performance. As mentioned earlier, cost growth for the owner occurs through contract changes. If owner-contractor conflict causes cost growth, it would be reasonable to assume that the primary contract change is to pay for contractor delays caused by the owner. Delay is a common dispute and should be addressed as part of a Dispute Resolution Management System (Gebken

and Gibson, 2006). Larger USACE contracts require partnering between the contractor, USACE and the customer as a way to establish lines of communication, minimize conflict and develop a conflict resolution process.

### *Cost Growth Causes - Contract Type Related*

There are two common themes among the literature that deal with contract selection – collaboration to help avoid delays and using a methodical approach to select the correct contract type. Traditional contracts can cause delay through owner interference, slow decision-making, and improper planning (Odeh and Battaineh, 2002). Certain contract methods can decrease the project duration, provide flexibility for changes, and reduce adversarial relationships (Gordon, 1992). The common goal between the various teams should be to keep the contractor on schedule. If a contractor can keep their schedule going and is not excessively delayed for submittal reviews, site access, construction/design decisions, requests for information, processing of contract modifications etc., they will spend less time on the job site. General conditions/field office overhead will be reduced if less time on the job site occurs, and the contractor will have a better chance to make a fair and reasonable profit. This in turn, means the contractor will be less likely to cut corners regarding quality or staffing, and the customer will get a better product faster. Therefore, a procurement method should enable the owner/construction management team to maximize the schedule performance of the contractor while assuring that the contractor meets the terms and conditions of the contract. The second theme of the contract related literature is to have a formal process that the customer can use to determine the best procurement method for their given situation. In order to maximize the effectiveness of a contract strategy, the final contract strategy should be selected from the possible combinations using a ranking method (Chua and Loh, 2006). Long-term contracts are complex and the interactions, communication, and understanding between contracting organizations are the most critical and intricate aspects to the success of a contract (Harper and Molenaar, 2014). The formulation of an appropriate contract strategy entails extensive expert knowledge and necessitates the need to organize and retain the experience gained during contract strategy formulation for decision support in future projects (Loh, et al., 2000). The subject research should include the building of a database of past successes/failures based on contract strategy. Correlation analysis shows that cost performance, client satisfaction, and relationship quality among contracting parties are significantly correlated with contract strategies (Florence, et al., 2015). In order to have successful relational contracting, clients and contractors must identify motivational factors, develop a collaborative culture, and establish structured interactions (Memon, et al., 2014).

## Methodology

The primary aim of this research is to determine if there is a correlation between USACE procurement methods and cost growth of construction projects. A mixed-method research methodology was used to conduct of this research with the goal of cross-validation of the findings. Quantitative data pertaining to actual completed construction projects was used in the first stage of the research. Structured interviews with USACE Resident Engineers were conducted to investigate the topic in the second stage of the research to further understand the complexities of the research topic. The resident office is where the construction management team is located in the USACE organizational structure. In order to study the aim of this research, quantitative data for all completed construction projects from 2012 to 2016 was obtained and analyzed from three resident offices in two different USACE districts. This date range provided the most recent data available at the time the study was conducted. Literature reviewed proved a need to conduct this study using more recent data as compared to studies completed in the 1980s and 1990s. The cost growth quantitative data obtained included the name of the project, procurement method, original contract sum, modified contract sum, original completion date and actual completion date. All of the project names were replaced with project numbers for ethical research conduct. Cost growth percentage is the final contract dollar amount (base plus all contract modifications) minus the original contract dollar amount (with any options) divided by the original contract dollar amount. Time growth percentage is the final period of performance (base plus any contract medications with time extensions) minus the original period of performance divided by the original period of performance. Period of performance is measured in days. All projects were then sorted by procurement method for further analysis. Data from a total of 408 completed construction projects was utilized as part of the study. Once the quantitative analysis was complete, qualitative data came from structured interviews of thirteen Resident Engineers from nine different districts. The role of the Resident Engineer in the USACE is to manage the resident office as both supervisor and administrative contracting officer. A database of all the Resident Engineers was generated from a global address book within USACE. The names of resident engineers were then selected from this database ensuring that multiple districts were covered. The interviews started off with questions about the type of work they support and the size and number of construction projects they manage. Then each resident engineer was asked what type of procurement methods they deal with and

how each method does regarding cost growth, delays and contingency. The interviews provided the perspective of those in the field that actually work with the contracts/contractors.

## Results and Discussion

The results for the quantitative and qualitative data are discussed sequentially. The quantitative is presented first, since this analysis was conducted prior to qualitative data collection.

### *Quantitative Data for Cost Growth and Time Growth in USACE Projects*

Data from a total of 408 construction projects was studied as part of this research. All construction projects from three resident offices from two USACE districts the in the date range previously mentioned were considered in the data analysis. These included 271 POCA, 16 IFB, 13 DB MATOC, 32 BVTO and 76 Paving IDIQ projects. The cost of the contract for the various projects ranged from less than one hundred thousand to more than twenty million, for each procurement method. The data from Table 2 shows the average contract amount, average cost growth, average of time growth and count of projects for all projects. The data indicates that DB MATOC has the highest cost and time growth whereas the BVTO has the lowest cost growth and Paving IDIQ has the lowest time growth.

Table 2. *'Average Cost Growth' and 'Average Time Growth' for all Projects.*

| Procurement Method | Average Contract | Average Cost Growth | Average Time Growth | Count of Projects |
|---|---|---|---|---|
| BVTO | $24,951,819.69 | 2.09% | 16.10% | 32 |
| DB MATOC | $7,256,643.54 | 13.91% | 62.10% | 13 |
| IFB | $7,370,176.15 | 4.60% | 43.67% | 16 |
| Paving IDIQ | $322,158.49 | 3.42% | 11.68% | 76 |
| POCA | $923,364.89 | 5.50% | 51.97% | 271 |

Due to the large variation in construction costs, the data was separated for further analysis, based on procurement method and project cost. The data separated based on the cost of the contract for less than $500K, more than $500K but less than $5 Million and projects with cost growth of more than $5 Million. Table 3 shows that only Paving IDIQ projects and POCA projects qualified for less than $500K in contract amount, and that Paving IDIQ has lower average cost growth and time growth as compared to POCA projects.

Table 3. *'Average Cost Growth' and 'Average Time Growth' for all Projects under $500,000.*

| Procurement Method | Average Contract | Average Cost Growth | Average Time Growth | Count of Projects |
|---|---|---|---|---|
| Paving IDIQ | $189,231.56 | 3.48% | 13.29% | 63 |
| POCA | $232,463.20 | 5.76% | 45.11% | 121 |

Table 4. *'Average Cost Growth' and 'Average Time Growth' for Projects between $500,000 and $5 Million.*

| Procurement Method | Average Contract | Average Cost Growth | Average Time Growth | Count of Projects |
|---|---|---|---|---|
| BVTO | $4,639,136.00 | -0.12% | 0.00% | 2 |
| DB MATOC | $3,707,532.33 | 12.45% | 61.57% | 6 |
| IFB | $3,393,579.30 | 3.82% | 44.62% | 5 |
| Paving IDIQ | $966,342.85 | 3.09% | 3.85% | 13 |
| POCA | $1,429,211.11 | 5.14% | 57.00% | 149 |

Table 4 shows that average cost growth and average time growth for all projects between $500,000 and $5 million. The data shows that BVTO has the lowest cost growth and time growth, whereas DB MATOC has the highest time growth and cost growth. IFB and POCA procurement methods also have very high time growth.

Table 5 shows the average cost growth and average time growth for all projects over $5 Million. The data indicates that the average cost growth and cost time growth is lowest for BVTO projects. BVTO projects performed best despite being substantially higher in number compared to other procurement methods but also while having much higher average project contract.

Table 5. *'Average Cost Growth' and 'Average Time Growth' for Projects more than $5 Million.*

| Procurement Method | Average Contract | Average Cost Growth | Average Time Growth | Count of Projects |
|---|---|---|---|---|
| BVTO | $26,305,998.60 | 2.24% | 17.17% | 30 |
| DB MATOC | $10,298,738.86 | 15.17% | 62.56% | 7 |
| IFB | $9,177,720.18 | 4.95% | 43.23% | 11 |
| POCA | $9,151,383.50 | 27.40% | 132.70% | 1 |

The results clearly show that BVTO procured projects have performed much better than others. The POCA procured projects are also typically negotiated projects but their performance is not as good compared to the BVTO projects. This could be explained by the fact that POCA projects are giving disadvantaged groups an opportunity to participate and learn from experience to perform federal work. The competitively priced procurement methods in DB MATOC and IFB showed consistently poor performance as it relates to cost growth and time growth.

## *Qualitative Data for Cost Growth and Time Growth in USACE Projects*

The qualitative data came from interviews of thirteen USACE Resident Engineers/Project Engineers from nine different districts. The data was compiled and analyzed using content analysis techniques via the process of 'open coding.' Since the discussion in this paper is about USCAE procurement methods, specifically the ones identified in the quantitative data, the results are presented by procurement method.

### *Sole Source/Performance Oriented Construction Activity (POCA)*

Sole source contracts go to small disadvantaged companies (as defined by the Federal Government) and are awarded using negotiations between the contractor and contracting officials. The overall consensus is that the lack of experience (especially government experience) of these smaller construction companies requires handholding by the employees of the resident offices. These small business contractors commonly have issues with the required contract paperwork (e.g. quality control plans, accident prevention plans, certified payroll, etc.) and with the three-phase inspection process (USACE's process for quality assurance/quality control). They also tend to ask for more change orders that were missed during negotiations and in turn causes more cost growth. The performance of these contractors rapidly improves after they receive the experience of a couple of projects or more. A trend that was clearly produced during the interviews is that these small business contractors perform very well in contract changes (i.e. very little changes) if they know that the resident office has a major say in their ability to get future work. These contractors are more willing and capable of moving their resources around to avoid costing delays. When the district contracting office instead of the resident office identified the sole source contractor, the small business contractors do not perform as well.

### *Design-Build Multiple Award Task Order Contract (DB MATOC)*

The DB MATOC procurement method had mixed reviews regarding construction cost growth. The two situations where DB MATOC did well are when the contract was discipline specific (roofing, utilities, paving, etc.) or where BVTO was used instead of LPTA for one specific installation. The DB MATOC method uses the first step of the two-step process to short-list the contractors (commonly four to six). Thereafter, only those four to six contractors proposed on the projects for the remainder of the overall capacity of the contract. So if a customer needs specialized experience such as airfield paving or hospital experience, they may not be able obtain that through a general construction DB MATOC since the bidder process is limited to the short-list of contractors. This in turn leads to more changes/cost growth. On the other hand, if a customer takes their requirement for specialized experience to a DB MATOC that was short-listed to that specific discipline, they will be more apt to find a contractor that better understands the common pitfalls/issues that lead to more change orders. The second instance where DB MATOC served well is when the entire contract was reserved for a given installation, the contractor was selected via BVTO and the contractors knew that they had to perform well to get future work based on their past performance. In this case, the contractors became very knowledgeable of the construction environment on the installation, often used the same key personnel (superintendent, quality control manager and safety officer) and were very conducive with the partnering process. The general consensus from the interviews is that DB MATOC method with LPTA performs very poor regarding construction growth. Terms like "*nickel and dime us*" and "*request for equitable adjustment (REAs) and claims*" were common

terms when describing this acquisition method. The DB MATOC uses the design build method for award. When the contractor proposes their lump sum price they are only looking at a preliminary design of 10% to 35%. Hence there can be enormous amount of unknowns that the contractor will base their pricing on. If the final decision is based on low price, then the general feeling is that the winning offer was too low for the other three to five contractors, and that they did not account for everything that will be in the 100% design. So the winning contractor will need to find ways to make up for their low winning cost. If on the other hand, the winning contractor is selected using the BVTO method, the contractor will ensure that their price covers all of the anticipated requirements since past performance plays a major role in how much future work they receive.

### *Invitation for Bid (IFB)*

For the interviewees, the IFB method was used exclusively with the design bid build (DBB) method. One interviewee did however; use the BVTO method with a DBB project. IFBs worked well in situations where USACE has been managing the specific type of work for a long time (e.g. dredging) where the contracts were very "*seasoned*" and had incorporated a large number of lessons learned. Across the board, the interviewees felt that the IFB method in conjunction with the DB delivery method put too much risk on the government and does not perform very well regarding cost growth. If the contract change requires an updated design then the government would have to pay for the contractor's extended field office overhead while they waited for the design change to be completed.

### *Best Value Tradeoff (BVTO)*

Of the thirteen interviewees, the Best Value Tradeoff method was used for numerous two-step design-build standalone contracts, once for a DBB contract and for a DB MATOC contract that was dedicated to one installation. The overwhelming consensus from the interviewees is that getting the right contractor is the most important factor to minimize construction cost growth. The only method that allows the government to choose the "*best*" contractor is the BVTO method. To quote one of the interviewees, "*without question, best value tradeoff gets you a much better contractor*". The general feeling is a contractor will have more of an attitude that is conducive towards partnering, managing delays and contract changes if they rely heavily on past performance as their market strategy. The BVTO method goes beyond its use with design-build as one interviewee had used it successfully with design-bid-build. There is also a clear pattern with interviewees that the DB MATOC contracts perform far better when using the BVTO rather than LPTA.

## Conclusions and Future Research

Based on the quantitative and qualitative data, it is comprehensible the most effective acquisition methods regarding construction cost growth are best value tradeoff for competitive procurement actions and using past performance/construction experience for sole source procurement actions. The quantitative data and qualitative data presented in this paper clearly demonstrates the following points:

- Regardless of the delivery method, the best value tradeoff procurement method yields better results regarding construction cost growth.
- Procurement methods that foster long-term relationships between contractors and the government tend to handle projects delays in a more cost efficient manner.
- Using the Lowest Price Technically Acceptable procurement method for the design build delivery method yields the worst results regarding construction cost growth.
- The majority of interviewees felt that obtaining the best contractor for the project was the most important aspect of the acquisition process regarding construction cost growth

The authors recognize a limitation to the study is the RMS database classification of reasons for change. The reclassification of the data is outside the scope of this study; however, the authors recommend input into the database should differentiate specifically results of changes and errors and omissions. The authors' recommendation for further research includes a study that looks at a larger subset of project data to more thoroughly determine how the best value tradeoff method performs regarding construction cost growth when compared to low cost selection methods. This would involve the compilation and analysis of procurement method data across several government agencies and numerous construction offices. The authors also recommend further research in how the various source selection criteria (past performance, construction experience, management approach, etc.) perform when analyzing construction cost growth.

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