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### **Stated Intentions vs. Actual Behavior: Choice-Based Conjoint (CBC) in DoD Source Selections**

December 2022

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Prepared for the Naval Postgraduate School, Monterey, CA 93943

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## ABSTRACT

Current source selection procedures have exposed the Department of Defense (DoD) to increased protest risk. This, in part, is due to contradictions in the U.S. government's stated order of importance for acquisition evaluation criteria (pre-award) versus their actual choice behavior during source selection (Butler, 2014). The objectives of this MBA project included the following:

- 1) Determine the degree of disconnect between stated preferences during pre-award acquisition phase and actual choice behavior in source selections
- 2) Develop an understanding of quality attributes for logistics-based services
- 3) Provide a Choice-Based Conjoint (CBC) framework that could be utilized to enhance source selection criteria development

Methodology included interviews and spend analysis techniques to identify quality attributes of logistics-based acquisitions. Then, after the attributes were identified, they were employed to develop a CBC model that calculated the attribute utilities and relative importance for each attribute. Using these important scores, the disconnect between stated preferences and choice behavior was found. None of the subjects in this investigative study could accurately order attribute importance in stated form to match their actual choices in simulated source selections. This author offers a framework and methods to mitigate the weaknesses found in developing evaluation attribute importance from stated preferences and reduce the risks of protests.



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## ABOUT THE AUTHOR

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## LIST OF ACRONYMS AND ABBREVIATIONS

ACA	Adaptive Conjoint Analysis
ACBC	Adaptive Choice-Based Conjoint
AFICC	Air Force Installation Contracting Center
AFLCMC	Air Force Life cycle Management Center
Ao	Operational Availability
B2B	Business to Business
B2C	Business to Consumer
B2G	Business to Government
CBC	Choice-Based Conjoint
CI	Confidence Interval
CO	Contracting Officer
CLIN	Contract Line Item Number
CPARS	Contractor Performance Assessment Reporting System
CPDT	Contract Protest Data Tool
CONOPS	concept of operations
CVA	Conjoint Value Analysis
DA	Department of the Army
DAU	Defense Acquisition University
DCE	Discrete Choice Experiments
DCM	Discrete Choice Modeling
DoD	Department of Defense
EA	Enterprise Analytics
FAPIIS	Federal Awardee Performance and Integrity Information Systems



FAR	Federal Acquisition Regulation
FY	fiscal year
GAO	Government Accountability Office
GSA	General Services Administration
HB	Hierarchical Bayes
INFOSLIN	Information Sub-Line Item Number
KBS	knowledge-based services
KPI	key performance indicator
LOGCAP	Logistics Civil Augmentation Program (USA)
LPTA	Lowest Price Technically Acceptable
LSS	logistics support services
MBC	Menu-Based Conjoint
MDT	Mean Down Time
MNL	Multinomial Logit
MTBM	Mean Time Between Maintenance
NCMA	National Contract Management Association
NDAA	national defense authorization act
NPS	Naval Postgraduate School
O&S	operations and support
PBL	performance-based logistics
PCO	procuring contracting officer
PM	program management
PMRT	Project Management Resource Tools
PSA	product support arrangement
R&D	research and development



RAND	Research and Development
RLH	Root Likelihood
RFP	request for proposal
RO	requirements office
RPM	real property maintenance
RUM	Random Utility Model
SAT	Simplified Acquisition Threshold
SLIN	Sub-Line Item Number
SSA	Source Selection Authority
SSAC	Source Selection Advisory Council
SSDD	Source Selection Decision Document
SSEB	Source Selection Evaluation Board
SSG	Source Selection Guide
SST	Source Selection Team
VATEP	Value Adjusted Total Evaluated Price
WTP	Willingness-to-Pay



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# I. INTRODUCTION

## A. BACKGROUND

Since its required inception in 2013, the U.S. Government Accountability Office’s (GAO) annual letter to congress summarizing bid protest data, cites that one of the most common reasons for sustaining a bid protest is a government agency’s unreasonable evaluations of contractor proposals (GAO, 2013, 2014b, 2015, 2016, 2017b, 2018a, 2019, 2020, 2021). The GAO more specifically cites that government agencies have and continue to unreasonably evaluate technical, past performance and cost or price evaluation factors when conducting source selections and/or other evaluation techniques (GAO, 2013, 2014b, 2015, 2016, 2017b, 2018a, 2019, 2020, 2021). Oftentimes, these unreasonable evaluations are tied to an agency’s inability to follow the evaluation criteria as specified within their solicitations and flawed selection decisions during source selections.

Department of Defense (DoD) procurement agents seek to deliver “quality and timely products and services to the Warfighter and the Nation at the best value to the taxpayer” (DoD, 2016b). Source selections offer said agents a structured method in which to obtain these best value products and services. To discover best value, source selections allow the government to implicitly communicate its requirements, allow industry to provide unique proposals in response, allow for meaningful differentiation amongst proposals, and ultimately allow the government to make the best value award decision (DoD, 2016b).

Current source selection procedures have exposed the DoD to increased protest risk and occurrences. Past GAO bid protests expose the government’s repeated difficulties in determining an effective scale of relative importance for evaluation factors and subfactors. These difficulties further exacerbate the risk and consequences of a GAO bid protest. When faced with bid protests, the DoD must divert its time, efforts, and use of valuable resources to resolve said protests. In an operating environment with increasingly complicated global threats, diverting already limited resources to avoidable GAO bid protests places the DoD and its capabilities in a precarious position.



The following paper offers initial insights into how we can address the illustrated disconnect between stated preferences during pre-award acquisition phase and actual choice behavior in defense acquisition source selections. In quantifying how the DoD acquisition workforce and its customers evaluate products to meet their needs, there can be a subtle, yet significant shift in how we better utilize our limited resources. Furthermore, understanding how the DoD evaluates perceived attributes of a product or service enhances future evaluation criteria. It may also reduce the risk of protests, by providing knowledge of perceived preferences, subconscious or otherwise. All ensure that acquisition professionals can better prioritize evaluation criteria during the contract pre-award phase ensuring the right solution, at the right time, and for the right customer.

## **B. PROBLEM STATEMENT**

### **1. Overview**

The National Defense Authorization Act (NDAA) of Fiscal Year (FY) 2016 created an independent advisory panel, entitled the Section 809 Panel (Section 809 Panel, 2017). Three years later, the 18 commissioners of the panel presented a roadmap in how the Department of Defense should close the “alarming gap between the capabilities within DoD and the continuously evolving threat [the] DoD must prepare to meet” (Section 809 Panel, 2018). Through streamlining stratagems and recommendations, the panel’s conclusions indicated an overwhelming demand to “simplify [government] acquisition, enable [the DoD] workforce, allocate resources effectively, and leverage the dynamic marketplace” (Section 809 Panel, 2018).

In its current state, acquisition source selection procedures have exposed the DoD to increased protest risk and occurrences. This, in part, is due to contradictions in the U.S. government’s stated order of importance for acquisition evaluation criteria (pre-award) versus actual choice behavior during source selections. Examining source selection choice behavior further and providing potential solutions that help deter future evaluation contradictions, have the potential to fulfill the demands, highlighted by the Section 809 Panel, mentioned above.

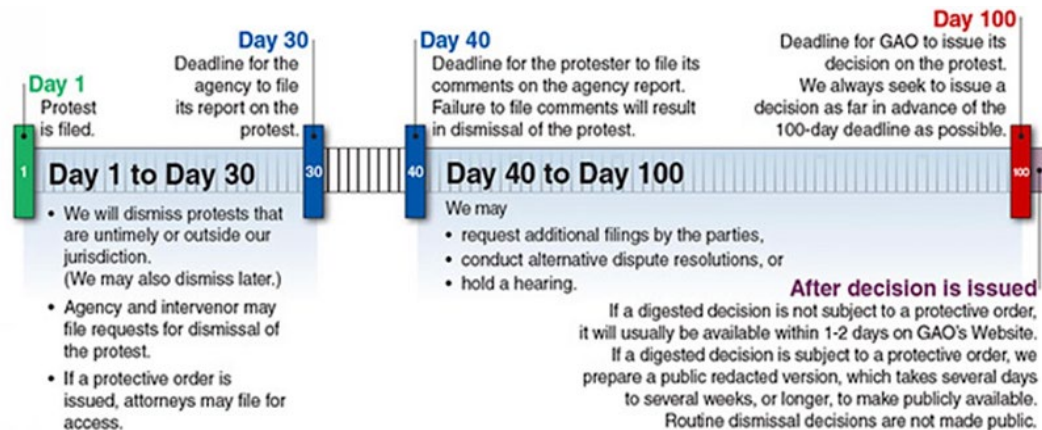




## 2. GAO Bid Protests

The GAO provides “an objective, independent, and impartial forum for the resolution of disputes concerning the awards of federal contracts” (GAO, 2018b). This forum hears disputes through a bid protest process, in which an interested party, or “actual or prospective bidder or offeror with a direct economic interest in the procurement” files a protest disputing “the acceptance or rejection of a bid or proposal and the award or proposed award of a contract” (GAO, 2018b). Figure 1 highlights the timeline and process once a bid protest is filed with the GAO (GAO, 2018b). The GAO can sustain, deny, or dismiss the protest once all relevant facts and information pertaining to the protest are reviewed (GAO, 2018b). When the GAO sustains a protest, is it acknowledging that the government “agency violated a procurement statute or regulation and that the violation prejudiced the protester” and will recommend corrective action to settle the procurement violation” (GAO, 2018b).

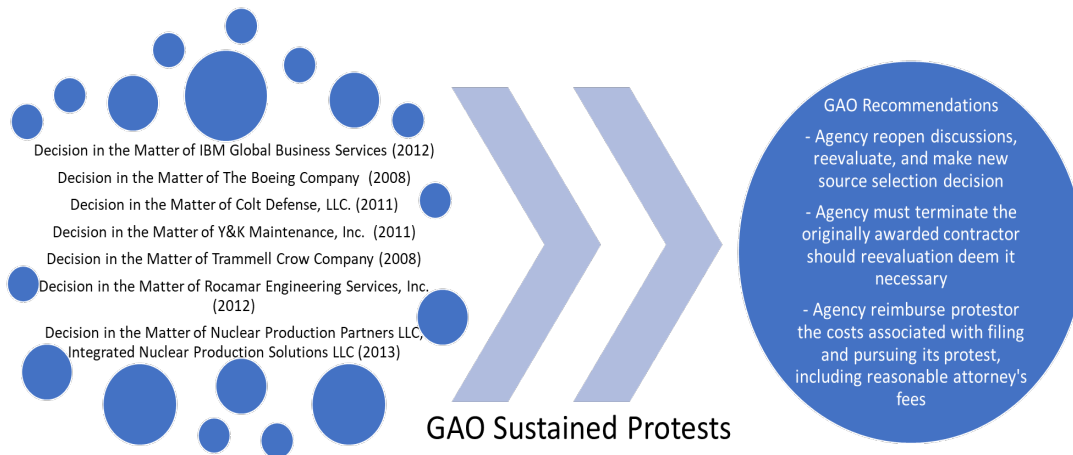
Figure 1. Timeline and Process of GAO Bid Protest. Source: GAO (2018b).



As previously mentioned in this paper’s background portion, the GAO is no stranger to bid protests involving unreasonable evaluations during source selections. Figure 2 denotes just some of the sustained GAO protests caused by unfair evaluation practices and inaccurate promotion of the relative importance of factors and subfactors within the solicitation.



Figure 2. Relevant GAO Bid Protests Involving Unreasonable Evaluations.  
Adapted from Butler (2014).



The GAO and its findings shed light on an issue this paper intends on addressing: agencies lack the ability to properly predict the ordered importance of price and non-price factors during the acquisition process. Put simply, agencies will advertise what they think they want in their solicitations, but once offers are received agencies may find that their stated preferences do not reflect what matters when they see the offers. Then they will evaluate, subconsciously or otherwise, based off what they truly need. This can lead them to discover that they need to cancel the solicitation and resolicit with a correct order of importance for evaluation criteria, or they may elect to circumvent their stated order of importance, risking a likely sustained protest and all the costs and delays that come with it.

### 3. Exposure To Bid Protests and MITRE Hot Spots

The MITRE Corporation's Contract Protest Diagnostic Tool (CPDT) further corroborates an ever-present issue in government contracting when it comes to the conduct of competitive source selections and evaluations. MITRE, a nonprofit organization, aims to solve problems in the interest of a safer world (MITRE Corporation, 2022). With their federally funded Research and Development (R&D) hubs and strategic networking with both public and private institutions, MITRE seeks to offer insight on how U.S. government policies, programs, and technologies could improve.



One such area of insight offers MITRE’s CPDT, “a data-driven application to proactively identify [government] contracting errors and mitigate protest exposure” (MITRE Corporation, 2022). Through a heatmapping visual technique as seen in Figure 3, CPDT illustrates exposure to protests within specific phases of federal acquisition phases. The darker the color, the more historically problematic these “hot spots” in each federal acquisition phase is.

Figure 3. MITRE CPDT Heatmap Visual. Source: MITRE Corp. (2022).

Category 1 - Sole Source & Preventing Competition	Category 2 - Defining of the Requirement	Category 3 - Conduct of the Competition	Category 4 - Communications Between the Government & Offerors	Category 5 - Pricing Issues	Category 6 - Small Business Issues	Category 7 - Bias & Unfair Government Conduct	Category 9 - Unique Contract Types or Procedures
1.1 Lack of Advance Planning ①	2.1 Writing the Specifications ②	3.1 Agency's Commercial Item Determination (Research Ongoing)	4.1 Clarifications ⑦	5.1 Requirement to Consider Cost or Price ⑧	6.1 Bundling and Consolidation (Research Ongoing)	7.1 Availability of Solicitations (Research Ongoing)	9.1 GSA Federal Supply Schedule (FSS) Ordering ①
1.2.1 Sole Source - Only One Responsible Source Exception ②	2.2 Improper Use of "Brand Name or Equal" Descriptions ②	3.2 Responsibility Determinations ②	4.2 Discussions ①	5.2 Price Reasonableness ①	6.2 Limitations on Subcontracting ②	7.2 Organizational Conflicts of Interest (OCIs) ⑦	9.2 GSA - Blanket Purchase Agreements (BPAs) Off Federal Supply Schedules ①
1.2.2 Sole Source - Unusual and Compelling Urgency ②	2.3 Ambiguities in the Solicitation ②	3.3 Negotiated Procurements: Tradeoff Process ②	4.3 Debriefings ②	5.3 Price Realism ②	6.3 HUBZone Contracting Procedures (Research Ongoing)	7.3 Offeror's Responsibility to Obtain Solicitation Documents (Research Ongoing)	9.3.2 IDIQ Guaranteed Minimum (Research Ongoing)
1.2.3 Sole Source - Other Exceptions to Competition ②	2.4 Unduly Restrictive Specifications ②	3.4 Competitive Range ②	4.4 Oral Presentations and Demonstrations ②	5.4 Cost Realism ②	6.4 Certainty of Competence (Research Ongoing)	7.4 Government Independence and Alleged Bias (Research Ongoing)	9.3.3 IDIQ Multiple-Award Preference ②
1.3 Contract Was Modified Beyond the Scope ②	2.5 Changed Requirements & Solicitation Amendments ②	3.5 Evaluation in Strict Accordance with the Solicitation ①		5.5 Other Cost & Price Matters (Research Ongoing)	6.5 SBA's 8(a) Program (Research Ongoing)	7.5 Proposal Compliance with the Terms of the Solicitation (Research Ongoing)	9.3.4 Protestability of IDIQ Task Orders ②
1.4 Post-Termination Reprourement Contract Did Not Seek Competition ②		3.6 Evaluation Team ②			6.6 Small Business Set-aside Consideration (Research Ongoing)	7.6 Cancellation of a Solicitation ②	9.4 Simplified Acquisition Procedures (SAPs) (Research Ongoing)
		3.7 Relative Importance of Factors and Subfactors in a Solicitation ②			6.7 Small Business Status Determination (Research Ongoing)		9.5 Other Transaction Authority (OTA) ②
		3.8.1 Past Performance - Evaluation Scheme ②					9.6 Basic Ordering Agreements (BOAs) (Research Ongoing)

As shown in Figure 3, two of the darker blocks fall under the federal acquisition phase of Category 3 – Conduct of the Competition. These hot spots indicate a historically significant risk of protest exposure and indicate the government consistently risks bid protests as its agencies do not (1) perform evaluations that are fair and consistent with the evaluation procedures described within the solicitation and (2) promote the relative importance of factors and subfactors within the solicitation in a way that does not accurately reflect the relative weights utilized during time of evaluation. In not addressing these hot spots of concerns during the acquisition process, agencies risk severe exposure to protest and the consequences that come with sustained GAO protests.



This paper and its focus attempt to address these very concerns while also providing a potential solution towards these problems.

#### **4. Further Research of Latent Service Quality Indicators for Source Selections**

In 2020, Lieutenant Colonel Daniel Finkenstadt (2020a) published his PhD research “Essays on Perceived Service Quality and Perceived Value in Business-to-Government Knowledge-Based services.” His study, in part, was built off the recognized and continued scrutiny of source selections methodology. Such scrutiny argues that current source selection procedures lead to an increased use of Lowest Price Technically acceptable (LPTA) to avoid the risks of improper articulation of the perceived relative order of importance and prioritization of evaluation factors found in best value tradeoffs (Finkenstadt, 2020a).

Finkenstadt’s study offers its readers a more finite definition of what a knowledge-based service (KBS) is, how government personnel define quality in terms of KBS, and what monetary value these personnel place on KBS quality service indicators (Finkenstadt, 2020a). To do so, the study utilizes choice-based conjoint methods to produce realistic choice scenarios for respondents in order to gather market research on customer choice in KBS-related transactions (Finkenstadt, 2020a). Said market research indicates that individuals are inefficient at predicting the ordered importance of price and non-price factors through empirical reasoning rather than theoretical deduction (Finkenstadt, 2020a). Individuals also have a poor grasp in determining a relative order of importance when the evaluation factors are in list form as they do not usually know how they would consider nonprice factors and price when given the choices in a full set of offers or grouped rather than individualized (Finkenstadt, 2020a). This paper’s research focuses on confirming these assumptions developed through Finkenstadt’s study, while applying much of the same methodology to another federal category of spend, besides KBS.



### **C. PROJECT OBJECTIVES**

The presence of increased, sustained protests, MITRE's hot spots, and past research on similar subjects all indicate a problem in how the government advertises its perceived importance of attributes versus how source selection evaluation determinations are made. This study intends to first determine and/or validate the presence and degree of disconnect between stated preferences during pre-award acquisition phase and actual choice behavior in defense acquisition source selections. The study also aims to develop a deep understanding of quality attributes in evaluating logistics-based acquisitions, as opposed to KBS, in the interest of continuing the work presented within Finkenstadt's study. Finally, the study seeks to provide a choice-based conjoint framework that the DoD could utilize to enhance source selection criteria development in both logistics and further categories of government spending.

### **D. PURPOSE AND BENEFIT**

Two key functions of the acquisition workforce are to correctly define performance preferences in solicitations and transparently evaluating proposals. Many industries strive to understand customers and have used CBC to better define customer wants and develop products based off those desired qualities. The DoD could implement the same tools to better identify and acquire the needs of the warfighter and how to evaluate this value during source selection.

### **E. THESIS STATEMENT**

The current source selection procedures have exposed the DoD to increased protest risk/occurrences, due to contradictions in the U.S. government's stated order of importance for acquisition evaluation criteria (pre-award) versus their actual choice behavior during source selection. Therefore, the DoD must better understand how it evaluates perceived attributes of a product/service, so that its acquisition personnel can better prioritize evaluation criteria during the contract pre-award phase ensuring the right solution, at the right time, and for the right customer.



## **F. SUMMARY**

This chapter synopsis the current environment produced, in part, by DoD source selection procedures and the systemic filing of bid-protests related to source selection evaluation criteria. Finally, it concludes with the thesis statement that encapsulates the overarching idea of this paper. As this paper has introduced the researcher's motivations, it will now illustrate the methodologies of the study.



## **II. LITERATURE REVIEW**

### **A. INTRODUCTION**

This chapter provides a brief summation of source selection procedures and the issues with source selections. The chapter also reviews the market research technique, conjoint analysis, as well as its decompositional method of Choice-Based Conjoint (CBC) Analysis. It then goes on to describe logistics in the Business-to-Government (B2G) environment to illustrate the Department of Defense’s current logistics initiatives and current service quality indicators for those initiatives. In extensively analyzing the literature, research, and existing information on these ordinarily unrelated components, the study has improved efficacy in applying CBC techniques to the DoD’s logistic-focused acquisition source selections.

### **B. DOD SOURCE SELECTION**

#### **1. Source Selection Overview**

Source Selection is a pre-award procurement process that aims to guide acquisition professionals in determining the proposal that represents the best value to the government (FAR 15.3, 2022). Best value is understood as “the expected outcome of an acquisition that, in the Government’s estimation, provides the greatest overall benefit in response to the requirement” (DoD, 2016b). The Federal Acquisition Regulation further expands on best value by utilizing the ‘best value continuum’, a notion that guides agencies to obtain best value by using the source selection approach that best meets the unique requirements of the procurement (FAR 15.1, 2022). Depending on the importance of such factors as cost/price, the definitiveness of the requirement, performance risk, and technical or past performance concerns, the source selection approach utilized will differ from procurement to procurement to ensure best value is determined (FAR 15.1, 2022). However, no matter the approach or combination of approaches used, all source selection outcomes must be based on best value as it ensures the government receives the “greatest



overall benefit in response to the government’s requirement” (Defense Acquisition University (DAU), 2022a).

To be considered a value-adding process, a source selection must be conducted in a way that ensures the Government’s requirements are understood to outside, invested parties (DoD, 2016b). A source selection team must craft evaluation criteria that allows the government to determine significant distinctions amongst contract proposals, while also finding the best possible solutions utilizing those same criteria (DoD, 2016b). Finally, in the case of the DoD, source selections must provide the best value to the Warfighter (DoD, 2016b).

Source Selections and their techniques are aided in determining best value through the development of evaluation factors and subfactors. These factors define the “features, qualities, or properties of an item or service” and essentially detail “the capabilities the Government wants” from the procurement (DAU, 2022a). As they are the basis for determining value, evaluation factors and subfactors can be quantitative, qualitative, or a blend of both (DAU, 2022a). While there are broad guidelines in developing evaluation factors and subfactors, it is important to note that every source selection shall evaluate both the “cost or price of the supplies or services being acquired” and the quality of the product or service (DAU, 2022a).

## **2. The Source Selection Plan (SSP)**

How the Government intends on organizing and conducting certain source selections is documented in the Source Selection Plan (SSP) (DAU, 2022a). A SSP is required for “all acquisitions conducted as part of a major system acquisition program” and for “all competitively negotiated Federal Acquisition Regulation (FAR) Part 15 (Contracting by Negotiation) acquisitions with an estimated value of greater than \$10 million” (DoD, 2016b). SSPs may exist for procurements of lesser dollar values as well. Regardless, the evaluation factors and criteria for each source selection are determined prior to the issuance of a solicitation and detailed within the solicitation.

While the complexity and detail of a SSP will differ from procurement to procurement, all SSPs must contain certain, mandatory elements. Elements such as the





evaluation factors and subfactors, information on the Source Selection Team (SST), and the overall acquisition strategy of the procurement are detailed in the SSP (DAU, 2022a). Ensuring these minimum elements are included in all SSPs provides a uniformity in the source selection process for both industry and government.

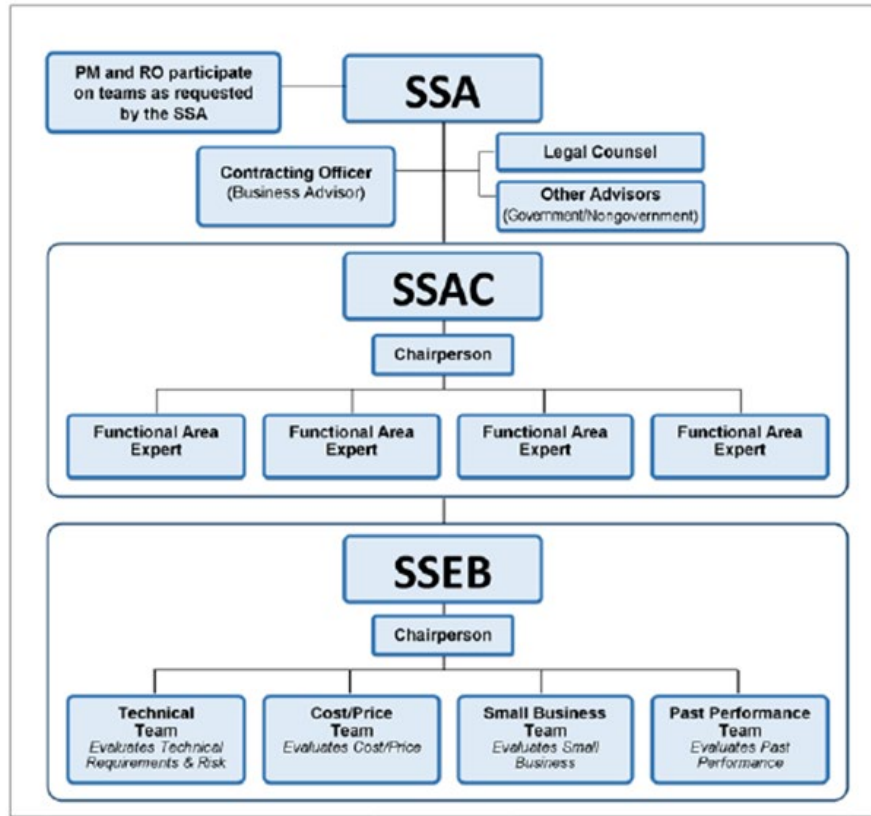
### **3. Major Roles in the Source Selection Process**

The source selection process is conducted by a team composed of various government professionals with a diverse set of backgrounds, expertise, and responsibilities. Source Selection Team (SST) composition and size vary and are dependent on the requirement's "size, complexity, and visibility" (DAU, 2022). However, formal source selections often consist of a Source Selection Authority (SSA) that has the overall authority and responsibility to determine the best-value proposal for the government requirement (DAU, 2022a). Depending on dollar amount, the Procuring Contracting Officer (PCO) can sometimes be the SSA, otherwise they act as a "primary business advisor and principal guidance source for the entire source selection" (DAU, 2022). Formal source selections sometimes have Source Selection Advisory Councils (SSAC) (DAU, 2022a). The SSAC's objective is to compare offers, deliver a comparative analysis, and provide a recommendation to the SSA who utilizes that information to make the final decision of source selection award (DAU, 2022a). SSACs are composed of functional area experts that can utilize that expertise to provide the SSA with a competent and extensive recommendation.

As Figure 4 displays, the SSA and SSAC are joined by the Source Selection Evaluation Board (SSEB) comprised of a chairperson and small teams focused on a particular portion of the evaluation of offers such as the cost or price of a proposal (DAU, 2022a). These teams utilize the stated solicitation requirements and evaluation criteria approved and illustrated within the SSP (DAU, 2022a). Figure 4 also specifies other functions such as legal counsel, the Program Management (PM) and/or Requirements Office (RO) also play niche roles within the SST and have varying degrees of responsibility to ensure the SST makes the best value decision for the government.



Figure 4. Common Structure of SST. Source: DoD (2016b).



#### 4. Source Selection Steps

Prior to any acquisition source selection, acquisition personnel and their requirements office must conduct acquisition planning, which entails activities that are critical to ensuring a successful source selection and procurement (DoD, 2016b). Defining a funded requirement, performing market research, developing a Request for Proposal (RFP), and creating a SSP must all be conducted prior to the source selection and are considered pre-solicitation activities. Once the RFP is released, contractor proposals are received in response to the RFP, and the deadline to submit a proposal has expired, a source selection can begin.

To ensure all relevant members of a source selection can conduct the steps effectively, the SSA must ensure that proper training and relevant guidance as to the roles and responsibilities of each member are provided and understood (DAU, 2022a). The Contracting Officer (CO) will perform an initial review of all offeror proposals to ensure that each offeror has provided the required information in the specific format specified in

the solicitation (DAU, 2022a). This portion of the source selection allows for “clarifications and award without discussion, communications with offerors before the establishment of the competitive range, and exchanges with offerors after establishment of the competitive range” (DAU, 2022a). If an award without discussions has not occurred, the source selection steps will proceed.

Proposals that have been reviewed by the CO will then be sent to the SSEB, whose members will evaluate each proposal. The evaluations can consist of determining each proposals strengths, weaknesses, deficiencies, and cost or price considerations (DAU, 2022a). Another important consideration the SSEB can utilize to evaluate proposals is a past performance evaluation (DAU, 2022a). When evaluating past performance, the information gathered on an offerors proposal can be gathered from the offeror, questionnaires, or contractor performance applications such as the Federal Awardee Performance and Integrity Information System (FAPIS) (DAU, 2022a). Such information is rated on its recency and relevancy and each offeror is given a Performance Confidence Assessment Rating (DAU, 2022a). Table 1 below illustrates a rating scale utilized by the SSEB’s past performance evaluation team. The SSEB will later conclude with a rating for each proposal that “identifies deficiencies, strengths, and weaknesses of an evaluation factor or subfactor” (DAU, 2022a).

Table 1. Past Performance Relevant Evaluation Rating Scale.  
Source: DoD (2016b).

Rating	Definition
<b>Very Relevant</b>	Present/past performance effort involved essentially the same scope and magnitude of effort and complexities this solicitation requires.
<b>Relevant</b>	Present/past performance effort involved similar scope and magnitude of effort and complexities this solicitation requires.
<b>Somewhat Relevant</b>	Present/past performance effort involved some of the scope and magnitude of effort and complexities this solicitation requires.
<b>Not Relevant</b>	Present/past performance effort involved little or none of the scope and magnitude of effort and complexities this solicitation requires.

With SSA approval, the CO will then establish a competitive range which is determined by the evaluated prices and evaluation factor ratings identified in the SSEB’s evaluation (DAU, 2022a). This competitive range consists of only the highest rated



proposals found by the SSEB and discussions with those offerors whose proposals are within the competitive range can occur. Once discussions are complete, the CO allows offerors to submit one final proposal revision which is then re-evaluated once all revised, final proposals are received (DAU, 2022a).

After final proposals are received by the SST, the SSEB will generate a Summary Evaluation Report which offers insight into their overall evaluation of the final proposals received (DAU, 2022a). The Summary Evaluation Report is presented either to the SSA or SSAC, who will then rank the proposals utilizing one of two technical evaluation rating methodologies (DAU, 2022a). The first methodology rates the offeror’s technical solution while examining risk stemming from the technical approach separately (DAU, 2022a). Table 2 and Table 3 illustrate this methodologies rating scale. The second methodology provides a rating scale in which the offeror’s technical solution will be rated with the risk associated with the offeror’s technical approach. Table 4 illustrates the scale that incorporates technical approach evaluation with the risks associated in such an approach.

Table 2. Technical Evaluation Rating Scale. Source: DoD (2016b).

<b>Color Rating</b>	<b>Adjectival Rating</b>	<b>Description</b>
<b>Blue</b>	<b>Outstanding</b>	Proposal indicates an exceptional approach and understanding of the requirements and contain multiple strenghts.
<b>Purple</b>	<b>Good</b>	Proposal indicates a thorough approach and understanding of the requirements and contains at least one strength.
<b>Green</b>	<b>Acceptable</b>	Proposal indicates an adequate approach and understanding of the requirements.
<b>Yellow</b>	<b>Marginal</b>	Proposal has not demonstrated an adequate approach and understanding of the requirements.
<b>Red</b>	<b>Unacceptable</b>	Proposal does not meet requirements of the solicitation and, thus, contains one or more deficiencies and is unawardable.



Table 3. Technical Approach Risk Rating Scale. Source: DoD (2016b).

Adjectival Rating	Description
<b>Low</b>	Proposal may contain weakness(es) which have little potential to cause disruption of schedule, increased cost or degradation of performance. Normal contractor effort and normal Government monitoring will likely be able to overcome any difficulties.
<b>Moderate</b>	Proposal contains a significant weakness or combination of weaknesses which may potentially cause disruption of schedule, increased cost or degradation of performance. Special contractor emphasis and close Government monitoring will likely be able to overcome difficulties.
<b>High</b>	Proposal contains a significant weakness or combination of weaknesses which is likely to cause significant disruption of schedule, increased cost or degradation of performance. Is unlikely to overcome any difficulties, even with special contractor emphasis and close Government monitoring.
<b>Unacceptable</b>	Proposal contains a material failure or a combination of significant weaknesses that increases the risk of unsuccessful performance to an unacceptable level.

Table 4. Technical Approach and Risk Rating Scale. Source: DoD (2016b).

Color Rating	Adjectival Rating	Description
<b>Blue</b>	<b>Outstanding</b>	Proposal indicates an exceptional approach and understanding of the requirements and contain multiple strenghts, and risk of unsuccessful performance is low.
<b>Purple</b>	<b>Good</b>	Proposal indicates a thorough approach and understanding of the requirements and contains at least one strength, and risk of unsuccessful performance is low to moderate.
<b>Green</b>	<b>Acceptable</b>	Proposal indicates an adequate approach and understanding of the requirements, and risk of unsuccessful performance is no worse than moderate.
<b>Yellow</b>	<b>Marginal</b>	Proposal has not demonstrated an adequate approach and understanding of the requirements, and/or risk of unsuccessful performance is high.
<b>Red</b>	<b>Unacceptable</b>	Proposal does not meet requirements of the solicitation and, thus, contains one or more deficiencies and/or risk of unsuccessful performance is unacceptable. Proposal is unawardable.

Once technical and risk evaluation and offerors are ranked, the SSA will utilize the source selection technique specified to determine which offeror brings the best value to the government (DAU, 2022a). When considering which source selection process to use, SSAs and their source selection team should consider the requirements indicated in Table 5.



Table 5. Source Selection Process Considerations. Source: DoD (2016b).

	<b>Subjective Technical Factor(s) Required</b>	<b>Objective/ Measurable Technical Factor(s) Required</b>	<b>Performance Risk Evaluation Required</b>	<b>Lowest Eval. Cost/Price = Best Value</b>	<b>Monetized Requirements</b>	<b>Best Value Tradeoff</b>
<b>Subjective Tradeoff</b>	Yes	Possible	Yes	Possible	Possible	Yes
<b>VATEP Tradeoff</b>	Possible	Yes (See para. B.2)	Yes	Possible	Yes	Yes
<b>LPTA</b>	No	Yes (Acceptable/ Unacceptable See Table C-1)	Evaluated with Technical Factor for acceptability only (See para. 2.3.4.2.1)	Yes	No	No

Lowest Price Technically Acceptable (LPTA) technique is most suitable for procurements whose requirements are well defined, where risk of an unsuccessful offeror’s performance is minimal, and there is no need for a higher performance that exceeds the technical acceptable rating of performance (DoD, 2016b). The tradeoff technique can include either the subjective tradeoff approach or the Value Adjusted Total Evaluated Price (VATEP) tradeoff (DoD, 2016b). The subjective tradeoff technique allows the government to look beyond price, as it does in LPTA, and has the government focused on tradeoffs amongst both cost or price factors AND non-cost or price evaluation factors (DoD, 2016b). When utilizing the subjective tradeoff approach to source selection, the solicitation must indicate both the importance of evaluation factors and subfactors in relationship to each other and cost or price (DoD, 2016b). VATEP monetizes the varying levels of performance, establishing minimum and maximum performance thresholds for offerors, in the efforts to maintain acceptable prices while incentivizing the contractor to develop more innovative solutions (DoD, 2016b). Once a technique is established and utilized, the SSA will indicate the best-value offeror for the procurement, with supporting rationale, within the Source Selection Decision Document (SSDD) (DoD, 2016b).

## 5. Issues with Source Selection Tradeoffs

The source selection procedures described above have somewhat jeopardized the three objectives of public procurement: transparency, value for money, and meeting



requirements (Finkenstadt & Hawkins, 2016). Key case law and sustained GAO bid protests further substantiate this scrutiny and highlights a growing divergence between how source selection teams publish what they need from industry versus how they actually evaluate industry proposals.

One of the most common reasons for industry to file a GAO bid protest stems from a perceived failure of source selection teams to evaluate proposals in strict accordance with the publicized solicitation terms (Butler, 2014, p. 79). While the GAO acknowledges that evaluation judgments can be subjective in nature, it still calls for government procurement to be conducted on an equal basis in which offerors are “provided with a common basis for the preparation of their proposals” (Butler, 2014, p. 81); therefore, the use of undisclosed evaluation factors that were not clearly encompassed within the solicitation’s stated evaluation criteria are clear grounds for a sustained protest from the GAO (Butler, 2014, p. 79). The following sustained protests corroborate the GAO’s espousal for government procurement to be conducted on an equal basis through, in part, use of the solicitation’s stated evaluation factors in source selection evaluations (Butler, 2014, pp. 296–297):

Nuclear Production Partners LLC, Integrated Nuclear Production Solutions LLC, B-407948 et al., Apr. 29, 2013  
Caduceus Healthcare, Inc., B-407791, Feb. 21, 2013  
Colt Defense, LLC, B-406696, July 24, 2012  
Rocamar Engineering Services, Inc., B-406514, June 20, 2012  
Y&K Maintenance, Inc., B-405310.6, Feb. 2, 2012  
PMO Partnership Joint Venture, B-403214, B-403214.2, Oct. 12, 2010  
APEX-MBM, JV, B-405107.3, Oct. 3, 2011  
DSS Healthcare Solutions, LLC, B-403713.3, June 22, 2011  
Mission Essential Personnel, LLC, B-404218.2, B-404218.3, June 14, 2011  
Wood Cuts, B-403960.3, May 19, 2011  
IBM Global Business Services, B-404498, B-404498.2, Feb. 23, 2011  
Retail Clean Management Systems, B-403651, B-403651.2, Nov. 18, 2010  
TrailBlazer Health Enterprises, LLC, B-402751, B-402751.2, July 20, 2010  
Wackenhut Services, Inc., B-402550.2, June 7, 2010  
T-C Transcription, Inc., B-401470, Sept. 16, 2009  
Master Lock Company, LLC, B-309982.3, Dec. 10, 2008  
New Jersey & H Street, LLC, B-311314.3, June 30, 2008  
Master Lock Company, LLC, B-309982.2, June 24, 2008  
The Boeing Company, B-311344 et al., June 18, 2008  
Consolidated Engineering Services, Inc., B-311313, June 10, 2008



The failure to follow solicitation evaluation criteria and an agency's utilization of undisclosed evaluation factor(s) leaves industry unable to "determine the buying agencies' priorities," determine "the level of performance to offer" the government, and define both the evaluation criteria and the relative weight of cost and price evaluation factors (Finkenstadt & Hawkins, 2016). If industry is struggling with these issues, the products and services it offers will likely not meet government requirements, will not provide best value to the government, and will observe a failure of transparency on behalf of the government. While this agency failure is not necessarily purposeful, it suggests that a gap in source selection procedures enables an agency's inability to fully understand, promote, and properly evaluate their requirement.

Another issue regarding DoD source selection procedures involves the failure to "evaluate proposals properly by failing to accord the appropriate weight to the competing factors in negotiated procurements" (Butler, 2014, p. 83). FAR 15.304(e) stipulates that agencies must "disclose whether the nonprice/cost factors, when combined are (1) significantly more important than cost/price, (2) approximately equal to cost/price, or (3) significantly less important than cost/price" (Butler, 2014, p. 83). Such a stipulation ensures that all offerors understand how the government places value on specific evaluation factors (Butler, 2014, p.83). Agencies across the DoD are either

Simply failing to advise offerors of the relative importance of the factors and subfactors and, instead of treating them equally, weighting some more heavily than others during the evaluation, using 'pass/fail' ratings for factors that are listed in 'descending' order of importance and thereby using incompatible evaluation techniques, or evaluating in a manner at odds with the relative value of factors that was stated in the solicitation. (Butler, 2014, p. 85)

The following sustained GAO bid protests represent the above missteps taken by DoD agencies (Butler, 2014, p. 297):

PCCP Constructors, JV; Bechtel Infrastructure Corp., B-405036 et al., Aug. 4, 2011  
PWC Logistics Services Company, B-400660, Jan. 6, 2009  
Helicopter Transport Services LLC, Inc., B-400295, B-400295.2, Sept. 29, 2008  
RCL Components, Inc., B-400175, Aug. 19, 2008  
Bio-Rad Laboratories, Inc., B-297553, Feb. 15, 2006  
Ultra Electronics Ocean Systems, Inc., B-400219, Sept. 8, 2008  
Locus Technology, Inc., B-293012, Jan. 16, 2004





Finlen Complex, Inc., B-288280, Oct. 10, 2001  
Lloyd H. Kessler, Inc., B-284693, May 24, 2000  
Ultra Electronics Ocean Systems, Inc., B-400219, Sept. 8, 2008

Similar to the first issue of evaluating in strict accordance with the solicitation, mistakes in applying value to evaluation factors and subfactors do not appear to be purposeful in nature; however, they impact the perceived transparency of the government and its procurement methods. The shortcomings also further the government from procuring what's actually needed and from receiving the best value.

In conclusion, DoD source selections suffer from disparities in the procedures that guide them and a source selection team's inability to state what really matters and how to quantify it. Past research, such as Finkenstadt's PhD findings and GAO protests, indicate that government personnel are rarely fully capable of predicting the ordered importance of price and non-price factors as they utilize theoretical deduction as opposed to empirical reasoning. Findings also indicate that government personnel do not usually know how they would consider nonprice factors and price when given the choices in a full set of offers or grouped, rather than individualized in list form. In short, current source selection procedures do not offer a method that shifts personnel away from ineffective evaluation factor determination and the a priori rank order of said evaluation factors. Conjoint analysis, and more specifically, choice-based conjoint analysis, can provide that method.

## **C. CONJOINT ANALYSIS**

### **1. Definition of Conjoint Analysis**

At its core, Conjoint Analysis is a tool that enables an entity to discover the preferences of individuals when they are presented a series of products or service offerings and their attributes. From a marketing perspective, conjoint analysis allows a manager or company to “model the factors that underlie and drive consumer choice” (McQuarrie, 2016) through utilization of a product or service's “separate (yet conjoined) parts” (Orme, 2020). With this technique one can vary attributes of a product or service, observe how respondents react to this variability, then determine, through statistical deduction and linear regression techniques, the scores or part-worths for the attributes



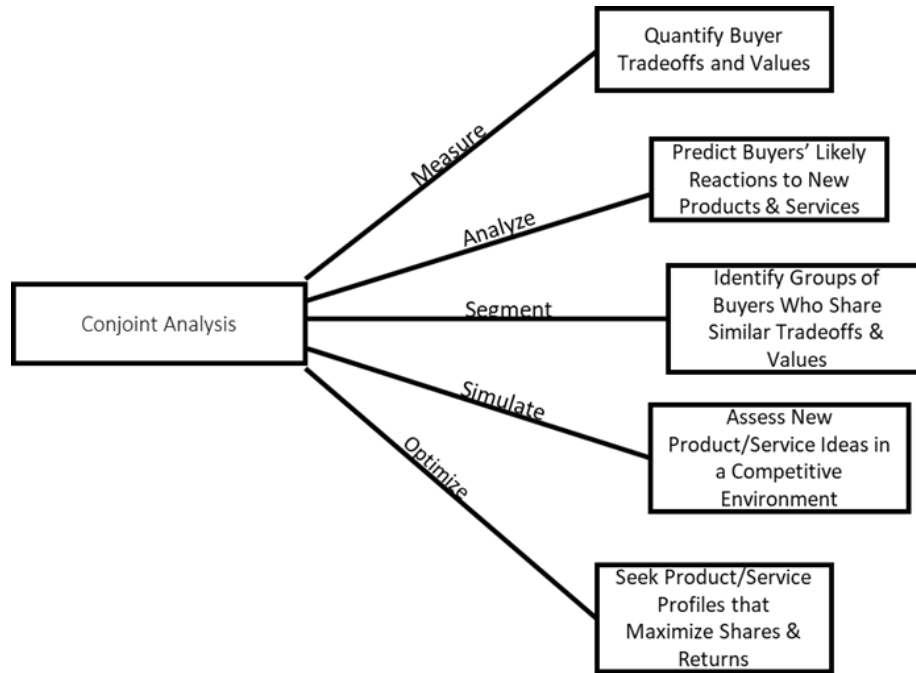
that respondents may be applying to establish the value of a product, subconsciously or otherwise (Orme, 2020). It's important to note that part-worths are defined as, "the utility associated with a particular level of an attribute" and utility, in reference to conjoint analysis, "refers to a buyer's liking for (or the desirability of) a product alternative" (Orme, 2020).

Conjoint measuring, the notion behind conjoint analysis in marketing, contrasts from other standard marketing techniques to discover consumer preferences because of its more decompositional nature (Orme, 2020). Instead of attempting to deduce consumer preference through methods that ask respondents to rate a product or service's attributes directly (compositional approach), conjoint analysis acts as a "back door" method where "preferences for attributes and [their] levels...are statistically deduced (decomposed) from the overall product evaluations of conjoint profiles" (Orme, 2020). Such an approach aims to reduce the fallibility of individuals directly describing how they rate their preferences and attributes. It also furthers the data collected as the scores compiled for product attributes can be used to develop market simulators (Orme, 2020). These what-if simulators can help to predict the overall attractiveness of a product profile and predict consumer's choice when faced with competing product profiles (Orme, 2020).

Despite the overall objective to provide insight into the "factors that underlie and drive consumer choice," conjoint analysis and its procedures act as multiple techniques that produce multiple outputs (McQuarrie, 2016). As demonstrated in Figure 5, conjoint analysis's features enable individuals to potentially gain unique understanding of a market's buyers, develop accurate market segmentation, or simulate new product ideas within the focused market. Through these techniques, conjoint analysis proves its indispensable value to market researchers, managers, and investigators alike.



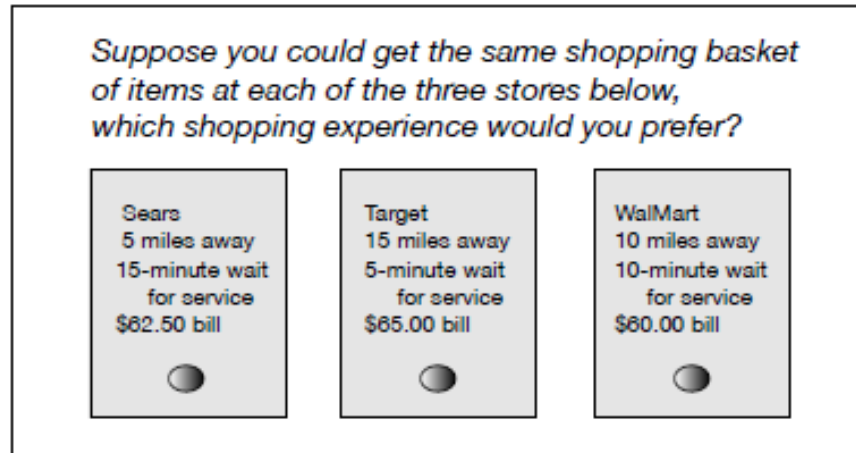
Figure 5. Features of Conjoint Analysis. Adapted from Rao (2014).



## 2. History of Conjoint Analysis in Marketing

The origins of Conjoint Analysis can be found as early as the 1920s, when the methodology of conjoint measurement was developed (Rao, 2014). It would not be until the 1960s and 1970s, though, that the concept of conjoint measurement would be considered in the realm of market research and business market problems (Orme, 2020). During that time conjoint analysis would be conducted on meticulously constructed cards using paper-and-instruments, each detailing product profiles, that would then be ranked from best to worst by the study's respondents (Orme, 2020). Figure 6 depicts an example of a card-sort conjoint analysis choice respondents could analyze and select from.

Figure 6. Card-Sort Conjoint Analysis Card. Source: Orme (2020).

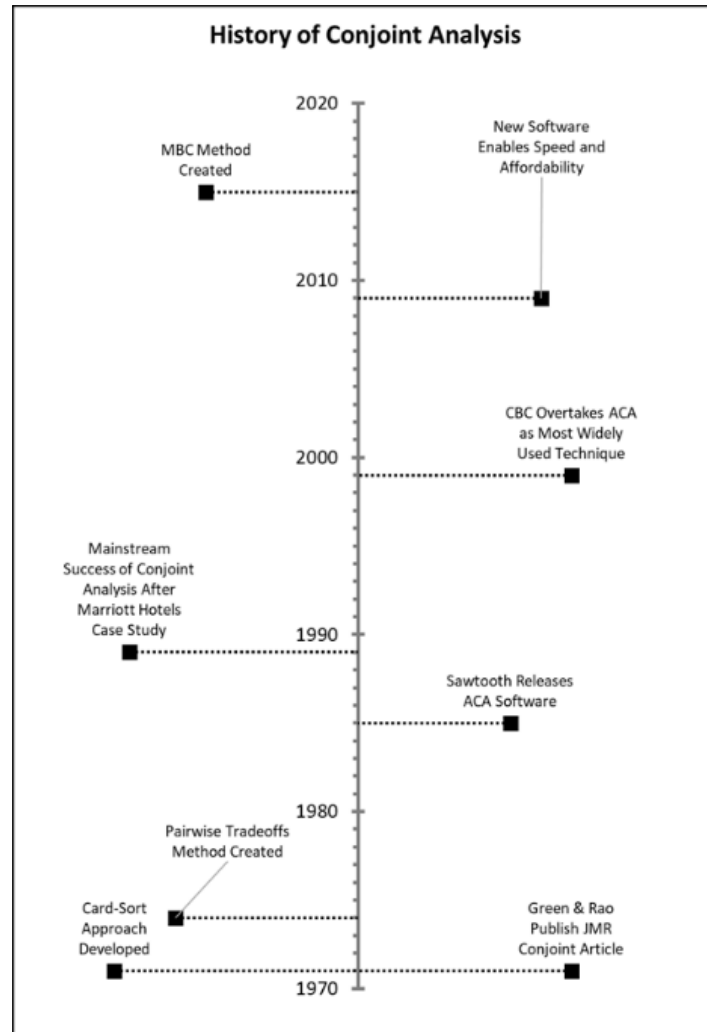


While researchers later discovered that a point system could be applied to this approach that would enable better data collection, the limitations of a card-based approach ensured that researchers must limit the attributes they were studying amongst these product profiles (Orme, 2020). Around that same time, a new method of conjoint analysis, pairwise tradeoffs, was developed to ascertain respondent's preferences when offered only two attributes at one time (Orme, 2020).

Figure 7 highlights the positive impact technology advancement and computer software had on conjoint analysis in the business marketing environment during the 1980s. Software allowed researchers to develop fuller, more comprehensive conjoint analysis studies and allowed them to surpass the limitations product profile cards introduced. Companies, like Sawtooth Software and Bretton-Clark Software, introduce market simulators into conjoint analysis software, enabling researchers to test the market acceptance for new products and services without the costs, time, and effort needed to introduce that product to the market (Orme, 2020). The introduction of conjoint analysis software rocketed the choice exercise method into the mainstream and by the end of the 1980s, successful application of conjoint analysis was emphasized in case studies (Orme, 2020). One such case in 1989, the Marriott Courtyard Hotel Case, reported the company's use of conjoint analysis to create a new hotel chain, Courtyard by Marriott, as the technique "provided specific guidelines for selecting target market segments, positioning services, and designing an improved facility in terms of physical layout and services" (Wind et al., 1989). Such successful application of conjoint analysis in this

specific case led Marriott to alter its new product development approaches (Wind et al., 1989).

Figure 7. Timeline of Conjoint Analysis in Marketing. Source: Orme (2020).



Further software advancements and the development of the Hierarchical Bayes (HB) method “to estimate individual-level models from discrete choice data” in the 1990s and early 2000s allowed further conjoint analysis techniques to be utilized in additional industries (Orme, 2020). Such developments facilitated that Choice-Based Conjoint (CBC) analysis overtook Adaptive Conjoint Analysis (ACA) as the most widely used conjoint analysis technique (Orme, 2020). After 2010, a new method of conjoint analysis, the Menu-Based Conjoint (MBC), allowed buyers to create their own products and

allowed organizations to take advantage of mass customization popularity amongst consumers (Orme, 2020). As software and technology advance, conjoint analysis continues to develop and new opportunities for its use continue to be created.

### **3. Assumptions of Conjoint Analysis**

To utilize conjoint analysis and its techniques, researchers must recognize the data collected under those techniques is influenced by several underlying assumptions. First, all products and services can be “conceptualized as a bundle of attributes” (McQuarrie, 2016). Each of these attributes has preference levels that differ from buyer to buyer. Certain attributes, that center towards a product or service’s performance, can offer multiple levels to its buyers.

Second, a buyer will appraise a “complex product or service based on a function of the value of its separate (yet conjoined) parts” (Orme, 2020). Conjoint Analysis seeks to measure and evaluate this appraisal utilizing part-worths, or the unobserved scores, of these conjoined parts. Hence why this marketing technique is aptly named conjoint analysis (Orme, 2020).

Third, the overall value of a product is then “equal to the sum of the value of its parts” (Orme, 2020). Such an assumption seems intuitive; however, it rightly remains an assumption as its simplistic nature cannot definitively explain the complex nature in which buyers make purchase decisions with complete accuracy (Orme, 2020). The fourth assumption that must be understood is that the mentioned complex decision-making buyers have, “can be explained using a limited number of dimensions” (Orme, 2020).

### **4. Weaknesses of Conjoint Analysis**

Once the above assumptions are understood and accepted, conjoint analysis’s weaknesses must be realized. The method’s weaknesses can be identified through its limits and constraints and one such limitation is that the ‘garbage in – garbage out rule applies’ (McQuarrie, 2016). In other words, if biases and critical attributes of the product are omitted or incorrectly applied, the output received from a conjoint analysis will lack valuable substance. Depending on the depth and needed results of a conjoint analysis, the method may also be time-consuming and resource intensive (McQuarrie, 2016).



While the method's ability to pinpoint the buying patterns and decisions of an individual prove beneficial, one of conjoint analysis's constraints lies with products that are purchased through a group-decision making process (McQuarrie, 2016). Though the method can work to produce results amongst a buying group, the complex nature of group buying decisions cannot always be fully understood through conjoint analysis.

The complexity of certain products also highlights the gaps of conjoint analysis. Certain products, such as software, can have hundreds of attributes with multiple levels. While conjoint analysis software aids managers and researchers in contending with such product complexity, the feasibility of a study lies in their ability to limit the number of attributes they are studying for the product (McQuarrie, 2016). Therefore, conjoint analysis cannot always deduce a product's buyer appraisal with all attributes of the product considered.

As most conjoint analysis occurs within a simulated, hypothetical environment there is a lack of real-life consequences to respondents; therefore, determining realistic preferences amongst respondents is problematic (Ding et al., 2005). It is recommended then that researchers build conjoint analysis studies by incorporating salient, incentive-aligned choice exercise conditions, so that respondents produce realistic, actual choice behavior (Ding et al., 2005). Such conditions also prevent behaviors from respondents, like exaggerating how much they are willing to pay for a product, incorporating a more real-world feel to the study (Finkenstadt 2020a).

In Finkenstadt's 2020 essay that utilized conjoint analysis, researchers utilized a number of choice exercise conditions that introduced incentive-aligned consequences to their conjoint choice exercise respondents. Table 6 describes each of the choice exercise conditions that were used amongst the respondents in a business to government market setting. Finkenstadt did not find any significant differences in the groups based on their incentive condition treatment except the BTS-Incentive group who had a lower willingness to opt out of choosing any of the offers in each profile (Finkenstadt 2020a). Finkenstadt concluded that, although BTS-Incentive may have a more realistic opt out utility than the others, the relative effort to conduct a BTS-Incentivized study is not efficient for repetitive use in practice. Given that all conditions were statistically similar



for calculating other attribute utilities and importance, a more efficient incentive alignment method should be utilized by B2G acquisition practitioners for investigative purposes. For the purposes of this study, the ‘Expert Scrutiny’ choice exercise condition was utilized.

Table 6. Incentive-Aligned Conjoint Choice Exercise Conditions.  
Source: Finkenstadt (2020a).

Choice Exercise Condition	Short Description
Expert Scrutiny	Subjects are told to answer realistically because an expert in public procurement will analyze their responses for reasonableness prior to including it in any decision to change public acquisition methods or policy. This mimics the formal source selection review process found in many public agencies.
Cheap Talk	Subjects are given details in a script regarding hypothetical bias, how it occurs and the researcher’s beliefs as to why it occurs. Then they are asked to respond realistically in order to curb the effects of hypothetical bias.
Consequential	Subjects are told their responses should be as realistic as possible because they can affect public policy.
Incentive-based Bayesian Truth Serum (BTS-Incentive)	Subjects are told their responses will receive a “Truth Score.” There is an incentive tied to the most truthful response. This truth score is obtained by asking them to order their preferences and then state their assumed distribution of other respondent preferences. This information is used to calculate the “Truth Score.”

## 5. Strengths of Conjoint Analysis

Despite its limitations, conjoint analysis offers researchers results that go beyond a standard survey involving scales or rank ordering tasks, as such surveys cannot fully examine the trade-offs buyers make among a product’s most important attributes (McQuarrie, 2016). A survey will allow responders the ability to claim all attributes of a product are important, while conjoint analysis leads buyers to make trade-off decisions amongst a product’s attributes offered in representative sets, ensuring more in-depth results that highlight the intricacies every purchase decision a buyer could make.

These intricacies may not even be known to the buyer on a conscious level. Therefore, conjoint analysis sheds light on the nuances of buyer decisions that isn’t self-





reported (McQuarrie, 2016). Enabling trade-off decisions ensures a buyer cannot state that all attributes are important and forces everyone to consider what it truly important to them. Such results can confirm researcher’s product assumptions or offer managers opportunities to explore new product variations without the extensive resource utilization that comes with building said product alternatives.

As Figure 7 further illustrates, the introduction of software advancements to conjoint analysis in the business marketing environment, has allowed the method to expand. This technique can handle much more of the complexity that stems from consumer buying decisions and product design alternatives (McQuarrie, 2016). Such expansion has introduced several conjoint method types that provide the most useful results to researchers given the research situation.

Conjoint analysis results may be analyzed to evaluate price elasticity of demand for a product, price sensitivity of consumers for that product or service, and the Willingness-to-Pay (WTP) of consumers for that product or service (Orme, 2020). Table 7 defines each of these measures, as its critical to understand these factors, especially WTP, for the research illustrated in this paper.

Table 7. Conjoint Analysis Result Measures. Source: Orme (2020).

Measure	Definition
Price Elasticity	The percentage change in quantity demanded divided by the percentage change in price. Price elasticity relates to the aggregate demand for a product and the shape of the demand curve. It is a characteristic of a product in a market.
Price Sensitivity	A characteristic of buyers or consumers. Some people are more sensitive to price changes than others, and the degree to which they are price sensitive can vary from one product or service to the next, one market to the next, or one time to the next. It can also vary with the characteristics of products described in terms of product attributes.
Willingness-to-Pay	A characteristic of buyers or consumers. A measure of willingness to pay shows how much value an individual consumer place on a good or service. It is measured in terms of money.



## 6. Types of Conjoint Analysis

As conjoint analysis has evolved, in part due to software advancements, so too has its approaches. How a researcher chooses to utilize conjoint analysis depends on the research situation and the outcomes they intend on achieving. Early uses of conjoint analysis in marketing utilized a ratings-based approach and the traditional method of card-sort conjoint or Conjoint Value Analysis (CVA) (Orme, 2020). Introduced in 1971, this traditional method implements full profiles of products, meaning the “product concept is fully defined using one level from each of the attributes in the study” (Orme, 2020). CVA is advantageous only when a researcher intends for a small-scale study where respondents are presented with one or pairwise concepts and are asked to rank or order said concepts (Orme, 2020). For its time, card-sort conjoint or full-profile conjoint analysis was popular in business problems research and still has relevance in certain research situations today; however, as software has improved, opportunities for more complex conjoint analysis methods have developed.

One such development, Adaptive Conjoint Analysis (ACA), takes a hybrid approach to conjoint analysis. As seen in Figure 8, conjoint analysis approaches can be split amongst the tactics researchers choose to implement amongst their study’s respondents. Earlier methods of conjoint sought out ratings-based approaches where respondents would rank full-profile products, while later techniques supported by more advanced software, allowed respondents to choose or trade-off amongst product configurations. ACA draws on both techniques and first allows respondents to rate the significance of certain attributes while later customizing specific trade-off decisions respondents must choose from. After introduced in 1987, ACA became the most extensively used method as it allowed researchers to evaluate more attributes than traditional CVA, though presented information to respondents in a way that did not overwhelm them (Orme, 2020).

Choice-based techniques have become more popular in recent decades, as their methodologies offer the most realistic environment for respondents. Choice-Based Conjoint (CBC) is discussed in the next section of this chapter; however, Adaptive Choice-Based Conjoint (ACBC) and a recently developed methodology, Menu-Based

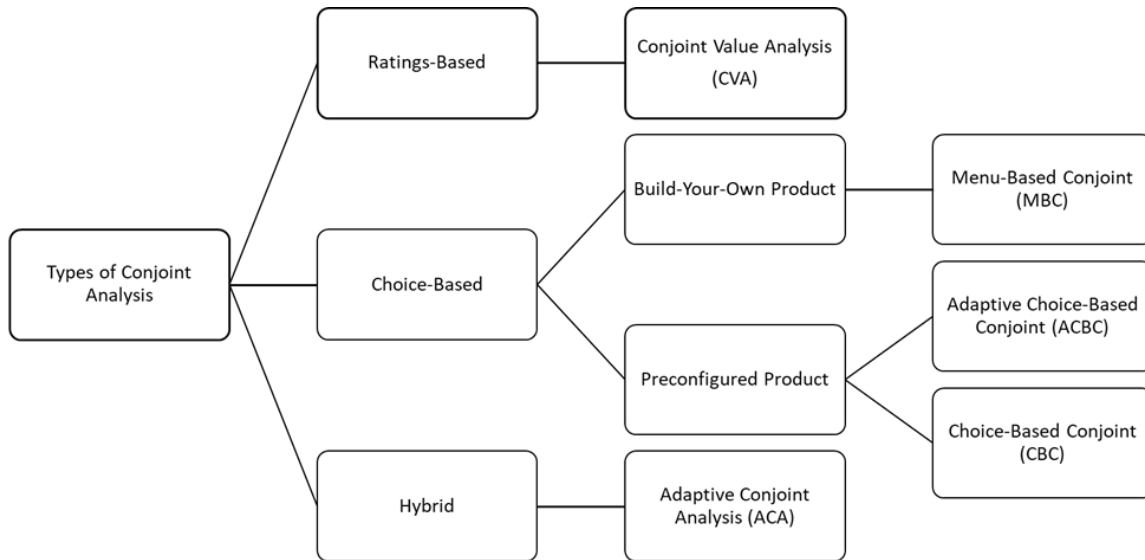


Conjoint (MBC), both build from the same foundation as CBC. ACBC offers an interview-like procedure that allows respondents to configure preferential product profiles, screen variations of the configured profiles, and finally choose a product based off that screening (Orme, 2020). Such an extensive process has shown to be beneficial to both the researcher and the respondent as it offers superior data output and a more satisfying experience for respondents than standard CBC (Orme, 2020).

MBC takes a more unique approach to choice-based analysis as it allows a respondent to construct their own preferred product from a single menu of options as opposed to standard CBC methods that present pre-configured product profiles (Orme, 2020). MBC offer researchers a way to utilize conjoint methods for a large sample size while offering respondents a highly realistic purchasing environment. While MBC offers an approach this study could potentially benefit from, MBC studies are difficult to “design, program, and analyze than other types of conjoint surveys, so those who are relative newcomers to conjoint analysis may want to rely upon experienced consultants in the field” (Orme, 2020). With that MBC studies require large sample sizes, usually more than 200 but often 600 or more respondents, to gather the necessary, relevant data it needs (Orme, 2020). The intentions of this study can be met utilizing both a smaller sample size and lower level of complexity; therefore, CBC, not MBC was chosen for the study.



Figure 8. Types of Conjoint Analysis in Marketing. Adapted from Orme (2020).



## D. CHOICE-BASED CONJOINT

### 1. Choice-Based Conjoint (CBC) Overview

CBC is a conjoint technique that presents questions called “choice tasks” that require respondents to decide from three to five product profiles (Orme, 2020). CBC stands out from other traditional approaches because it does not ask respondents to rate products, as buyers would not realistically, solely rate products presented to them in a store. They would either buy one or defer their purchase if unhappy with the choices. A CBC study instead asks them to choose which product is preferred based off its attributes and attribute levels with an option to opt out of choosing any of the choice profiles presented.

While CBC has gone by other names such as Discrete Choice Modeling (DCM), Discrete Choice Experiments (DCE), Discrete Choice, or Choice Analysis, the theory behind such applications remains the same (Orme, 2020). Random Utility Model (RUM) theory offers both a “theoretical and mathematical foundation for most choice-based conjoint applications” (Orme, 2017). RUM seeks to answer how people make non-trivial choices by assuming “that on each choice occasion, individuals choose the alternative they perceive to have the greatest utility on that occasion” (Raghavarao et al., 2010). In the context of conjoint analysis, utility refers to the overall desirability of a product

alternative when a buyer is presented with multiple product alternatives (Orme, 2020). The overall utility of a product alternative can further be delineated into a product alternative's part-worths which seek to describe the value of a product's attributes or components (Orme, 2020).

## **2. Estimating Preference in CBC Applications**

The preference of respondents in a CBC application can be estimated using several analytical methods including Logit Analysis, Latent Class Analysis, or the Hierarchical Bayes (HB) Analysis. Logit Analysis, or Multinomial Logit (MNL), is a “multivariate statistical model for relating utilities to probabilities of choice” (Orme, 2020). In other words, a MNL model aims to aid researchers in predicting the probability of an individual choosing a certain product alternative among several choices. To do so, a researcher must gather data from a substantial number of individuals or a considerable amount of data from an individual respondent. That data can then be used to successively improve a researcher's estimations of part-worths until they find convergence, or the “point at which part-worth utility estimation routines settle on the maximum likelihood solution” (Orme, 2020). MNL models can be seen as aggregate choice analysis in which collected data is used to iteratively accumulate respondents and develop a “single set of part-worths to represent all respondents” (Orme, 2020). Utilizing aggregate choice analysis to predict choice behavior, facilitates homogeneity amongst respondents that inevitably ignores the complex, individual preferences of buyers and respondents.

To better address such individuality and heterogeneity amongst respondents, a Latent Class Analysis, or the Finite Mixture Model, can be used. Such an analysis can guide researchers to analyze data taken from a CBC application and discover “groups of respondents that exhibit similar choice patterns and develop a set of part-worth utilities for each class” (Orme, 2020). So, while MNL develops a set of part-worths for all respondents, Latent Class Analysis builds up a set of part-worths for each segment discovered. This provides a better understanding of individual market choices while still benefiting from aggregate choice analysis. It is important to note that Latent Class Analysis segments respondents based on their preferences and while it does not



necessarily assign them to groups it does provide a probability that a respondent is in a particular group (Orme, 2020).

The Hierarchical Bayes (HB) estimation takes the analysis of CBC data a step further by offering a model that can reasonably estimate part-worths on an individual-level (Orme, 2020). As mentioned previously, HB analysis was only possible after extensive computer software advancements. These advancements have enabled researchers to discover individual-level part-worth utilities as opposed to group or overall part-worth estimates gathered through MNL and Latent Analysis techniques. Like Latent Analysis, HB models will iteratively collect data from multiple respondents, until researchers can find the convergence point that most precisely reflects part-worth utility estimation. What differentiates the two analysis is that HB models seek individual-level estimates while Latent Analysis builds up segment or group estimates. What is fortunate about these models is that they can be used simultaneously to gather estimates on both levels.

### **3. Previous Work in CBC For Business-To-Consumer (B2C)**

The utilization of CBC applications in the B2C environment continues to be an extremely prevalent method in trying to understand and predict human choice. Companies today, like General Motors, are spending millions of dollars to routinely analyze the choice behavior of consumers in the hopes of maximizing profits (Hauser et al., 2019). The success of CBC analysis and further developments in its application have also expanded its use in efforts outside of boosting revenue. Fields like “psychology, economics, environmental science, geography, management, marketing, political science, recreation, and transportation” have all seen increasing use of CBC tools as understanding human choice is of interest to researchers in these fields (Raghavarao et al., 2010). Two such fields, the healthcare and hospitality industry, have seen substantial use of CBC. Such utilization can offer key insights into the methodology and design of further CBC applications, including the CBC created for this MBA project.



**a. Healthcare Industry**

For the healthcare industry, there is a growing interest in determining patient preferences. CBC analysis has allowed researchers to develop a better understanding of what patient’s want when it comes to their treatment, their healthcare providers, and even their personal health data (Chitturi et al., 2020). However, despite its growing popularity in the healthcare industry, CBC analysis continues to be a point of contention as there is a “lack of standard methodologies on how best to utilize CBC” (Chitturi et al., 2020). Specifically, there appears to be no discernible commonality as to how a CBC choice exercises should be dispensed, how risk in CBC choice exercises are described to patients, and the analysis of CBC data remains irregular amongst its applications in the field (Chitturi et al., 2020). This lack of cohesion has created a “barrier to more widespread use of CBC in healthcare” (Chitturi et al., 2020).

The CBC design issues experienced in healthcare-focused conjoint studies, provides a better understanding in how to best conduct a CBC. For example, maintaining an effective amount of choice sets within each CBC is important. Having too many choice sets, attributes, or attribute levels may lead to respondents making imprecise choice decisions, providing researchers inaccurate data (Chitturi et al., 2020). Another issue discovered was that researchers were including attributes and attribute levels that did not provide the precise or relevant data researchers were aiming to garner in their study (Chitturi et al., 2020). Prior to any CBC being released, determining the most effective attributes and their levels is critical to ensuring a well-designed CBC that provides researchers with the most relevant, accurate data.

**b. Hospitality Industry**

When reviewing past CBC studies centered on the hospitality industry, a dollar metric is prevalent amongst those experiments. WTP is a metric tied to part-worth utility contrasts amongst attribute levels and indicates the “amount respondents would be willing to pay to get an improved level over a less desirable level” (Orme, 2020). The WTP metric can also be utilized when comparing product alternatives against one another, indicating how much respondents would pay for one alternative over another (Orme, 2020). As the cost or price of a procurement is always considered in a source



selection, the WTP metric is a key supplemental component of analysis for the CBC created in this MBA project.

#### **4. Previous Work in CBC for Business-To-Business Environment**

CBC and conjoint studies have also been a common application in the Business-to-Business (B2B) environment. The commercial use of CBC and packages like Sawtooth Software have been applied in B2B transaction involving employee compensation packages, university curricula designs, and supplier behavior studies (Orme, 2020). Legal litigation between businesses has seen the use of CBC, as “courts have awarded billion-dollar judgments for patent or copyright infringement based on CBC studies” (Hauser et al., 2019).

CBC in the B2B environment has shown to be an effective tool for buyers regarding their suppliers and may offer advantageous insight and potential opportunity to the government. For example, past studies have used conjoint analysis to examine supplier trade-off behaviors in terms of supply chain finance methods like Reverse Factoring and supplier security preferences (Banerjee et al., 2021). The post-pandemic economy has shown the significant impact global supply chain issues have on both the consumer and the DoD. So, finding tools to better measure, understand, and analyze supplier’s behaviors and preferences could help to enable better buying relationships between the government and their suppliers.

#### **5. Previous Work in CBC For Business-To-Government**

The Section 809 Panel, an acquisition advisory team that presented a roadmap in how the DoD should close the “alarming gap between the capabilities within DoD and the continuously evolving threat [the] DoD must prepare to meet” further supports the need to find new ways to develop relationships with suppliers, new and old, while discovering further methods of incentivizing them to do business with the government (DoD, 2019). CBC and conjoint analysis offer both the government as buyer and its suppliers to learn more about one another, their preferences, and ways in which to incentivize a more consummate relationship with each other.





While the commercial sector has seen a growing popularity in the use of conjoint applications, including, CBC, its use in government applications remains a somewhat foreign concept. The most notable, recent CBC in the Business-to-Government (B2G) sector, specifically DoD operations, focuses on the service quality and perceived value in B2G KBS. Published in 2020, Lieutenant Colonel Daniel Finkenstadt's PhD dissertation focuses on discovering perceived attributes of value for KBS then later utilizing these discovered attributes to create a CBC approach that monetarily rates these perceived attributes.

The study was conducted, in part, to determine if these perceived qualities of KBS could be “monetized for operational use in making best value determinations for KBS” (Finkenstadt, 2020b). Like Finkenstadt's study, this MBA project explores whether CBC methods can aid acquisition personnel in making best value determinations by first focusing on a different category spend than KBS, such as logistics, and later developing a CBC-related framework that could be utilized to aid in further DoD categories of spend. This study specifically explores the direct level of discontinuity between stated preferences and actual choice behaviors alluded to in Finkenstadt's work, but not the primary focus of it.

## **E. MILITARY LOGISTICS**

### **1. Military Logistics Overview**

Logistics may not win a war for you, but it can certainly cause you to lose one.

—Levy, 2018, p. 8

For the purposes of this paper, logistics is defined as “the transfer of personnel and materiel from one location to another, as well as the maintenance of that materiel” (American Research and Development Corporation [RAND], n.d.). In the military, logistics “support deals with everything required to provide warfighters with the *right stuff at the right time at the right place at the right cost*” (Apte et al., 2006). Ensuring the military has a well-defined logistics system is as essential as it having knowledgeable troops and reliable weapon systems as all three ensure the military's readiness and power



(Apte et al., 2006). Military logistics includes a broad range of functions, including, “transportation, inventory management, modifications and maintenance activities” (Apte et al., 2006).

The overarching goal of military logistics is to ensure the military reaches and maintains the highest level of readiness, or its operational availability ( $Ao$ ) (Apte et al., 2006). In mathematical terms, operational availability can be articulated as (Apte et al., 2006):

$$Ao = \frac{MTBM}{MTBM + MDT} = \frac{Uptime}{Uptime + Downtime}$$

MTBM = Mean Time Between Maintenance

MDT = Mean Down Time

Often expressed as a percentage,  $Ao$  provides answers as to how often a piece of equipment or weapon system is available for use (DAU, 2022b). Simply put,  $Ao$  provides the “quantitative link between readiness objectives and supportability” (DAU, 2022b).

In recent years, operational availability and military readiness have been articulated as a “headline concern of U.S. defense policy” (Mooney et al., 2018). As the United States military shifts its focus from nonstate adversaries to peer or near-peer adversaries, such as Russia and China, sustaining an effective military logistics system holds a role of crucial importance as these peers have the known capabilities to interfere with military mobility and logistics (Kepe, 2018). One of the objectives of this paper’s research includes developing a deep understanding of quality attributes in evaluating logistics-based service acquisitions. While this objective may be a small component in the efforts to improve logistics within the U.S. military, understanding how government personnel perceive value in logistic-based services and acquisitions, can enable better buying power that ensures the warfighter gets “the *right* stuff at the *right* time at the *right* place at the *right* cost” (Apte et al., 2006).

## 2. Logistics Support Service and PSC R706

As discussed in previous portions of this paper (see ‘Methods and Data’), military logistics includes a broad range of activities that the researcher could not develop a



rational number of service quality indicators within the sole CBC developed for this study. Therefore, the focus on this portion of the literature review is to only briefly describe those logistics activities under the logistics management services category and, more specifically, the federal logistics support services category. It concludes with further specificity on PSC R706, Support – Management: Logistic Support, as this PSC was selected to determine a limited, yet viable, number of service quality indicators to use in one CBC analysis.

***a. Logistics Civil Augmentation Program***

Logistics Management Services are those support services associated with facilitating supplies, systems, or equipment military requirements and includes two types of services: the Logistics Civil Augmentation Program (LOGCAP) and Logistics Support Services (DAU, n.d.). While LOGCAP is designated as a United States Army program, LOGCAP can and does support other U.S. military branches, multinational forces, and other government/non-government agencies (Department of the Army [DA], 2017). LOGCAP acts as a contingency program and “supports scalable, ready, and responsible logistics and base support services by integrating contracted private sector capabilities to fulfill the operational commander’s requirements” (DA, 2017). Private Sector contractors plan and provide services that support contingency operations and the facilities, supplies, services, maintenance, and transportation requirements of those operations (DAU, n.d.).

In 2019, the U.S. Army Sustainment Command designated four companies as contractors under the LOGCAP V contract (Army Sustainment Command Public Affairs, 2019). LOGCAP V contractors provide operational commanders with a plethora of capabilities, including, but not limited to:

Supply operations, Field services, Clothing exchange and bath, Laundry, Clothing repair, Food service, Mortuary affairs, Hazardous materials/waste disposal, Billeting, Morale welfare/recreation, Facilities management, Personnel support, Information management, Maintenance, Other operations and services, Medical services, Transportation, Signal support services, Engineering and construction, Power generation and distribution, Support of Army personnel and equipment retrograde, Standard Army Management Information Systems operations. (DAU n.d.)



For the intended ten years (five-year base term followed by five option years), the U.S. Army plans to obligate \$3 - \$3.5 billion dollars annually (\$82 billion cap) to ensure these contractors provide a “dedicated regional sustainment capability with a 72-hour response time, and capability and flexibility that aligns with the military operational tempo” (Army Sustainment Command Public Affairs, 2019).

***b. Logistics Support Services***

Besides LOGCAP, Logistics Management Services also include those services categorized under Logistic Support Services (DAU, n.d.). Logistic Support Services include those services relating to the following:

Maintenance, overhaul, repair, servicing, rehabilitation, salvage, modernization, or modification of supplies, systems, or equipment

And

[The] operation of Government-owned equipment, facilities and systems.  
(DAU, n.d.)

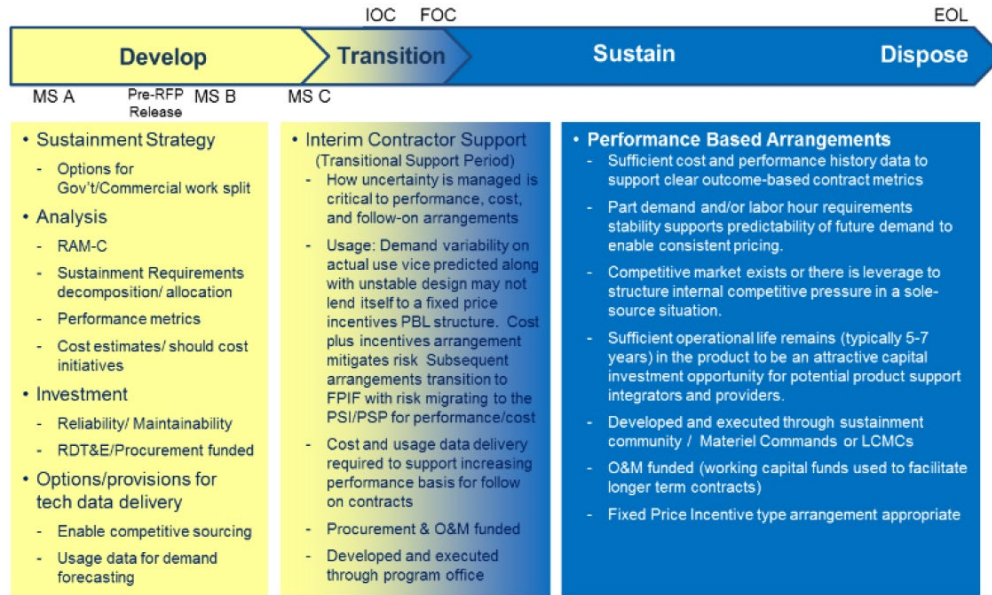
For those services that fall under the Logistic Support Services category, the DoD emphasizes the use of performance-based contracts as opposed to transaction-based contracts, so that the DoD receives the best long-term value from its contracts (DAU, n.d.). As outlined in FAR Subpart 37.6, performance-based contracts should “describe requirements in terms of results to be obtained rather than the methods of performance,” include measurable objective performance standards, and incorporate financial penalties and incentives for contractors based on their performance (DoD, 2016a).

For military logistics, Performance Based Logistics (PBL) has been the preferred sustainment strategy for the DoD since 2001 (DoD, 2016a). This is to ensure that the DoD and its components implement performance-based contracting standards to various product support contracts and service contracts such as equipment-related services, transportation-related services, and even the focus of this study’s CBC: facility-related services. As a Product Support Arrangement (PSA), PBLs are “contracts, task orders or any type of other contractual agreement or non-contractual arrangement within the Federal Government, for the performance of sustainment or logistics support required for major weapon systems, sub-systems or components” (DAU, n.d.). As shown in Figure 9, PBL and its activities can be applied to any “new, modified, or legacy system” and “at a



platform, system, sub-system or component-level” (DAU, n.d.). PBL seeks to deliver “an integrated, affordable product support solution that satisfies Warfighter requirements while reducing Operating and Support (O&S) costs” (DoD, 2016a).

Figure 9. PBL Development and Implementation Activities Across Program Life cycle. Source: DoD (2016a).

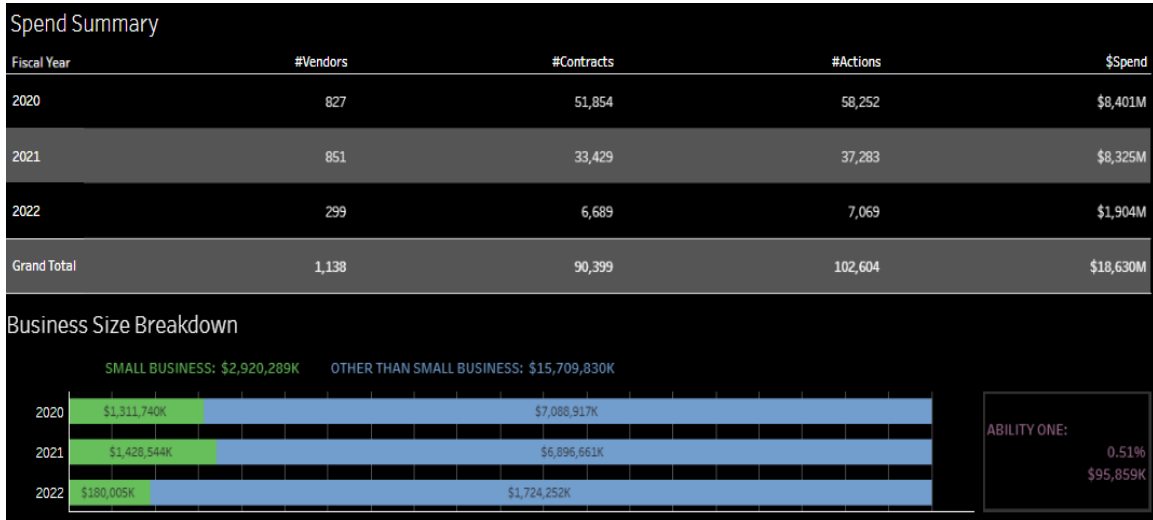


**c. Support-Management: Logistic Support [PSC R706]**

Under the category of Logistic Support Services, PSC R706 [Support – Management: Logistic Support] accounted for the largest DoD dollar spend (approximately \$18.6 Billion) during FY 2020 – FY 2022 quarter 1 (AFICC, 2022). During this timeframe, over 90,399 contracts across the DoD are associated with the PSC, and some of the largest defense contractors, such as Lockheed Martin Corporation, General Dynamics, and the Boeing Company provide services for these contracts (AFICC, 2022). Figure 10 further breaks down the PSC in terms of DoD dollar spend and the vendors associated with it.



Figure 10. PSC R706 Spend and Vendor Composition. Source: AFICC (2022).



The North American Industry Classification System (NAICS) categorizes vendors based on the products and services they offer (U.S. Census Bureau, 2022). A review of those NAICS most often associated with PSC R706 indicates that frequent services categorized in conjunction with the PSC include facilities support services (NAICS 561210), engineering services (NAICS 541330), and process/physical distribution/logistics consulting services (NAICS 541614) (AFICC, 2022).

As the ‘Methods and Data’ portion of this paper illustrated, real property maintenance services, those services often associated with NAICS 561210 (facilities support services), are one of most frequent types of services tied to PSC R706. For this reason, real property maintenance was utilized within the CBC conducted for this study. Real property is defined as “any interest in land, together with the improvements, structures, and fixtures located thereon (including prefabricated movable structures, such as Butler-type storage warehouses and Quonset huts, and house trailers with or without undercarriages), and appurtenances thereto, under the control of any Federal agency” (Real Property Policies, 2022). There are a number of exceptions to this definition, such as those interests associated with the public domain, lands committed for national park purposes, minerals reserved for public land mining, and even crops that are to be removed from real property (Real Property Policies, 2022).



The maintenance of real property is defined as, “the upkeep of property only to the extent necessary to offset serious deterioration; also, such operation of utilities, including water supply and sewerage systems, heating, plumbing, and air-conditioning equipment, as may be necessary for fire protection, the needs of interim tenants, and personnel employed at the site, and the requirements for preserving certain types of equipment” (Real Property Policies, 2022). The military includes further distinction between ordinary maintenance and preventative maintenance within its definition of real property maintenance. Ordinary maintenance includes the recurring work associated with everyday operations, while preventative maintenance is the work conducted at scheduled intervals (Real Property Policies, 2022).

## **F. QUALITY METRICS AND SERVICE QUALITY INDICATORS**

### **1. Perceived Quality in Logistics Services**

Insight on how the DoD currently evaluates logistics-based services is foundational knowledge that offers better understanding in how to determine accurate service quality indicators for this study. For this study, the researcher reviewed evaluation metrics employed under PBL strategies. Furthermore, it was also necessary to analyze the system in which the DoD gathers and internally circulates contractor performance information. The following section reviews evaluation tactics under PBL and examines the Contractor Performance Assessment Reporting System (CPARS). It later illustrates why the highlighted metrics in CPARS or PBL guidebooks are *not* used in this study and how a different metrics scale, SERVQUAL, would be utilized in the study’s CBC, instead.

### **2. Performance-Based Logistics (PBL) Metrics**

PBL metrics “track, measure, and assess the implementation and effectiveness of the PBL arrangement” and help to recognize gaps between the expected performance versus the actual performance of the contractor (DoD, 2016a). When selecting metrics in which to evaluate performance in a PBL arrangement, government personnel are urged to seek metrics that are specific, measurable, attainable, relevant, and timely or S.M.A.R.T



(DoD, 2016a). The following section breaks down the S.M.A.R.T test the PBL guidebook encourages acquisition personnel to conduct (DoD, 2016a):

S = Specific: clear and focused to avoid misinterpretation, specifying the allowable range or threshold

M = Measurable: the unit of measure is specified and tied to underlying data to allow for meaningful statistical analysis

A = Attainable: achievable, reasonable, cost-effective, and credible under expected Concept of Operations (CONOPS)

R = Relevant: tied to the Warfighter requirements, appropriate to the specific level of scope and responsibility, designed to motivate the right long-term behavior, and linked to appropriate incentives

T = Timely: doable within the given time frame

Determining the proper metrics in a PBL scenario is also reliant on what the government wants out of the arrangement, whether the requirement is at the system, subsystem, or component application level, and the product support element (DoD, 2016a).

Along with selecting the right metrics, it's also important to review how each metric interacts with one another. If there is redundancy or metrics negate one another, the desired behavior of the contractor will not be met by the PBL arrangement (DoD, 2016a). To counteract a poor combination of metrics, government personnel are advised to implement the PBL metrics hierarchy (DoD, 2016a). The three-level hierarchy provides a method in which to “demonstrate how metrics should ‘roll up’ and relate to one another in a complementary manner” (DoD, 2016a). The following section describes the hierarchy in more detail and Figure 11 provides an example of the PBL hierarchy in action:

Level 1 Metrics = overarching, top-level performance goal or attribute for the PBL arrangement

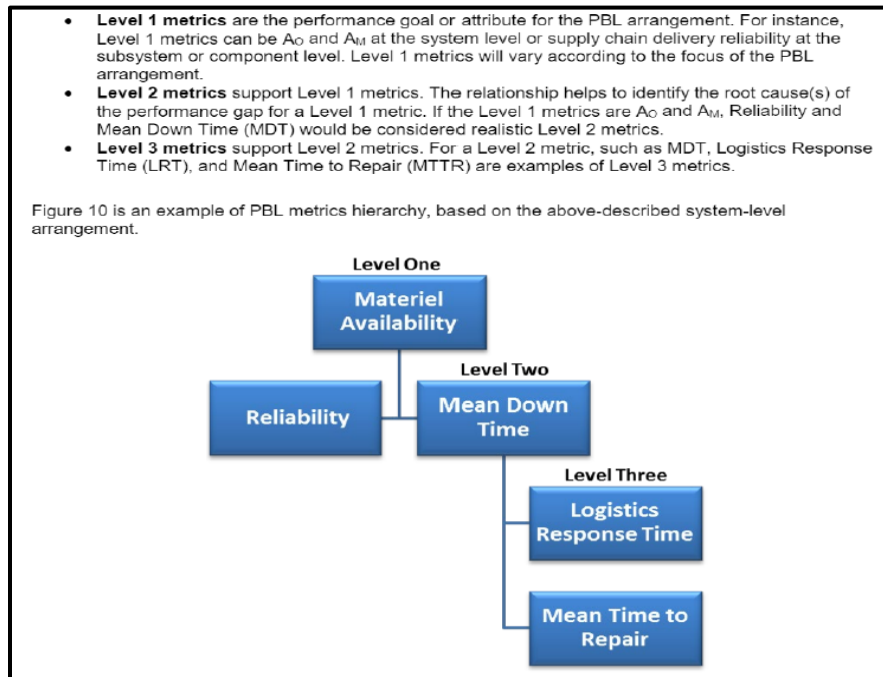
Level 2 Metrics= diagnostics and support for Level 1 metrics. The diagnostic relationship helps to identify the root cause or causes of a performance gap for a Level 1 metric

Level 3 Metrics = diagnostics and support for Level 2 (DoD, 2016a)



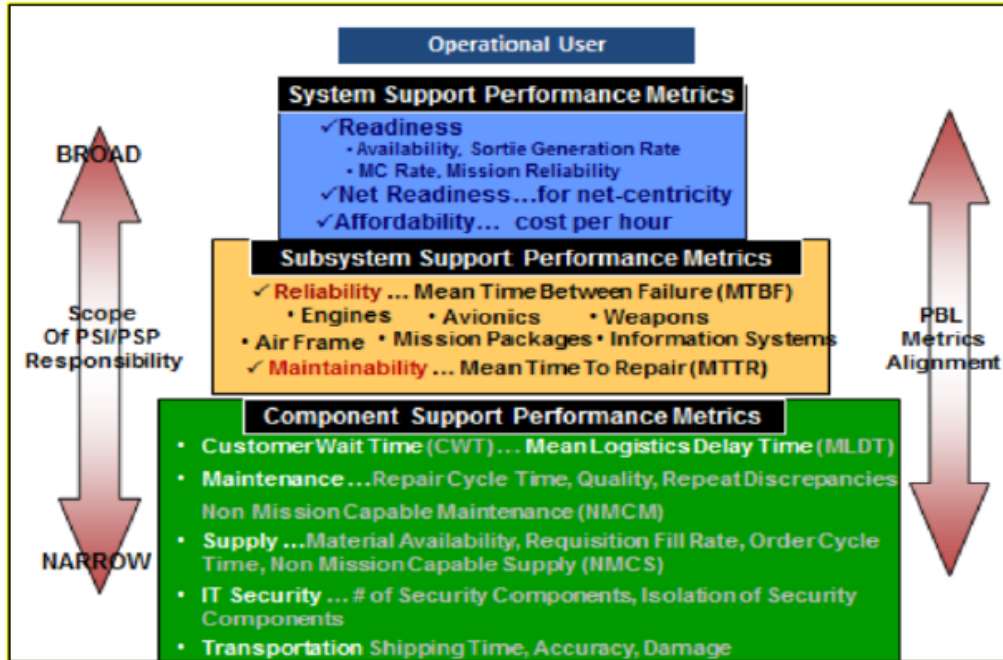


Figure 11. PBL Metrics Hierarchy and Decomposition. Source: DoD (2016a).



As diverse as the services in military logistics are, so too are the common metrics utilized in PBL arrangements. Depending on the service required and the contractor behavior desired, government personnel can choose from a plethora of metrics related to quality service categories such as program management, transportation, time, supply, maintenance, reliability, etc. (DoD, 2016a). Figure 12 demonstrates a possible PBL arrangement with metrics broken down into these service categories and by application level (system, subsystem, component).

Figure 12. PBL Metrics Scenario. Source: DoD (2016a).



When determining the metrics for a PBL arrangement, it is noted that every arrangement should have a “manageable number of Key Performance Indicator (KPI) metrics – two to five (maximum) – that reflect the desired Warfighter outcomes and cost reduction goals” (DoD, 2016a). KPI metrics are top level metrics that are utilized to penalize or reward contractors in the PBL arrangement (DoD, 2016a). While an arrangement can have more than five lower-level metrics, an arrangement with more than 5 KPIs could reduce the incentive or ability for contractors to meet the outcomes set forth by the KPIs (DoD, 2016a).

### 3. Contractor Performance Assessment Reports System (CPARS)

CPARS contains both performance evaluations and integrity records for applicable federal government contracts (United States General Services Administration [GSA], 2022). Those with access to CPARS can “review relevant performance and integrity information before making an award decision” and “objectively evaluate performance” of contractors (GSA, 2022). CPARS guides acquisition personnel to evaluate contractors by utilizing a rating system that focuses on factors such as quality,

schedule, cost control, management, small business subcontracting, regulatory compliance ratings, and others (GSA, 2022).

FAR 45.1502 requires that evaluations such as those recorded in CPARS be prepared annually and once the work required by the contract is completed (FAR 45.1, 2022). Evaluations must be conducted on those contracts over the Simplified Acquisition Threshold (SAT), which is \$250,000 unless in a declared contingency or during humanitarian/peacetime operations (Assay, 2018). Additionally, past performance evaluations are also required for construction contracts of \$750,000 or more and architect-engineer service contracts of \$35,000 or more (Naval Sea Logistics Center Detachment Portsmouth, 2011).

Despite the importance CPARS has in ensuring past performance records for contractors include current, complete, and accurate information, the system has seen scrutiny in years past. GAO reports and the Office of Federal Procurement Policy describe multiple failures on the part of contracting agencies, in properly filing past performance records within the system on time (Black et al., 2014). Furthermore, the information collected on CPARS was oftentimes found to be “not reliable, robust, or comprehensive enough to allow source selection officials to place a significant enough weight on past performance” (Black et al., 2014). Agencies responsible for reporting the information in CPARS state that poor timeliness and ill-quality of the evaluations are due to their low manning, the other priorities of the agency, and issues with receiving the needed feedback on contractor performance (GAO, 2014a). It is important to recognize the limitations of CPARS as it highlights the need to develop key service quality indicators that go beyond the standard information required by CPARS that’s often inaccurate or untimely anyways.

#### **4. SERVQUAL vs. CPARS and PBL Metrics**

Despite the value CPARS and PBL metrics add to source selection evaluations and contractor performance, this study utilized SERVQUAL, a “concise multiple-item scale with good reliability and validity that companies can use to better understand the service expectations and perceptions of their customers” (Zeithaml, 2009). Further information on SERVQUAL and its impact are discussed within the ‘Methods and Data’



section of this paper; however, it should be noted that here that five SERVQUAL dimensions were used as a lens in which to establish attributes for the CBC developed. The decision to use SERVQUAL, as opposed to PBL attributes, developed after conducting interviews with a diverse set of logistics-focused government personnel. The focus of said interviews was to establish what mattered most to experienced interviewees when selecting a logistics service. For many, it was perceived service quality attributes, such as reliability and responsiveness, that appeared to matter most as they often emphasized and repeated attributes relating to or exactly like those SERVQUAL dimensions previously discussed. Consequently, while PBL metrics, such as Mean Time Before Failure or Customer Wait Time, are important, this study treated those metrics as ones that could be evaluated and used as pass/fail criterion in early, initial evaluations of contractor proposals. Then, the study modified certain SERVQUAL dimensions to be those final evaluation criteria a source selection team would observe to make final determination within the CBC's simulated source selection. More regarding the specific service quality indicators chosen from SERVQUAL and modified for this study is discussed within the 'Methods and Data' section of this paper.

## **G. SUMMARY**

This chapter presented an overview of the DoD Source Selection process and the issues associated with the current process in place. The chapter later presents a method that has the potential to rectify those issues: conjoint analysis. After an in-depth summary of conjoint analysis, the chapter later narrowed into the method of conjoint analysis used in this study, choice-based conjoint. The chapter later ventured into military logistics, the macro-level category of spend in which the study's choice exercise is based on. This particular section of the literature review went on to describe current processes in which acquisition personnel develop metrics and evaluate the performance of a contractor providing logistics-based services.

This study aims to confirm the degree of disconnect between stated preferences during pre-award acquisition phase and actual choice behavior in defense acquisition source selections. Such disconnect is due to current source selection procedures not offering a method that shifts personnel away from ineffective evaluation factor



determination and the a priori rank order of said evaluation factors. Conjoint analysis, and more specifically, choice-based conjoint analysis, is utilized in this study to confirm that it can provide that method of solution.



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### **III. METHODS AND DATA**

As alluded to in previous portions of this paper, the scope of this study focuses on confirming the assumptions developed through Finkenstadt's 2020 PhD study, while applying much of the same methodology to another federal category of spend, besides KBS. The researcher first concentrated on service categories that the DoD allocated large portions of federal spending to, so that the study and its results offered valuable insight into a critical, high-spend component of the DoD. The U.S. Air Force Installation Contracting Center's (AFICC) Business Intelligence tool, AFBIT Lite, was used to conduct a visual spend analysis of DoD contract data over fiscal periods 2020, 2021, and 2022 Quarter One.

#### **A. CATEGORY OF SPEND**

The chosen level 1 category of high spend for this study, Transportation and Logistics Services, included over 500,015 contracts and 547,013 contract actions, costing the DoD over \$48.9 Billion dollars (See Figure 13) (AFICC, 2022). The Transportation and Logistics Services Category includes a diverse set of functions and services, such as packaging, motor vehicles, fuels, and logistic support services; therefore, the researcher narrowed the category of spend in order to ensure a cohesive study and conjoint analysis. The researcher selected the level 2 category, Logistics Support Services (LSS), because it included the largest DoD spend amongst all level 2 categories at approximately \$18 Billion (see Figure 14) (AFICC, 2022).



Figure 13. DoD Level 1 Contracting Spend for FY20, FY21, FY22 Qtr 1.  
Source: AFICC (2022).

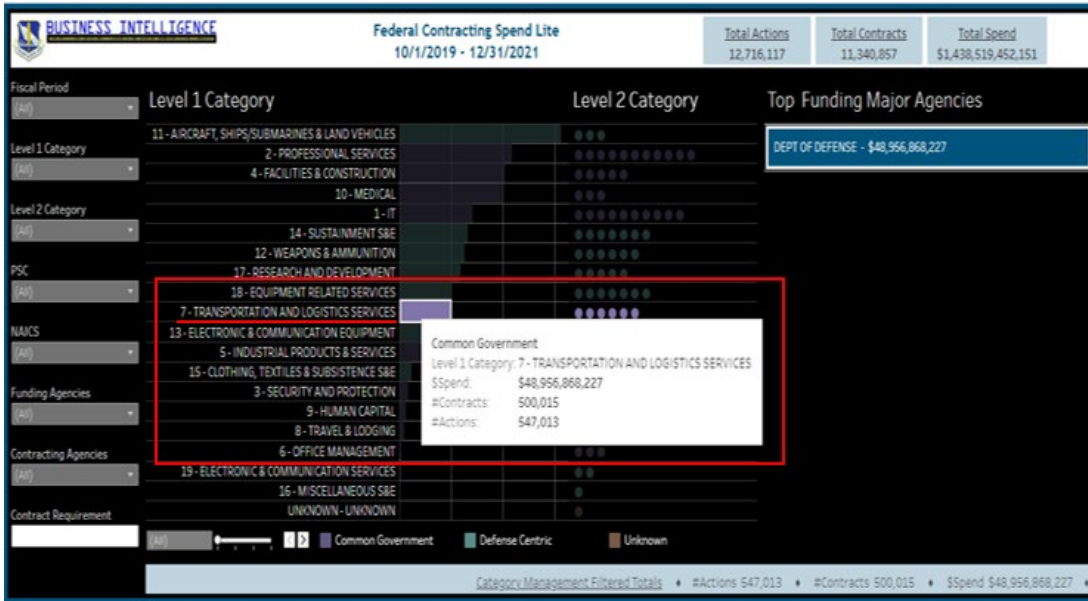
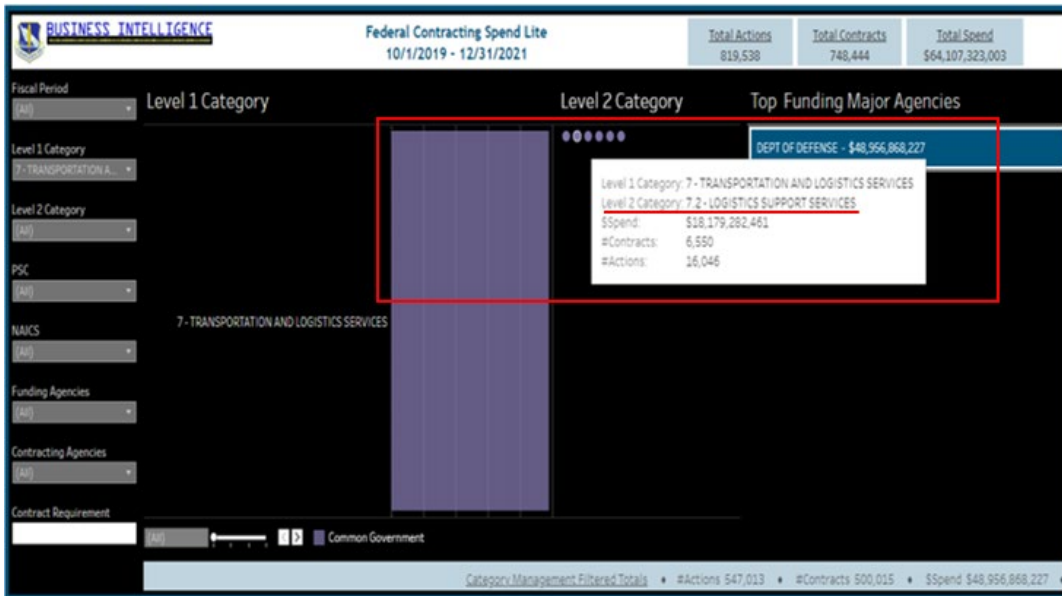


Figure 14. DoD Level 2 Contracting Spend Under Transportation and Logistics Services. Source: AFICC (2022)





## **B. PRODUCT SERVICE CODE R706**

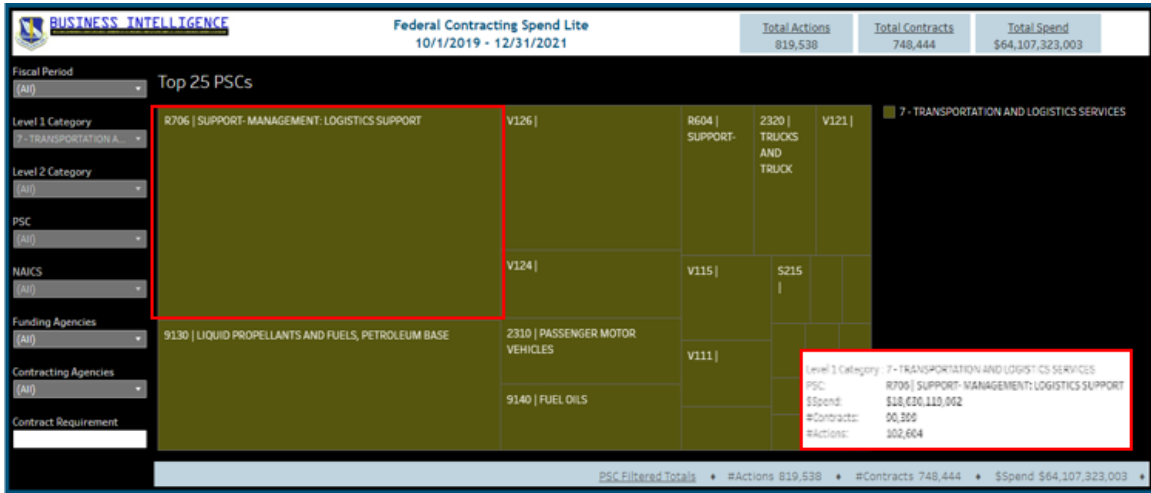
Similar to the broader Transportation and Logistics Service category (level 1), the LSS category (level 2) includes a diverse set of logistics support functions that could not effectively be illustrated with only one conjoint analysis. For instance, how a source selection team evaluates for general freight trucking services would be very different in how that same source selection team evaluates general warehousing and storage services. So, while part of this study is determining service quality indicators for a particular category of spend the DoD contracts for, one conjoint analysis cannot successfully incorporate all services under that category of service.

While further sections in this paper discuss CBC and conjoint analysis attribute determinations, it is important to note here that “defining proper attributes and [attribute] levels are arguably the most fundamental and critical aspect of designing a good conjoint study” (Orme, 2020). When developing a CBC, the researcher must present attributes concisely, offer their respondents with a full range of possibilities per attribute, delineate between independent and mutually exclusive attributes, and establish a balanced number of attributes (eight or fewer) and attribute levels (no more than five) (Orme, 2020). If a study attempted to transform all possible service quality indicators for all services the DoD contracts for into the attributes of a CBC, the researcher risks improper design of the CBC, unnecessary hardship for respondents attempting to complete the CBC choice exercise, and unproductive results from the CBC.

It was then necessary to use only *one* of the Product Service Codes (PSC) under the level 2 category, Logistics Support Services, to determine both a limited scope for the CBC scenario and a viable number of service quality indicators. As the researcher utilized highest DoD dollar spend to cleanse and choose services amongst the federal level 1 and level 2 categories of spend, it was determined that a consistent strategy was required to further narrow level 2 services by PSC. In analyzing the top 25 PSCs under the level 2 category, PSC R706 – Support Management: Logistics Support, includes the largest dollar spend at approximately \$18.6 Billion (See Figure 15) (AFICC, 2022).



Figure 15. Top 25 PSCs Under the Transportation and Logistics Service Category. Source: AFICC (2022).



### C. REAL PROPERTY MAINTENANCE

A review of North American Industry Classification System (NAICS) codes associated with PSC R706 indicates a diverse set of services, such as engineering services, facilities support services, process/physical distribution/logistic consulting services, and many more (AFICC, 2020). In the interest of creating a defined CBC scenario, the researchers reviewed CLIN data on the DoD’s Project Management Resource Tools (PMRT) Enterprise Analytics (EA) application CON-IT application. More information regarding that data can be found within the ‘Results’ section of this paper. Through this examination, the researchers determined that the CBC scenario would involve Real Property Maintenance (RPM), a service that is regularly associated with the PSC R706 category and is one of the more prevalent services contracted for under PSC R706.

### D. METHODOLOGY

The study outlined in this paper utilized a mixed-method approach to produce both qualitative data regarding service quality indicators in PSC R706 services and quantitative data gathered through conjoint analysis methods. The study includes methods such as a literature review, interviews, a spend and data analysis, and discrete choice modeling and simulation.

## **1. Literature Review to Inform Methods**

The literature review explored critical aspects that help build the foundation of this study. The researcher explored topics such as DoD source selection procedures and current DoD-related logistic services. When examining logistic-based services, the researcher sought to determine what, if any, procedures or scale was in place to measure the quality of these services. The literature review continues with a valuable depiction of conjoint analysis, CBC, and its use in the Business to Consumer (B2C), Business to Business (B2B), and Business to Government (B2G) markets. In providing comprehensive analysis to the literature, research, and existing information on these somewhat unrelated components, the study has improved efficacy in applying CBC techniques to the DoD's logistic-focused acquisition source selections.

## **2. Interviews to Develop CBC Attribute**

Initial efforts of the researcher focused on interviews that would aid in the determination of service quality attributes or bolster the attributes discovered through the literature review, associated with logistics-based acquisitions or services. The six interviews were conducted with government personnel that either had (1) experience in acquiring logistic-based services and/or commodities, (2) a military logistics background, or (3) experience in source selections focused on evaluating proposals for logistic-based services and commodities. The following interview questions, and other related follow-up questions, were proposed to each interview respondent:

- What types of logistic-focused services/supplies has your organization acquired?
- When evaluating these service/supplies, what were the non-price discriminators used by your organization?
- What non-price related factors has your organization included in evaluating logistic-based acquisitions during source selections?
- How did your organization measure or evaluate these non-price related factors?
- Were these non-price related factors as important as price to your organization?
- What price ranges have been observed by your organization during source selections for logistic-based acquisitions?
- What lot or unit sizes have been frequently observed by your organization in regard to the services/supplies acquired?



Those interviewed hold a diverse array of roles within notable military logistic fronts, such as the joint command of United States Transportation Command (USTRANSCOM), at prominent military materiel segments, like the Air Force Installation and Mission Support Center (AFIMSC), and in enterprise sourcing squadrons that deal with wing level contracting for air mobility portfolios.

It should be noted that the researcher ensured every interview followed this same set of questions. However, the researcher supplemented interviews using Lean Six Sigma's Define-Measure-Analyze-Improve-Control (DMAIC) principles regarding interview methods. This included the use of follow-on questions to clarify responses, asking questions to gather more detail regarding a specific respondent's point of view on certain service issues, and test specific ideas regarding performance indicators or service attributes (Apte et al., 2006). In essence, the interviews were conducted to learn what is important to customers, the acquisition workforce, and military logistics personnel when it comes to logistics-based services or supplies.

Despite the variety of acquisition personnel interviewed, the researcher noticed patterns and trends amongst responses. Common factors were consistently brought up in terms of how interviewees evaluated service quality in logistics services. These factors can be attributed to SERVQUAL. Prior to divulging the CBC attributes selected from the interview data, it is first important to understand SERVQUAL, service quality, and indicators of service quality.

Service quality is defined "as the extent of discrepancy between customers' expectations or desires and their perceptions" (Zeithaml, 2009). A number of factors can influence how a customer's expectations are shaped. First, word-of-mouth communications or what customers are hearing from other customers has impact over the customer's expectations (Zeithaml, 2009). Second, the unique requirements or personal needs of the customer can influence their expectations (Zeithaml, 2009). Third, past experience or past performance of a service provider has influence over customer expectations (Zeithaml, 2009). Finally, external communications or those communications coming from service providers, including the prices advertised, to their customers may dictate customer expectations (Zeithaml, 2009).



Perceptions of service quality or how customers judge the quality of service can often be described utilizing a set number of evaluative criteria (Zeithaml, 2009). These criteria often fall under a number of core dimensions:

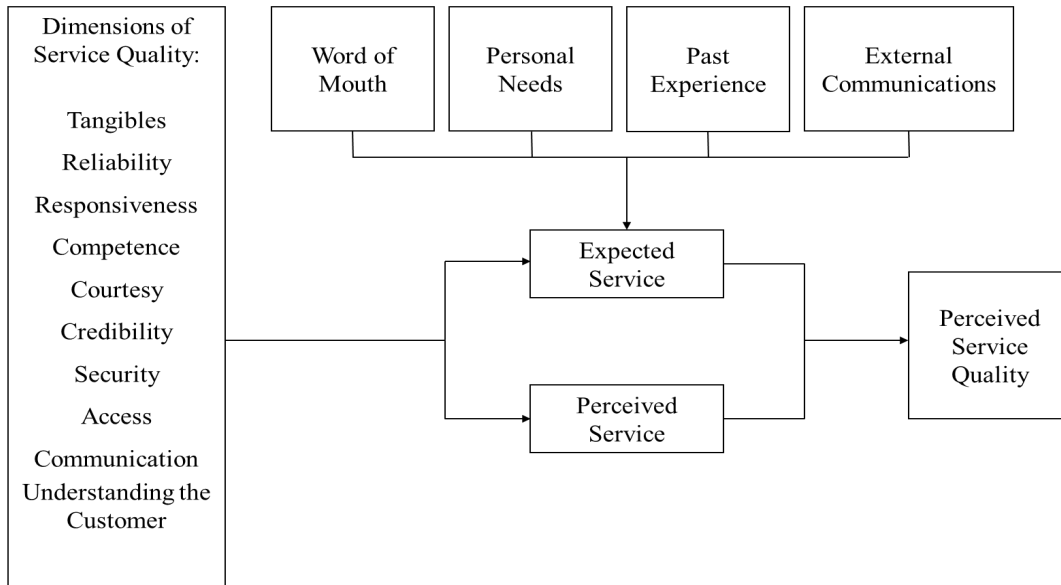
Table 8. Dimensions of Service Quality. Source: Zeithaml (2009).

<b>Dimension</b>	<b>Definition</b>
Tangibles	Appearance of physical facilities, equipment, personnel and communication materials
Reliability	Ability to perform the promised service dependably and accurately
Responsiveness	Willingness to help customers and provide prompt service
Competence	Possession of the required skills and knowledge to perform the service
Courtesy	Politeness, respect, consideration, and friendliness of contact personnel
Credibility	Trustworthiness, believability, honesty of the service provider
Security	Freedom from danger, risk, or doubt
Access	Approachability and ease of contact
Communication	Keeping customers informed in language they can understand and listening to them
Understanding the Customer	Making the effort to know customers and their needs

When the expectations of a customer and the perceptions of service quality are extrapolated, perceived service quality is deduced. Figure 16 depicts this relationship in terms of the customer's assessment of service quality (Zeithaml, 2009).



Figure 16. Customer Assessment of Service Quality. Source: Zeithaml (2009).



SERVQUAL further consolidates the above-described dimensions and perceptions of service quality into five concise definitions:

- Tangibles:** Appearance of physical facilities, equipment, personnel, and communication materials
- Reliability:** Ability to perform the promised service dependably and accurately
- Responsiveness:** Willingness to help customers and provide prompt service
- Assurance:** Knowledge and courtesy of employees and their ability to convey trust and confidence
- Empathy:** Caring, individualized attention the firm provides its customers (Zeithaml, 2009)

Though the study developed unique service quality indicators for those services under PSC R706, it was important to (1) establish a baseline understanding of what service quality means, (2) how customers perceive/evaluate service quality, and (3) utilize the factors developed for SERVQUAL, a widely used and recognized model, to determine, modify, or construct service quality indicators to measure perceived quality within the study’s CBC. Therefore, when analyzing interview responses, it was determined that three of the five consolidated SERVQUAL dimensions consistently arose: Tangibles, Reliability, Responsiveness. Further interview information suggested that another SERVQUAL dimension, Competence or “the possession of the required

skills and knowledge to perform the service,” was a perceived service quality indicator (Zeithaml, 2009)

These dimensions, along with price, were then used as the five attributes of this study’s choice exercise. Table 9 illustrates how the four SERQUAL dimensions were modified to represent the important attributes necessary for the simulated logistics-based service source selection.

Table 9. Selected Choice Exercise Attributes Modified from SERQUAL Dimensions. Adapted from Zeithaml (2009).

Attribute	Explanation from Interviews	Description to Respondents
Competence	Multiple interviewees stressed the importance that contractors needed to demonstrate capability and they have the capacity to perform the required service.	Real Property Maintenance firm’s employees applied existing best practices to execute requirements on past contracts.
Reliability	Multiple interviewees stated they seek contractors that perform how they state they [contractors] can perform.	Real Property Maintenance firm demonstrated an ability to perform dependably and accurately on previous contracts.
Tangibles	Multiple interviewees stated they need contractors that can accurately and demonstrably provide the manpower and materials required to perform the needed service.	Real Property Maintenance firm demonstrated they have the facilities, equipment, personnel, and communication materials needed to complete the service
Responsiveness	Multiple interviewees stated that contractors chosen through LPTA evaluations failed to provide the needed qualitative, technical capabilities. Interviewees now aim to find those firms that understand the requirement and will take their service to the next level to meet that requirement, even if that means a higher price.	Real Property Maintenance firm demonstrated a willingness to help customers and provide prompt service on previous contracts

### 3. Spend and Data Analysis to Establish CBC Service and Price Points

To reinforce or corroborate the information gathered through interviews, the researcher reviewed DoD contract spend and actions utilizing PMRT EA. PMRT EA is a data analytics tool that generates visualizations of data collected from acquisition applications such as the U.S. Air Force’s contract writing tool, CON-IT. This tool allowed the researcher to determine common Contract Line-Item Number (CLIN) units of measure, CLIN unit prices, CLIN descriptions and CLIN amounts for those contracts utilizing PSC R706. This data was employed to select a specific service and create hyper-realistic transactions within the CBC.

As mentioned in previous portions of this paper, the researcher determined that to conduct a proper CBC with a determined, limited scope and viable number of service quality attributes, it was necessary to use only one of the Product Service Codes (PSC)



under the level 2 category, Logistics Support Services: PSC R706, Support Management: Logistics Support. As PSC R706 is attached to a host of logistics services, the researcher deemed it necessary to narrow the PSC down further to just one service, Real Property Maintenance. Further information on this service determination can be found below. When initially reviewing the PMRT EA CLIN data associated with PSC R706, it became clear that the researcher would first have to filter the data and utilize that subset for observing and analysis. First, the researcher filtered the data's timeframes so that it would match the same scope utilized during the AFBIT Lite data gathering, FY2020 to FY2022 Quarter 1. The researcher further filtered the data from that timeframe to eliminate all CLIN information not associated with a definitive, awarded contract. With that, the researcher also filtered out CLINs that included a price of \$0.00 or those with negative amounts as they suggested CLIN data associated with contract de-obligations and modifications to contracts. In reviewing PSC R706's contract action composition, it was clear that the data would require further filtering, as it included contract actions associated with services (96.7% of total contract actions) and products, such as personal property or real property (3.3% of total contract actions) (Air Force Life cycle Management Center [AFLCMC], 2022). Therefore, all contract actions referencing personal property or real property were sorted out of the observable data, as the study and CBC focus on real property maintenance services. Real property maintenance service was chosen as the focal service of the CBC after the researcher determined that the service was frequently utilized and was connected to the majority of CLINs attached to PSC R706. Finally, the PSC R706 data was further scrubbed to eliminate data associated with any Sub-Line Item Number (SLIN) or Information SLIN (INFOSLIN) so that only data connected to CLINs could be observed. This left the researcher with 17,831 CLINs to review and pull data from.

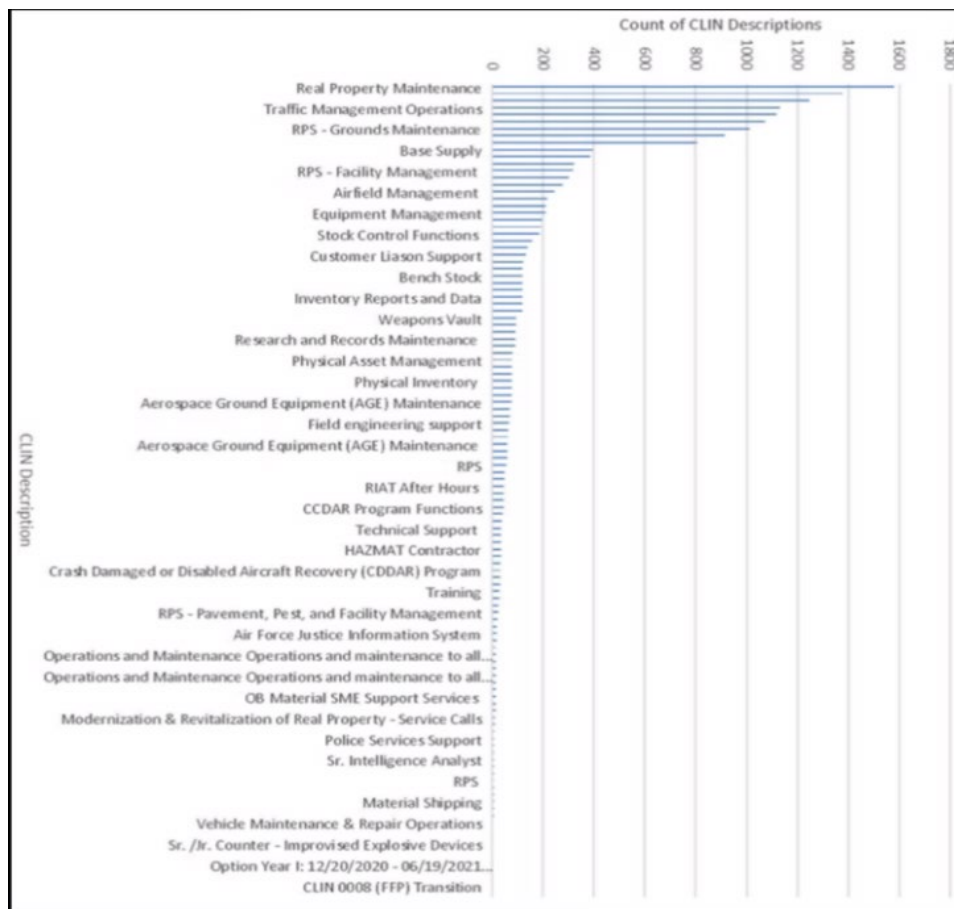
Since the data on PMRT EA includes information submitted by different contracting professionals and organizations, the CLIN descriptions were often varied and offered their own unique description of the exact or similar service. As the researcher still had to first narrow the PSC R706 down to just one service and its price points, the process of data scrubbing was necessary for these CLINs. Therefore, unique verbiage, CLIN numbers, PWS references, and other unnecessary information was scrubbed from





the CLIN descriptions so that CLINs could be familed together and patterns would emerge. Once CLIN descriptions were scrubbed and modified to reflect more homogenous depictions, a pivot table was created to discover trends amongst the CLINs and what services were most utilized during that FY period originally used to filter the data. Figure 17 represents the findings of the pivot table when the researcher sought to see which CLIN descriptions were utilized most often.

Figure 17. Pivot Table Bar Chart Indicating Top Contracted Services Under PSC R706. Adapted from AFLCMC (2022).



As visually indicated above, the number of CLINs associated with a particular service varied greatly; however, the top three services based off the count of CLINs were Real Property Maintenance, Fuels Management, and Vehicle Maintenance and Repair Services. As highlighted in previous portions of this paper, real property maintenance services were selected as the focal service utilized in the CBC due to the patterns reflected in the data gathered from PMRT EA, its filtering, scrubbing, and later its

analysis through use of the pivot table. With the pivot table completed, the researcher then had 1,579 CLINs to examine and extract realistic price points from. The five price points determined can be found in Table 10 of this paper.

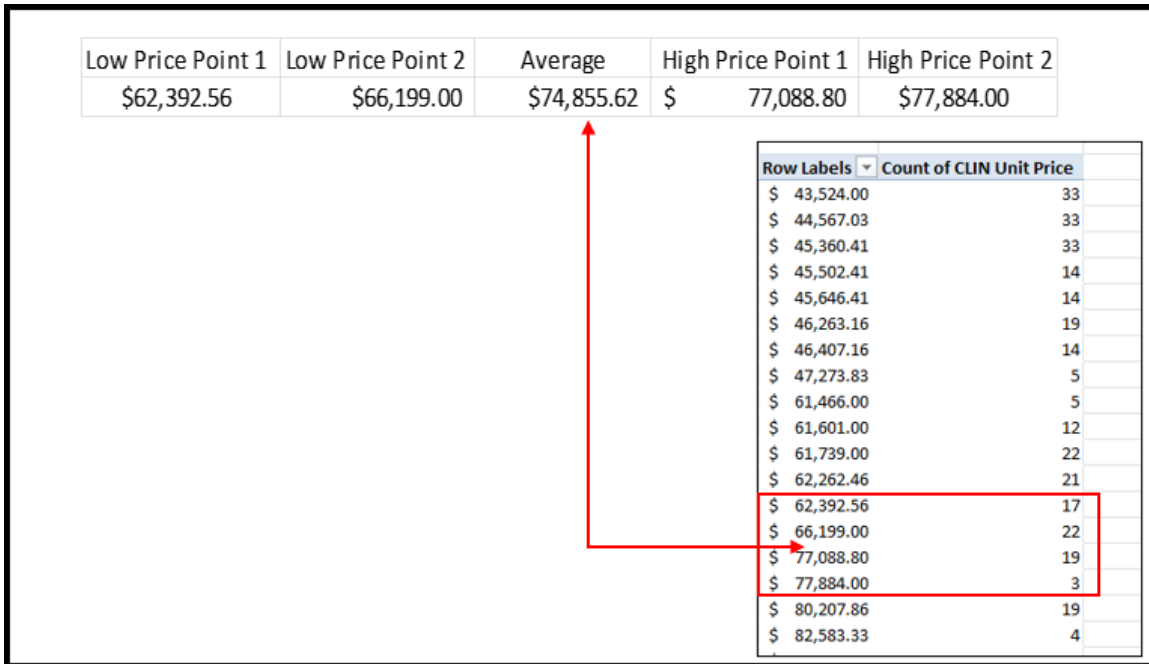
Besides the four quality attributes and their levels, a price attribute was also incorporated into the CBC. Utilizing the data collected from the PMRT EA tool, the study contained five price points. These five price points were determined using an average total contract price for real property maintenance services awarded during FYs 2020, 2021, and 2022 quarter 1.

To find the average total contract price, the researcher first filtered all PMRT EA contract CLIN data for the RPM contracts awarded during the FY20, FY21, and FY22 quarter 1. Price per CLIN ranged from approximately \$43,000 to \$250,000 per month. This meant that further analysis of the CLIN prices was required, so that the researcher could utilize five price points with smaller variance between them. The researcher then determined the standard deviation of the price point data was \$34,166.16; however, when evaluating the CLIN prices for these contracts, it was determined that the price data was not normally distributed. Therefore, attempting to utilize the standard deviation of the data to determine price points created too much variance between the points, generating an unrealistic price scenario for the choice exercise.

With the standard deviation method eliminated, the researcher determined the average price for the CLINs observed within the PMRT application. The average monthly price per month for RPM services was determined to be \$74,885.62. Once an average monthly price was calculated, the researcher created a pivot table using the CLIN price data. The pivot table included the CLIN unit price in its rows, while a count of CLIN unit price was calculated. Upon examining the pivot table results, the researcher found that the average price of \$74,885.62 fell between to very common price points: \$66,199.00 and \$77,088.80. Figure 18 signifies a visual representation of this process:



Figure 18. Price Point Pivot Table and Price Determination



The choice exercise required five price points, the researcher selected the average, \$74,885.62, the first two amounts below the average, \$62,392.56 and \$66,199.00, and the first two amounts above the average, \$77,088.80 and \$77,884.00. All five of these amounts were then increased to amounts that reflected a price for a firm-fixed contract with a 12-month base period and four 12-month option periods. The total increased price shown also includes pricing for a 6-month extension of service clause if necessary. The final price levels calculated were applied to the CBC.

Table 10. CBC Price Attribute Levels

Attribute Levels	Total Contract Price with 6-Month Service Extension [Description to Respondents]
Low Price (1)	\$4.12 Million
Low Price (2)	\$4.37 Million
Average Price	\$4.94 Million
High Price (1)	\$5.09 Million
High Price (2)	\$5.14 Million

The CBC also included price reference points that helped to facilitate realistic financial constraints within the choice exercise, as government personnel must ensure

they understand how much a service should cost and how much funding they have for a particular service (Finkenstadt 2020b). The choice exercise included a government estimate range from \$4.1 Million to \$5 Million. The CBC also provided respondents with a government budget of \$5.2 Million. The budget and estimate provided to respondents also enabled respondents to select contract offers that were within the budget but perhaps over the estimate, signaling they found the contractor's offer worth the additional price.

#### **4. Discrete Choice Modelling – Choice-Based Conjoint**

For the purposes of this study, a CBC analysis was used to develop choice scenarios for respondents to examine and select best value from. The aforementioned methodologies described above (literature review research, interviews, and contract data analysis) were employed to develop attributes for the CBC model. Four levels were established for each attribute, using the DoD Source Selection performance confidence assessment ratings. The DoD source selection guide was utilized to develop attribute levels, because it would offer the study a degree of realism that provides realistic choice scenarios and immerses respondents in credible source selection decision-making. Furthermore, certain terminology such as “High,” “Reasonable,” and others were chosen for the exercise, and taken directly from the source selection guide's rating definitions. This was purposefully done to add another element of realism for respondents participating in the choice exercise.

The following table describes each level and highlights the scale respondents observed and used throughout the CBC:



Table 11. CBC Attribute Level Ratings. Adapted from DoD (2016b).

Streamlined Scale Rating	Adjectival Rating from DoD Source Selection Guide Table 5	Description to Respondents
High	Substantial Confidence	Based on the offeror’s recent/relevant performance record, the Government has a high expectation that the offeror will successfully perform the required effort.
Reasonable	Satisfactory Confidence	Based on the offeror’s recent/relevant performance record, the Government has a reasonable expectation that the offeror will successfully perform the required effort.
Low	Limited Confidence	Based on the offeror’s recent/relevant performance record, the Government has a low expectation that the offeror will successfully perform the required effort. [NOTE: A low rating does not mean the offer is unacceptable]
Neutral	Neutral Confidence	No recent/relevant performance record is available, or the offeror’s performance record is so sparse that no meaningful confidence assessment rating can be reasonably assigned. The offeror may not be evaluated favorably or unfavorably on the factor of past performance.

The choice exercise and its respondents benefitted from the streamlined scale shown in Table 11 because it reduced its respondents’ cognitive load. If a CBC has too many levels for its attributes, respondents often feel like they are inundated with too much information. This leads them to resort to simplification strategies (Orme, 2020). It is important to note that “unless respondents employ the same sort of simplification strategies when making real-world decisions, full profile results may place too much emphasis on the few most important features” (Orme, 2020). Put simply, if respondents utilize these simplification strategies, the choice exercise risks gathering faulty, unrealistic data as it overloaded its respondents with too much information.



Respondents were directed to assume that all choice profiles, or contract offers, observed were (1) vetted as technically acceptable, that (2) the prices shown for each contract offer were realistic, and (3) that the final recommendations they were making are based on the contractor's past performance record and established through tradeoff decision-making between the contract price and the other four service quality attributes (Finkenstadt, 2020a). The simulated choice-task exercise was issued to government personnel that held one or more of the following positions:

- Contracting Officer
- Contracting Manager/Administrator
- Contracting Officer Representative/Quality Assurance Personnel
- Program Manager
- Customer for Acquisition Requirement
- Other positions within government

As CBC introduces respondents to choice profiles in a simulated environment, there is often a need to incorporate incentive-aligned conditions to the choice exercise, as there is little consequence to respondents if they complete the choice exercise utilizing anything other than actual, realistic choice behavior. Information on potential incentive-aligned choice exercise conditions can be found within the 'Weaknesses of CBC' portion of this paper's literature review. For this CBC, the researcher chose to utilize the Expert Scrutiny condition where, "subjects are told to answer realistically because an expert in public procurement will analyze their responses for reasonableness prior to including it in any decision to change public acquisition methods or policy. This mimics the formal source selection review process found in many public agencies referred to as 'Expert Scrutiny'" (Finkenstadt, 2020a). Respondents for this CBC observed the following condition in efforts to produce actual, realistic choice behavior from them:



Figure 19. CBC Expert Scrutiny Choice Exercise Condition

USTRANSCOM spends over \$4.4 Billion a year on supplies and services enabling their logistic-focused mission. Many of its programs with industry partners are thoroughly tracked and publicly advertised by USTRANSCOM. Each contract value ranges from hundreds of thousands of dollars to hundreds of millions of dollars. Furthermore, much of the contract activity USTRANSCOM TCAQ initiates includes high spend activity that requires the best possible solutions for the taxpaying public and the warfighter.

With that, please treat the following survey as a real-world example. Make your choices as realistic as possible and answer to the best of your ability. Due to the impact the results will have in potentially changing DoD acquisition methods or policy, the results from your survey will be evaluated by public procurement/acquisition experts to determine response reliability.

The CBC was built utilizing Sawtooth© Choice Based Conjoint Software. Through the software, researchers constructed 12 random, distinct scenarios in which respondents chose from three contract offers or select none of the options available as the CBC allowed respondents to opt out of a choice set. Figure 20 demonstrates just one of the scenarios presented to respondents. Following the choice scenarios, respondents were asked to rank order aspects of logistics-based service quality and price in a price performance tradeoff. These aspects were identical to those attributes chosen for the CBC portion of the choice exercise; however, respondents were provided with the definition of the quality attribute instead of just the short attribute title used in the CBC portion of the exercise. This was purposefully crafted by the researchers to reduce the ability for respondents to memorize their choice selections from the CBC and apply their same methodology to the rank order question of the choice exercise, essentially ‘gaming’ the system. Figure 21 shows the rank order question provided to respondents. To review the CBC in full, please see Appendix A.



Figure 20. CBC Choice Scenario Example.

If these were your only options, which would you choose? **Note: You can hover over ALL attributes (left) to review definitions of each.**

(1 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.12M	\$5.09M	\$5.09M
Tangibles	Low	Reasonable	Neutral
Reliability	Reasonable	High	Reasonable
Responsiveness	Low	Neutral	Neutral
Competence	High	Reasonable	High

Option 4  
NONE: I wouldn't choose any of these.

Figure 21. Rank Order Choice Exercise Question

The team is interested to know what you believe are the most important aspects of selecting a logistics-based service provider in a price performance tradeoff. Below are (7) responses that include five (5) perceived quality attributes, price, and an option for "Other option not listed". Please place each item in order of importance from 1-Most important to 7-Least Important.

Items to Rank	Most Preferred
Price	
Firm has the facilities, equipment, personnel, and communication materials needed to complete the service.	
Firm demonstrates an ability to perform dependably and accurately.	
Firm has a willingness to help customers and provide prompt service.	
RPM firm's employees applied existing and innovative best practices to execute requirements on past contracts.	
Other Option Not Listed.	
	Least Preferred

The researcher first conducted a pretest of the choice exercise at a National Contract Management Association (NCMA) conference in July 2022 to assess the functionality of the choice exercise and gather helpful feedback to potentially improve the CBC. Over 19 respondents completed the pretest and certain feedback was utilized to adapt the CBC. Researchers then issued a final revision of the choice exercise in August





2022 to collect data on respondent's choice behavior. An analysis of respondent responses is discussed further in the 'Results' portion of this report. It is important to note here that the results of the CBC were investigated to determine the alignment or disconnect between stated preferences and choice behavior during simulated transactions.

## **E. SUMMARY**

The second chapter of this paper concentrated on the methods and some of the data collected from specific methods of the study. First, the chapter delved into how the researcher developed a primary logistics area of spend to utilized within the simulation. Second, the researcher described how the project's methodologies determined specific price and non-price attributes were developed for that area of spend, Real Property Maintenance. With that, the chapter goes on to define the method in which price ranges for Real Property Maintenance services were determined and their use in the choice-based simulation. Finally, the chapter concludes with a generalized overview on one of the project's methods of research, discrete choice modelling. As this paper has introduced both the researcher's motivations and the scope and methodology of the study, it will now review the exploratory findings of the literature review.



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## IV. RESULTS

The following chapter summarizes the findings from the discrete choice modelling method described within the ‘Methods and Data’ portion of this paper. The results section is comprised of those findings, and their analysis, gathered from the choice exercise issued to Naval Postgraduate School (NPS) students and staff. The results from the choice exercise were used from an investigatory perspective, so that the researcher could verify the developing hypothesis initially substantiated through Finkenstadt’s 2020 PhD research by determining the degree of disconnect between stated pre-award preferences and actual choice behavior during a simulated source selection.

### A. RESPONDENT BACKGROUND AND DEMOGRAPHICS

The CBC exercise was open from 01 August 2022 – 15 September 2022, for applicable NPS faculty and students. Choice exercise reminders were sent out to those same faculty and staff to ensure maximum participation in the choice exercise. The choice exercise population included a total of 174 individuals: 93 from the NPS Department of Defense Management Group, 28 from the NPS 815 Acquisition program, and 53 from the Systems Engineering NPS Group. Of that group a total of 30 individuals, or 17.4% of the choice exercise population, completed the choice exercise. Forty-four other individuals from that same population, opened the choice exercise, but never completed the exercise. The data collected from those 44 respondents was not utilized or analyzed for this study. While 30 respondents for the choice exercise would be considered a low completion rate, “for investigational work and developing hypotheses about a market, between thirty and sixty respondents may do” (Orme, 2020).

#### 1. Experience

Those that completed the choice exercise, held a varied range of government roles within the acquisition environment. The choice exercise asked each respondent to select one or more acquisition-related roles, whether those roles included experience with RPM or logistics-based services, and how many years they had worked within the role(s).

Table 12 represents respondents experience background demographics. As respondents



were allowed to select multiple roles to describe their acquisition experience, the total column's count sums to more than 30 respondents.

Table 12. Choice Exercise Experience Demographics

Position Held	Totals
Contracting Manager/Administrator/Specialist without RPM or Logistics-Based Services Experience	12
Contracting Officer without RPM or Logistics-Based Services Experience	11
Contracting Manager/Administrator with RPM or Logistics-Based Services Experience	5
Customer without RPM or Logistics-Based Services Experience	5
Other without RPM or Logistics-Based Services Experience	5
Contracting Officer with RPM or Logistics-Based Services Experience	4
Program Manager without RPM or Logistics-Based Services Experience	4
COR without RPM or Logistics-Based Services Experience	3
Contracting Officer Representative/Quality Assurance Personnel with RPM or Logistics-Based Services Experience	1
Other with RPM or Logistics-Based Services Experience	1
Program Manager with RPM or Logistics-Based Services Experience	0
Quality Assurance Personnel without RPM or Logistics-Based Services Experience	0

As Table 12 indicates, many of the respondents held the position of Contracting Manager or Contracting Officer; however, fewer respondents held that same role while working with RPM or logistics-based services.

Table 13 further highlights the respondents' years of experience in each their role(s). Those cells with the blue shading represent respondents who held role(s) with RPM or logistics-based service experience, while gray cells represent respondents who held a position(s) without RPM or logistics-based service experience.



Table 13. Choice Exercise Experience Years

<b>Role</b>	<b>Years of Experience</b>
Other: NPS Faculty	32
Customer	28
COR	
Program Manager	19
Customer	
Program Manager	18
Contracting Officer	
Contracting Manager/Administrator/Specialist	18
COR	
Program Manager	
Customer	
Contracting Officer	16
Customer	
Other: Assistant Research Professor	15
Contracting Officer and Contracting Manager/Administrator	11
Contracting Officer	11
Contracting Manager/Administrator/Specialist	11
Contracting Officer	10
Contracting Manager/Administrator/Specialist	10
COR	
Contracting Officer	9
Other: Senior Lecturer	8
Contracting Manager/Administrator	7
Contracting Officer and Contracting Manager/Administrator	6
Contracting Officer	6
Contracting Manager/Administrator/Specialist	6
Program Manager	6
Contracting Manager/Administrator/Specialist	6
Other: OSI Agent	4
Contracting Officer	4
Contracting Manager/Administrator/Specialist	4
Contracting Officer	4
Contracting Manager/Administrator/Specialist	4
Customer	4
Contracting Officer	4
Contracting Manager/Administrator/Specialist	4
Other: Ship Division Officer	4
Contracting Officer	3
Contracting Manager/Administrator	3
Contracting Officer	3
Contracting Manager/Administrator/Specialist	3



Role	Years of Experience
Contracting Officer Contracting Manager/Administrator/Specialist	3
Other: Company Commander	2
Contracting Manager/Administrator/Specialist	2
Contracting Officer Contracting Manager/Administrator/Specialist	2
Contracting Manager/Administrator	1
Contracting Officer Representative/Quality Assurance Personnel	1

Those respondents who held their position(s) for over ten years were often those that did not have experience with RPM or logistics-based services. Furthermore, those that did have experience with ROM or logistics-based services had experience in those positions from one to eleven years.

## 2. Random Respondents

Prior to the researcher utilizing every respondent's data to answer the proposed research questions of this study, it was important to validate the quality of every respondent's data. To do so, the researcher utilized a number of data points Sawtooth Software collects for every respondent in a choice exercise. While the researcher did not eliminate any of the 30 respondents' data for analysis as they wanted to ensure the number of respondents met investigatory standards, it is important to note the limitations of the data as well as the quality of the respondents' choices. The following section covers three different checks for quality responses in the choice exercise per respondent: repeated choices, completion times, and root likelihood.

### a. Repeated Choices

The first quality check the researcher utilized was a visual inspection of each respondent's choices from the twelve random choice tasks presented to them within the CBC. As there was random concept order within the CBC, no pattern of choices or repeated selection of the same concept, or in this CBC contractor, should occur. Once the researcher exported the respondent data through the sawtooth software's data management feature, respondents' data points and choices were reviewed through an excel file. Using heatmap and conditional formatting techniques, the researcher was able



to verify that only four respondents of the total thirty, had four or more repeated selections. This meant that they selected the same ordered contractor offer four times or more (i.e., always selected the first listed offer etc.), despite each of the choice tasks (12 total) having random attribute levels within each contractor’s proposal. Table 14 shows the visual analysis performed to determine how many respondents had repeatedly select the same contractor four or more times over the course of 12 random choice tasks. Each number under the “CBC n,” represents a contractor. The researcher looked through each of the twelve selections made for each respondent and searched for repeated numbers. Those blocks highlighted in red, represent repeats of four or more.

Table 14. Repeated Choices for CBC Respondents

Respondent	CBC 1	CBC 2	CBC 3	CBC 4	CBC 5	CBC 6	CBC 7	CBC 8	CBC 9	CBC 10	CBC 11	CBC 12
1	3	4	1	4	2	3	1	4	4	2	4	1
2	2	2	1	2	3	1	1	1	4	2	1	1
3	1	2	2	2	2	2	2	2	3	3	1	3
4	4	1	4	1	3	3	2	4	3	4	4	3
5	2	2	1	1	3	3	3	3	3	2	3	1
6	1	3	3	2	4	2	4	1	3	2	2	2
7	4	4	2	4	3	4	4	1	4	3	2	2
8	1	1	1	2	2	3	3	3	2	1	4	2
9	3	3	1	3	2	2	2	3	3	2	2	2
10	1	2	2	2	3	3	1	1	1	2	3	3
11	1	4	4	1	2	2	1	2	3	3	1	3
12	2	4	1	1	3	4	2	1	2	3	4	1
13	2	3	1	3	2	2	2	3	2	1	3	3
14	3	2	2	1	4	4	4	3	1	2	4	1
15	2	3	1	2	2	3	3	3	1	2	1	3
16	3	1	1	3	2	3	2	1	3	1	3	1
17	1	3	1	3	3	3	2	2	2	3	4	1
18	3	3	1	1	2	3	1	1	4	1	1	2
19	3	3	3	1	2	3	4	4	4	4	3	1
20	1	3	3	3	1	1	3	2	2	2	2	1
21	1	3	2	2	2	3	3	2	1	1	2	3
22	3	1	3	2	2	3	3	1	3	3	2	2
23	1	3	3	1	2	2	3	3	3	2	1	2
24	2	4	1	2	4	4	4	1	4	4	3	3
25	3	1	3	1	2	1	3	2	3	1	2	3
26	1	3	4	2	3	1	2	2	1	3	3	2
27	1	1	3	4	4	2	4	4	4	3	1	4
28	2	1	3	1	2	4	4	4	2	3	3	3
29	1	4	4	1	2	3	4	4	1	2	3	2
30	4	4	2	2	3	1	2	3	4	2	1	3

The 13% of respondents who met the four or more repeat conditions, were also examined in terms of the time it took to complete their choice exercise. Further information on completion time is discussed further in the next section. However, with these four respondents with high repeat selections, it was interesting to observe that two of these respondents had two of shortest time of completions (9 minutes) for the choice exercise. The other two respondents had almost double (at 44 minutes) or triple (at 88

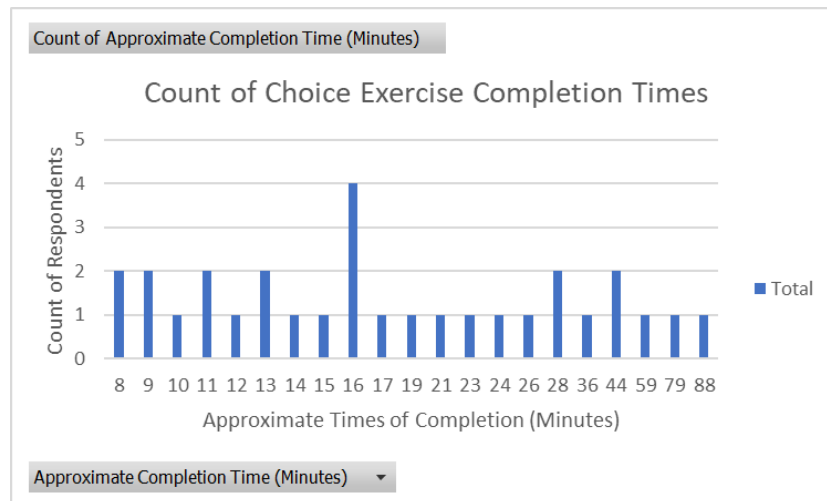


minutes) the average completion time which was approximately 24 minutes. This could suggest that these four respondents are answering randomly (fast completion time) or perhaps they were confused about the purpose of the choice exercise or weren't entirely confident in the choices they were making. Again, as the researcher is not eliminating respondent data to ensure an investigation can still be performed, this analysis supplements the conclusions and limitations of this study, which is further discussed in later portions of this paper.

**b. Choice Exercise Completion Time**

Another method in which to test for the reliability of respondents' data is to examine the completion times of each respondent for the choice exercise. The pre-test choice exercise conducted at the NCMA conference (previously mentioned in the 'Methods and Data' portion of this paper), found that the average time taken by the 23 pre-test respondents to complete the full choice exercise was approximately 21 minutes. When reviewing the completion times for the final choice exercise, the average time of completion for all 30 respondents was approximately 24 minutes. Figure 22 displays a count of choice exercise completion times for the choice exercise.

Figure 22. Count of Choice Exercise Completion Times



The most common completion time for the choice exercise was around 16 minutes; however as indicated by Figure 22, the times are not normally distributed and the variance in completion times is extremely wide. The lowest time of completion was





eight minutes, while the highest time of completion was 88 minutes. As Sawtooth software allows respondents to start a choice exercise, leave the exercise, and start the choice exercise again from their initial stopping place, the higher completion times, such as those double or triple the average completion time, could be explained for that feature of the software. The extremely short completion times could suggest that those respondents randomly selected options to complete the exercise faster and that the quality of their responses should be questioned. Due to the investigatory nature of this study, these respondents' data was kept but noted within the limitations portion of this study.

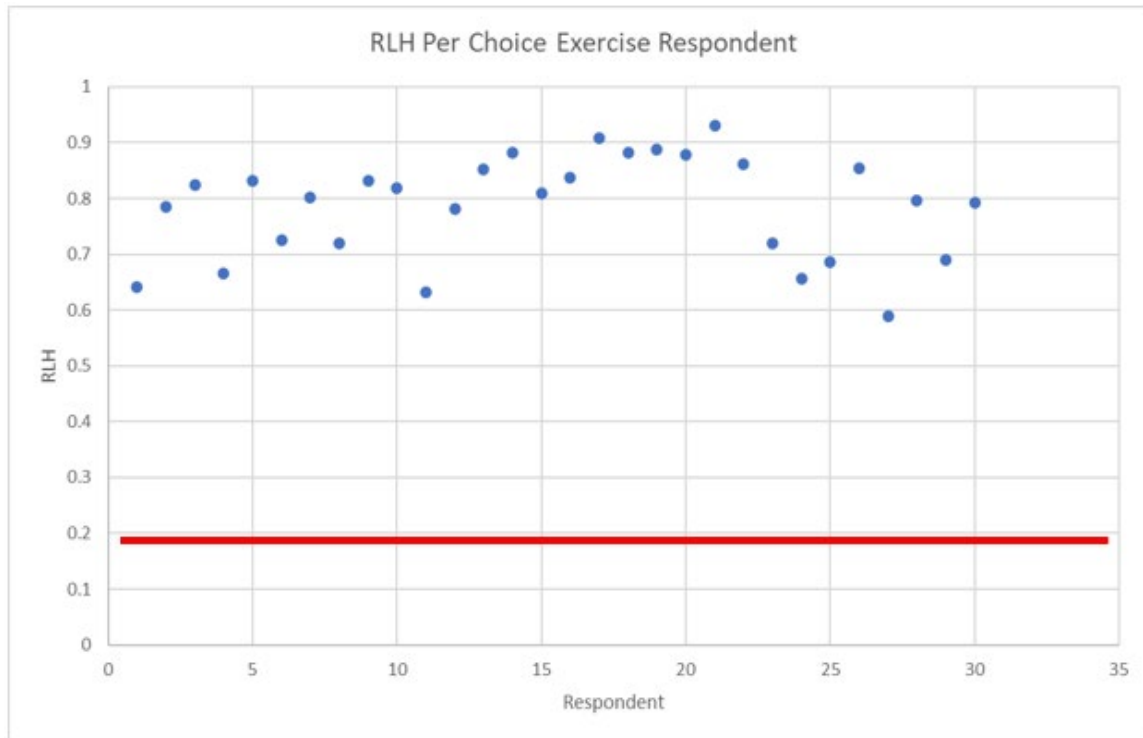
*c. Root Likelihood*

The last method in which to analyze the quality of respondents' data is a featured measure Sawtooth software provides amongst the rest of the choice exercise data. The Root Likelihood (RLH) is "an intuitive measure of how well the solution(s) fit the data...[it] is an intuitive probability expression of how successful the utility scores are in predicting which items respondents pick" (Sawtooth Software, 2022). RLH values range anywhere from zero to one, where one represents a perfect fit (Sawtooth Software, 2022). Furthermore, the magnitude of RLH is impacted by the number of alternatives presented in the CBC (Sawtooth Software, 2022). For this choice exercise, there were three alternative contractors and a 'None' option, totaling four alternatives. As there are only four alternatives for each choice task, "the null likelihood expected by chance is  $1/4 = 0.25$ . We should hope that the respondent's answers fit the data better than just the chance (at random) level. If showing 4 items at, a respondent who achieves an RLH of 0.5 has a fit twice the null level" (Sawtooth Software, 2022).

In reviewing the RLH levels in this choice exercise, all respondents had an RLH at least twice the null level of 0.25. The lowest RLH for respondents was 0.589, while the highest RLH from respondents was 0.931. Figure 23 displays the RLH per choice exercise respondent. As all respondent's RLH falls well above the null likelihood of 0.25, the researcher determined that the utility scores produced by the respondents are likely successful at predicting what is important to each individual respondent. In essence, the respondents' choices do not appear to be purely random.



Figure 23. RLH of Each Choice Exercise Respondent



## B. AGGREGATE CBC RESULTS AND ANALYSIS

### 1. Hierarchical Bayesian Analysis

The 30 respondents' choice data was analyzed using a method provided by Sawtooth software, the Hierarchical Bayesian (HB) method. HB models will iteratively collect data from multiple respondents, until researchers can find the convergence point that most precisely reflects part-worth utility estimation (Orme, 2020). The method also estimates individual-level models from the respondents' discrete choice data (Orme, 2020). Table 15 represents the aggregate data collected for each attribute and the average utility scores. As a reminder, the utility, in reference to conjoint analysis, "refers to a buyer's liking for (or the desirability of) a product alternative" (Orme, 2020).

Table 15. Aggregate HB Analysis Results

Attribute	Average Utilities (Zero-Centered Diffs)	Average Utilities	Standard Deviation
Price	\$4.12 Million	38.64213	29.68360
	\$4.37 Million	17.41472	7.87537
	\$4.94 Million	-1.75601	10.64901
	\$5.09 Million	-13.51832	18.27485
	\$5.14 Million	-40.78253	21.92382
Tangibles	High	37.85013	13.23521
	Reasonable	27.77283	13.35501
	Low	-42.03319	15.62904
	Neutral	-23.58977	10.74654
Reliability	High	49.58324	14.50481
	Reasonable	27.63529	10.24036
	Low	-73.48580	7.96226
	Neutral	-3.73272	10.70076
Responsiveness	High	35.25599	16.28151
	Reasonable	18.24712	6.08668
	Low	-53.29998	20.35169
	Neutral	-0.20314	14.29685
Competence	High	52.63094	14.35025
	Reasonable	20.92674	7.35324
	Low	-63.98951	11.24169
	Neutral	-9.56817	15.24389
None	NONE	4.76714	38.90288

From the average utility levels, it's clear and confirms that respondents prefer lower prices and a higher level of the attribute, whether that be tangibles, reliability, responsiveness, or competence.

How greatly the respondents prefer or dislike a particular attribute of the RPM service is where the results indicate less obvious preferences. For example, the average utility scores for high competence (52.63) and reliability (49.58) are greater than those utility scores for high price, tangibles, and responsiveness, suggesting that respondents desired competence and reliability over the other three attributes. Meanwhile, the lowest average utility scores for attributes at their highest levels, were responsiveness (35.25) and tangibles (37.85). The two lowest utility levels seen across the averages belong to the two attributes with the largest utility levels, competence (low, -63.98) and reliability



(low, -73.48). As with respondents’ desiring a high level of these attributes, so too do they greatly dislike when these attributes are performed at a low level.

Another interesting result of the aggregate HB analysis data was the ‘None’ average utility score. While 4.76 is not the lowest utility score, that low of a score highlights an interesting facet in terms of respondent demographics pooled for this choice exercise. Those that participated in this choice exercise had to have experience in certain positions revolving around government acquisitions in order to participate. Unlike a regular consumer, government acquisition personnel and the positions involved are guided by ensuring a warfighter’s mission needs or requirements are met. Selecting the ‘none’ option for consumers is far simpler as they can walk away from product alternatives if they don’t desire any of the options available. Government acquisition personnel and their customers do not have the same ease of walking away from all alternatives that could meet a mission requirement. A low utility score for ‘none’ supports this assumption that government personnel desire a solution to a warfighter or mission requirement rather than choosing no service alternative. Such an assumption is also supported by Finkenstadt’s 2020 PhD findings where respondent’s utility scores for the ‘None’ option ranged from 4.55 to 20.81, depending on the Incentive-Aligned Conjoint Choice Exercise Conditions (i.e., BTS, expert scrutiny, cheap talk, etc.) (Finkenstadt, 2020a).

The other aggregate results the HB analysis provided were the average importance per attribute calculated through the individual importance scores taken from the respondents’ choices. Table 16 displays the average importance scores gathered through this aggregate analysis.

Table 16. Average Importance Scores Per Attribute

<b>Attribute</b>	<b>Average Importance</b>	<b>Standard Deviation</b>
Price	16.81986	8.68942
Tangibles	16.89784	4.59180
Reliability	24.92471	3.29404
Responsiveness	18.03350	6.29986
Competence	23.32409	4.52853



Due to the limited observations collected for this choice exercise (30 respondents), the average importance scores are far too close together to effectively rank each attribute from most important to least important. Therefore, the researcher cannot definitively conclude the aggregate results of the HB analysis in terms of attribute importance. This limitation is noted within later sections of this paper. Despite this limitation, there is an observable shift in terms of importance levels. For example, reliability (24.92) and competence (23.32), are the two most important attributes according to respondents' choices in the exercise. The lowest importance scores were attributed to price (16.81) and tangibles (16.89). While more observations are required, this study's investigation indicates that best value for RPM services doesn't always equate to contractors that offer lower prices. Instead, finding a contractor that applies best practices while performing these services dependably and accurately are what is important.

## **C. CBC INDIVIDUAL RESPONDENT RESULTS AND ANALYSIS**

### **1. Choice Behavior vs. Ranked Preference**

While the limited respondent pool means the researcher could not definitively report the aggregate difference and importance ranking of each attribute, there is individual respondent data that can get to the core objective of this study: to determine the degree of disconnect between stated preferences during pre-award acquisition phase and actual choice behavior in defense acquisition source selections. To do this, the researcher utilized the respondent choice data from two sources: 1) the choices selected during the CBC and 2) the ranked preference question at the end of each respondent's choice exercise. The distinct choice data collected from each source was compared to each other in order to determine the match rate, and in turn, the disconnect between the actual choice behavior collected during the CBC and the ranked preferences respondents stated when asked directly what was most important to least important. For a full visual demonstration of this process, please see Appendix B – Individual Respondent CBC Results vs. Ranked Preference.

As mentioned, the first part of this process started with collecting the choice preferences collected from the 12 random choice tasks presented to respondents during



the CBC. Figure 20 shows one of the twelve random choice tasks presented. Each selection made by the respondent allows Sawtooth software to estimate importance scores for each attribute per individual respondent. Table 17 indicates the importance scores generated through the software and gathered by the researcher.

Table 17. CBC Individual Importance Scores Per Respondent

<b>Respondent</b>	<b>Price</b>	<b>Tangibles</b>	<b>Reliability</b>	<b>Responsiveness</b>	<b>Competence</b>
1	15.35437	13.95127	26.18789	15.77734	28.72914
2	38.77005	14.19632	22.80028	6.8724	17.36095
3	20.34852	23.82053	19.7129	14.53701	21.58104
4	6.1063	17.51175	24.67448	26.1377	25.56978
5	23.19053	20.56684	27.44157	11.28664	17.51443
6	20.58427	22.19826	23.52144	14.5261	19.16992
7	7.72683	14.49259	28.9684	23.7424	25.06978
8	17.26002	15.67074	25.00742	16.16383	25.89799
9	28.85697	20.0963	21.16121	11.76638	18.11915
10	20.78097	28.06142	19.80186	13.71696	17.63879
11	11.41264	16.30745	21.56323	27.34676	23.36991
12	14.07932	13.28963	25.42101	16.69622	30.51382
13	21.07294	16.46564	20.89432	15.83543	25.73168
14	7.46573	9.06788	29.68934	24.47462	29.30243
15	22.47177	15.43122	23.63169	16.1193	22.34602
16	4.90415	14.53434	28.06384	30.51748	21.98018
17	8.15209	11.98993	26.55606	24.62871	28.67321
18	27.89499	20.61131	21.58292	11.01287	18.89791
19	6.48874	15.41981	26.19325	23.85643	28.04177
20	25.34969	23.40266	20.70524	8.7042	21.8382
21	21.06862	20.30179	24.06359	10.83193	23.73406
22	19.49001	14.73438	25.86596	17.39287	22.51678
23	21.73412	16.35209	28.65789	18.1412	15.1147
24	3.90716	16.17451	27.25348	26.2906	26.37425
25	24.26609	19.10173	24.00935	17.14051	15.48232
26	26.22331	21.61195	22.88639	10.1777	19.10064
27	6.91567	5.10399	33.39819	25.99038	28.59176
28	11.11214	13.50383	29.19329	20.76542	25.42532
29	14.24861	17.7801	22.91868	17.1422	27.91042
30	7.35924	15.18506	25.91598	23.41337	28.12635



Once the individual importance scores were reviewed, a ranking of the most important to least important attribute was constructed for every respondent. An excerpt from this transition from importance scores to ranked-choice attributes can be seen in Table 18.

Table 18. Data Excerpt of Individual Importance Scores (CBC) to Ranked-Choice Attributes

<b>Ranking</b>	<b>Respondent 1</b>	<b>Respondent 2</b>	<b>Respondent 3</b>	<b>Respondent 4</b>	<b>Respondent 5</b>
1	Competence	Price	Tangibles	Responsiveness	Reliability
2	Reliability	Reliability	Competence	Competence	Price
3	Responsiveness	Competence	Price	Reliability	Tangibles
4	Price	Tangibles	Reliability	Tangibles	Competence
5	Tangibles	Responsiveness	Responsiveness	Price	Responsiveness

The second source of data used for this part of the study was gathered from the rank order choice exercise presented to each respondent after the CBC. Figure 12 shows the question proposed to respondents to collect this data. For the ranked exercise a sixth option in which respondents could enter an entirely different attribute not utilized in the CBC was included; however, no respondent submitted another attribute, and every respondent ranked this option as the sixth and least important attribute preference. This lends additional validity to our interview findings regarding the most important attributes for these services. Table 19 shows the stated ranked preferences for all respondents.



Table 19. Stated Preferences of Choice Exercise Respondents

Respondent	1	2	3	4	5	6
1	Competence	Price	Reliability	Tangibles	Responsiveness	Other
2	Price	Reliability	Tangibles	Responsiveness	Competence	Other
3	Responsiveness	Tangibles	Price	Reliability	Competence	Other
4	Competence	Responsiveness	Price	Tangibles	Reliability	Other
5	Reliability	Responsiveness	Price	Competence	Tangibles	Other
6	Responsiveness	Price	Reliability	Tangibles	Competence	Other
7	Competence	Responsiveness	Tangibles	Reliability	Price	Other
8	Price	Tangibles	Responsiveness	Competence	Reliability	Other
9	Responsiveness	Reliability	Price	Competence	Tangibles	Other
10	Responsiveness	Price	Tangibles	Reliability	Competence	Other
11	Reliability	Tangibles	Price	Responsiveness	Competence	Other
12	Competence	Responsiveness	Tangibles	Reliability	Price	Other
13	Reliability	Responsiveness	Price	Competence	Tangibles	Other
14	Responsiveness	Reliability	Price	Competence	Tangibles	Other
15	Reliability	Competence	Price	Tangibles	Responsiveness	Other
16	Competence	Price	Tangibles	Reliability	Responsiveness	Other
17	Competence	Responsiveness	Reliability	Tangibles	Price	Other
18	Price	Tangibles	Reliability	Competence	Responsiveness	Other
19	Competence	Responsiveness	Price	Reliability	Tangibles	Other
20	Responsiveness	Competence	Price	Reliability	Tangibles	Other
21	Competence	Price	Tangibles	Responsiveness	Reliability	Other
22	Tangibles	Reliability	Price	Responsiveness	Competence	Other
23	Reliability	Responsiveness	Price	Tangibles	Competence	Other
24	Responsiveness	Competence	Tangibles	Reliability	Price	Other
25	Tangibles	Competence	Price	Reliability	Responsiveness	Other
26	Price	Tangibles	Reliability	Responsiveness	Competence	Other
27	Competence	Tangibles	Price	Reliability	Responsiveness	Other
28	Reliability	Responsiveness	Competence	Tangibles	Price	Other
29	Tangibles	Price	Reliability	Responsiveness	Competence	Other
30	Reliability	Responsiveness	Tangibles	Price	Competence	Other

Once each ranking was constructed, each respondent’s CBC preferences and ranked preferences were compared to one another. Appendix B includes the full comparison of all 30 respondents. Figure 24 displays the process for one of the respondents of the choice exercise. The total match rates for all respondents were calculated and Table 20 represents the total matches by respondents.





Figure 24. Stated Ranked Preferences vs. CBC Choice Behavior

Respondent 2	1	2	3	4	5
CBC	Price	Reliability	Competence	Tangibles	Responsiveness
Rank	Price	Reliability	Tangibles	Responsiveness	Competence
# Matched	2 of 5	Position(s) Held: Program Manager w/out RPM or USTRANSCOM-Related Svc. (18 Years)			
% Match	40%				

Table 20. Respondent Match Rate Percentage

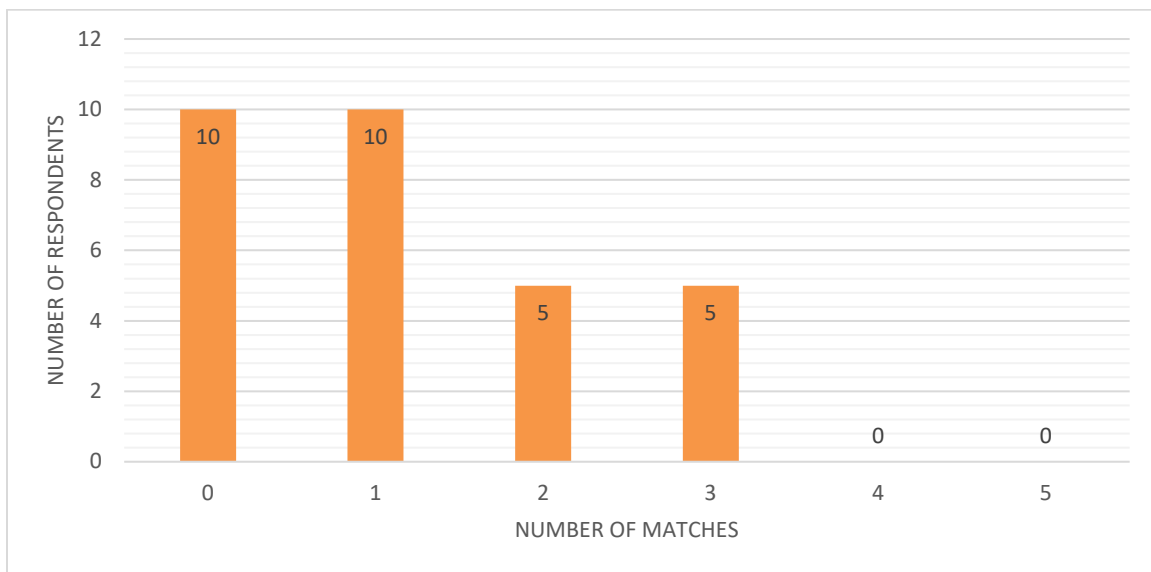
Respondent	Match %
6	0%
8	0%
11	0%
13	0%
14	0%
16	0%
21	0%
25	0%
27	0%
30	0%
1	20%
4	20%
7	20%
10	20%
12	20%
15	20%
19	20%
20	20%
26	20%
29	20%
2	40%
3	40%
5	40%
9	40%
22	40%
17	60%
18	60%
23	60%
24	60%
28	60%



Overall Match Rate Trends:
0 of 30 Respondents got 100% Match Rate (5 of 5 Matches)
0 of 30 Respondents got 80% Match Rate (4 of 5 Matches)
5 of 30 Respondents got 60% Match Rate (3 of 5 Matches)
5 of 30 Respondents got 40% Match Rate (2 of 5 Matches)
10 of 30 Respondents got 20% Match Rate (1 of 5 Matches)
10 of 30 Respondents got 0% Match Rate (0 of 5 Matches)

A supplemental bar chart was created to visually analyze the match rate as well in Figure 25. It is important to note here that the match results are not normally distributed, and Figure 25 indicates the distribution is skewed right, or that there is a positively skewed distribution. This suggests that respondent's ranked selections are not matching their CBC importance scores, suggesting a disconnect between their stated preferences and their actual choice behavior. Additionally, the data's non-normal distribution has further implications in terms of what statistical analysis could be conducted. Further information on that is discussed in later portions of this paper.

Figure 25. Bar Chart – Total Matches by Respondent



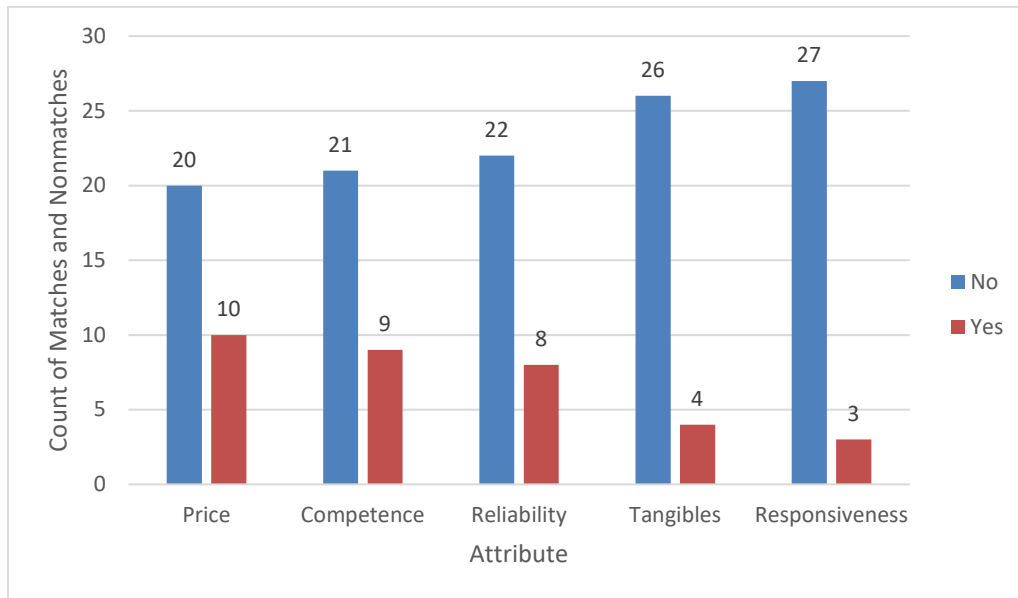
The inverse of the match rate, the disconnect rate or the primary value this project sought to collect (research objective 1), can then be determined. Those who had zero matches had a disconnect rate of 100%, respondents with 1 match had a disconnect rate of 80%, 2-match respondents had a disconnect rate of 60%, and finally those respondents with 3 matches had a disconnect rate of 40%. The average match rate accumulated

through all respondent match rates was 23%, leaving the average disconnect rate at 77%. Therefore, in this simulated source selection, the disconnect between the stated preferences of respondents and actual choice behavior could be confirmed and measured at over three times the rate at which respondents, and their stated level of attribute importance, actually matched their choice behaviors.

Another insight the data collected from the CBC and the stated ranked listing provides this study is whether any of the five attributes (price, tangibles, competence, responsiveness, reliability) are predicted better by the respondents of the choice exercise, i.e., is a specific attribute more successfully matched when comparing the choice behavior in the CBC and the stated preferences in the rank exercise. To analyze the data, the researcher first utilized an 'if/then' statement to compare whether each respondent's stated ranked preferred attributes matched the CBC choice behavior. As there were 5 attributes to compare for each respondent, a total of 150 (30 \* 5) matches or nonmatches were then used in an if/then formula in excel to produce a 'Yes' or 'No'. The 'Yes' counts were matches, while the 'No' counts were nonmatches. This data was then placed into a pivot chart, where the five attributes were placed in the rows block, while the 'Yes' and 'No' counts were totaled by attribute. The resulting Figure 26 visually represents the conclusions drawn from the if/then formulas utilized in excel.



Figure 26. Match – Disconnect Rate by Attribute



Attribute	No	Yes	Grand Total
Price	20	10	30
Competence	21	9	30
Reliability	22	8	30
Tangibles	26	4	30
Responsiveness	27	3	30
<b>Grand Total</b>	<b>116</b>	<b>34</b>	<b>150</b>

As reflected in Figure 26, the attribute respondents could better ‘predict’ was price, with ten out of the 34 possible attribute matches collected during the study. Meanwhile, responsiveness was the attribute which respondents were least successful at matching their ranked choices to their CBC choice behavior. This suggests that respondents were more successful at ranking ‘hard’ metrics like price, while ‘soft’ attributes such as responsiveness are less understood and therefore may lead to an inability to rank properly. However, this assumption would require further future research as another arguably ‘hard’ attribute, tangibles (does the contractor have the facilities, equipment, personnel, and communication materials needed for service), was this fourth lowest attribute in terms of successful matching.

## 2. Proximal Match Rate

The researcher also utilized the match data collected from the study to discover situations in which respondent's ranked attribute preferences are similar to their CBC choice behavior but do not have an exact match. More specifically, the researcher reviewed the order of importance for both exercises and observed if any attributes' order was off by one. For example, this inclusive proximal comparison searched for respondent's that stated price was the second most important attribute, but their choice behavior indicated price was either their first or third most important attribute based on the CBC importance scores. This proximal comparison process is outlined in Table 21.

Table 21. Proximal Comparison Process

<b>Comparison</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Stated Rank</b>
<b>Exact Match</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>CBC</b>
<b>Inclusive Proximal</b>	<b>1 or 2</b>	<b>1 or 2 or 3</b>	<b>2 or 3 or 4</b>	<b>3 or 4 or 5</b>	<b>5 or 4</b>	<b>CBC</b>

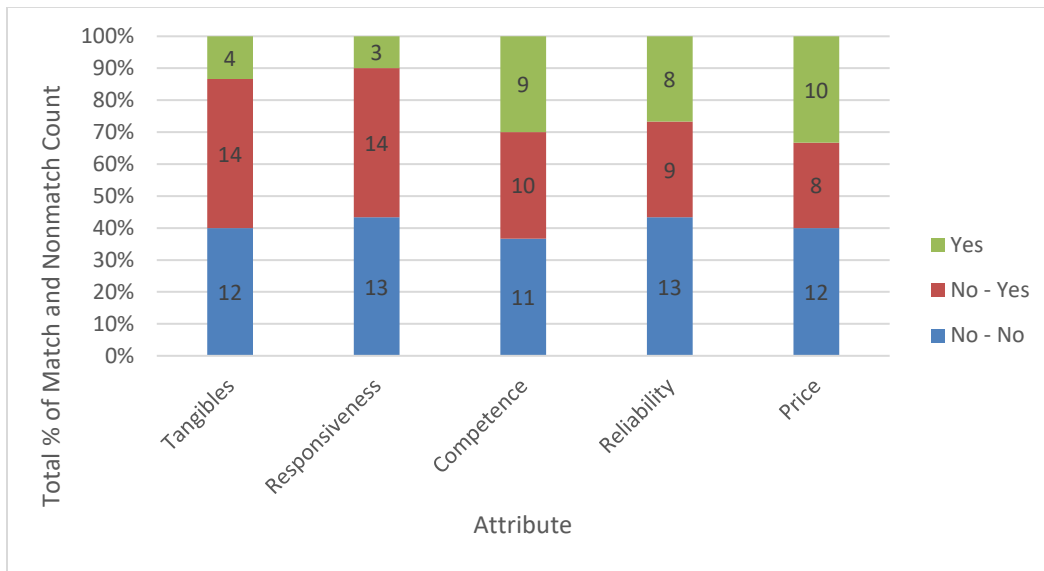
To observe when and how many times this situation occurred in the data, the researcher utilized a similar if/then formula utilized in 'Match-Nonmatch Rate by Attribute' section previously mentioned in this paper. However, the if/then formula was altered to not only check for an exact match, but also to verify whether that ranked attribute matched one ranking (above or below) the same attribute in the CBC choice behavior. The if/then formula verifying an inclusive proximal match would then generate a 'Yes' or 'No'. The 'Yes' result would indicate a proximal match while the 'No' result would indicate a non-proximal match. These results were then placed in a pivot chart, with attributes placed in the rows block while the total counts for 'Yes' and 'No' results were generated.

Figure 27 represents the results drawn from the inclusive proximal comparison process. In Figure 27, the green portion of the stacked bar represents the 'Yes' count, or those times there was an exact match for an attribute between the stated ranked exercise and the



CBC choice behavior. The red portion of the stacked bar represents the ‘No-Yes’ count in situations where respondents did not get an exact match for the attribute but got an inclusive proximal match between stated preference and their choice behavior. Finally, the blue portion of the stacked bar represents the ‘No-No’ count that represented situations in which respondents did not get an exact match, nor did they get an inclusive proximal match for that attribute.

Figure 27. Inclusive Proximal Match Comparison by Attribute



Row Labels	Count of Inclusive Proximal Match		Column Label:		Grand Total
	No	Yes	No Total	Yes Grand Total	
Tangibles	12	14	26	4	30
Responsiveness	13	14	27	3	30
Competence	11	10	21	9	30
Reliability	13	9	22	8	30
Price	12	8	20	10	30
<b>Grand Total</b>	<b>61</b>	<b>55</b>	<b>116</b>	<b>34</b>	<b>150</b>

As indicated in Figure 27, the proximal match count for each attribute was almost always greater than the exact match count for that same attribute, except when it came to the attribute of price. So, while price has the highest exact match count amongst all attributes, it did not include the largest proximal match count. What is extremely interesting to note is that the two attributes that had the lowest exact match rate (see



Figure 26), tangibles and responsiveness, were now the two attributes with the highest proximal match count, each with 14 proximal matches.

When examining the total percent of the match and nonmatch count, about 40% of the time respondents did not have an attribute match, whether it was proximal or exact, when comparing their stated ranked choices versus their CBC choice behavior. Another 40% of the time, respondents did not have an exact attribute match but did have a proximal match. Finally, depending on the attribute, respondents had an exact match about 10–30% of the time. Due to the small number of observations this study collected, further observations are required to draw definitive conclusions on these particular results; however, it is noted as a future area of research in a later section of this paper.

### **3. Experience vs. Match Rate**

As the CBC asked respondents to provide some acquisition career background, the researcher looked for systematic trends in the data based off respondents' experience. While not necessarily a primary objective of the research, determining if respondent experience mattered in their ability to match their stated behavior with their choice behavior in the CBC would enable future research implications and could add value to the overall results of this study. Unfortunately, the pool of 30 respondents for the CBC was too small to find sufficient, definitive evidence as to if experience plays a true role in respondents better matching or predicting behaviors during the CBC. The limitations of respondent pool size and its future research implications are discussed in the 'Conclusion and Recommendations' portion of this paper. The following section discusses the explorative processes of this study when examining respondent experience and match rate data.

#### ***a. Correlation Between Experience and Match Rate***

The first explorative process the researcher conducted on the data was to examine if there was a statistical correlation between respondents' experience and their match rate data. To determine the correlation, the researcher utilized the 'CORREL' function in excel, with the formula utilizing each respondent's years of experience and their match rate percentage, or the percentage in which the respondent was able to match their stated



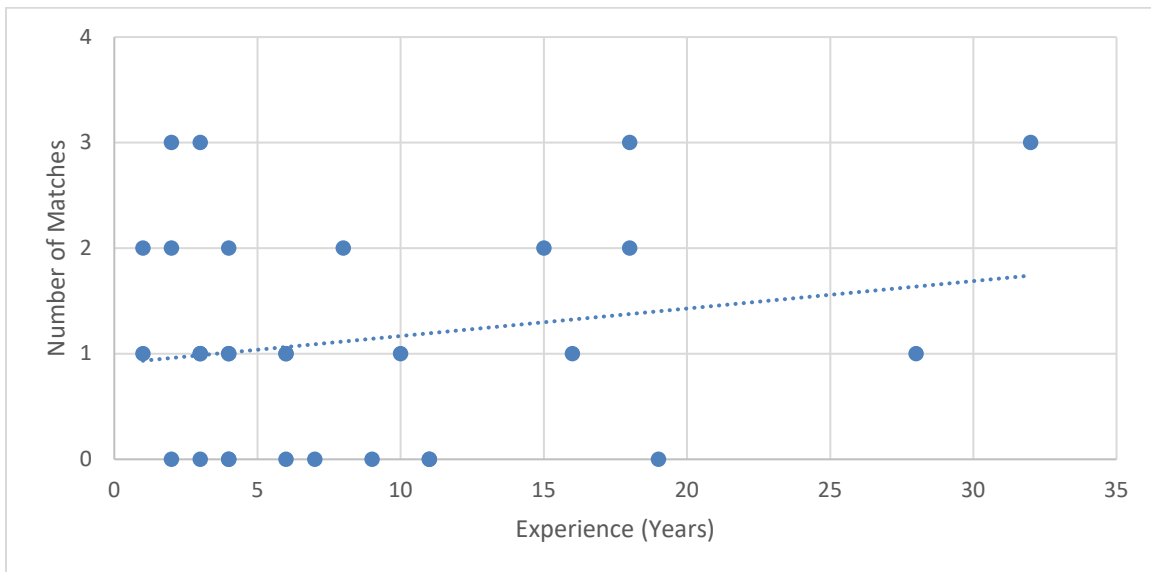
ranked attributes with their CBC ranked attributes, which was turned into a decimal number. The following formula was generated through this process:

$$=CORREL(A2:A31, B2:B31)$$

where A2:A31 = Experience Years and B2:B31 = Match Rate

The Correlation Coefficient ( $r$ ) produced from this process was approximately 0.197863. For reference,  $r$  will always be a value between -1 and 1, and the closer  $r$  is to 1 will indicate a strong linear relationship while the closer  $r$  is to -1 will indicate a negative linear relationship (Khan Academy, n.d.). With  $r$  equaling 0.198, experience and match rate do not appear to have any relationship, positive or negative. The lack of relationship is also visually demonstrated in Figure 28. Figure 28 indicates no correlation as observed by the plotted points with no trending pattern, whether positive or negative. Further respondent data would be necessary to definitively state if there is any relationship between experience and match rate.

Figure 28. Scatter Plot – Experience vs. Match Rate



***b. Experience Mean Difference***

Another explorative process utilized to discover trending patterns with experience and match rate was to determine the mean difference or the “absolute difference between the mean value in two different groups” (Independent Media Associates, Inc., n.d.). In





this instance, the researcher wondered if the total population (30 respondents) was broken into two different subsets, one with high experience levels and one with low experience levels, would the mean difference or their absolute mean difference be significantly enough to determine if high or low experience mattered in terms of match rate in the choice exercise. To split the population into two experience subgroups, the researcher determined that those respondents with nine or more years of experience, in any role, were considered to be a part of the high experience group, while all respondents with under nine years of experience were considered to be in the low experience group. Nine years was utilized as the cut-off point, as the average experience (in years) for the total population (30 respondents) was 8.67 years, and that average was then rounded to nine. Once the total population was split, the match rate mean of each sub-group was calculated to produce the following:

High Experience Respondent Group (n = 11): 0.236 mean

Low Experience Respondent Group (n = 19): 0.221 mean

In order to statistically calculate the difference in means between these two respondent groups, the researcher performed a t-test through the excel data analysis software. More specifically, the researcher ran the ‘t-test: two-sample assuming equal variance’ utilizing the calculated means above and an alpha of 0.05. Table 22 displays the results of that test.

Table 22. T-Test: Two-Sample Assuming Equal Variances

	<i>High Experience Group</i>	<i>Low Experience Group</i>
Mean	0.236	0.221
Variance	0.055	0.040
Observations	11.000	19.000
Pooled Variance	0.045	
Hypothesized Mean Difference	0.000	
df	28.000	
t Stat	0.191	
P(T<=t) one-tail	0.425	
t Critical one-tail	1.701	
<b>P(T&lt;=t) two-tail</b>	<b>0.850</b>	
t Critical two-tail	2.048	



One of the more important values found through this t-test is the p-value (highlighted in green in Table 22). At 0.850, the p-value for this t-test is larger than the alpha (0.05), indicating that the researcher is unable to there is a statistically significant difference between the means of the two sample groups. With so little difference between these two means paired with the size of total population, and the non-normal distribution of the overall match rate data, inferences about these two means cannot be made and the researcher could therefore not determine any significant independence or results from them. Therefore, all exploratory processes described in this section do not provide sufficient evidence that experience does or does not impact overall match rates. However, if this correlation coefficient and mean test results were to hold with increased observations, we would see additional evidence that experience alone is not enough to resolve the stated versus observed preference problem that we see in source selection, lending credence for the use of CBC methods in advance of non-price trade source selections

#### **4. Willingness-to-Pay**

Sawtooth Software allows researchers to run simulations that produce the measure, WTP, or the preference level of an attribute in terms of money (Sawtooth Software, 2022). For this project, WTP offers an interesting additive that could provide higher assurance about actual respondent preference per attribute, while also allowing the simulation of tradeoffs that could help to derive potential best value trade ranges for SSTs. This study also supports Finkenstadt's PhD assertion that WTP can be viewed "as the best means of extracting the relative tradeoff value between [the study's] attribute levels of perceived quality [and that] public procurement agents can use the same information to inform the population of how much more they should pay for increased quality levels" (Finkenstadt, 2020a). Firms have consistently complained about the government's inability to express the relative tradeoff they would consider for higher levels of service offerings. WTP is a method that allows buying agencies to discern this information a priori and consider using it to inform industry in how to best position their offers to compete based on true best value determinations.



Utilizing the same data that was used for the HB analysis, the researcher ran a simulation to determine the WTP for each attribute presented in this study's CBC. In this simulation, WTP is calculated at each of the attribute's levels (low, high, reasonable, neutral), with the least preferred level of each attribute considered the reference level (Sawtooth Software, 2022). This means that for every WTP calculated at each level of the non-price attribute, the WTP is the monetary value of that level with respect to the reference level which in this instance is the low level of non-price each attribute (Sawtooth Software, 2022).

Sawtooth software allows the researcher to build a WTP scenario utilizing the same attribute information while also allowing the researcher to modify specific settings that change the sampling methods the simulator uses to generate the WTPs. For this study, the researcher ran the 'share of preference' simulation method which defines the WTP as the difference between the low-level attribute and the enhanced level of the attribute. In terms of sampling method, the researcher utilized a bootstrap sampling method that may take longer for the simulator to process, but allowed the researcher to estimate 95% confidence intervals, standard error, and more accurate estimates of the WTP. For reference, bootstrap sampling is "a strategy that includes drawing sample data consistently with substitution from a data source to determine a populace parameter" (Vadakkanmarveetil, 2021, para. 1). The advantage to bootstrapping is that it is a statistical technique that is especially useful for small sample sizes that lack normal distribution (Taylor, 2019, para. 1). As discussed in previous portions of this paper, the study's CBC received only 30 respondents with match rate data that was not normally distributed. Therefore, the resampling technique bootstrapping utilizes was thought to be most advantageous when determining WTP. With the bootstrap sampling technique in the WTP simulation, the software utilized over 300 bootstrap samples with 30 competitive sets per sample. These values are the default values presented to the researcher by the software and were considered sufficient to generate WTP results. The researcher did try the default sampling offered by Sawtooth software that does use bootstrap sampling; however, the WTP results were nearly or exactly the same but with larger extrapolation and convergence rates.



Prior to introducing the WTP results of this simulation, it should be noted that these values should be interpreted with caution. Since the study collected only 30 respondents, the aggregate utility data is 1) not enough to draw definitive conclusions from and 2) the WTP simulation had to extrapolate WTP values. In simulations with extrapolation, Sawtooth Software had to extrapolate WTP values “to drive the share of preference for the enhanced WTP product back to its base case share or preference” and the software warns its researchers what percentage of the “sample draws the WTP value caused price to exceed the range included in [the] experiment” (Sawtooth Software, 2022). Furthermore, the software warned that a certain percentage of the WTPs could not converge to determine the point at which raising the price of an enhanced attribute starts to reduce the share of preference the simulator attempts to calculate. Those values impacted by extrapolation and convergence should be interpreted with caution.

Table 23 displays the results from the bootstrap sampling simulation run to generate WTP for each attribute and their levels. The confidence intervals produced for each level provide the estimated range at which the WTP would fall under if the researcher were to perform the test again. These confidence intervals were generated by the software after the program computed “the standard deviation of the WTP results across the bootstrap samples. Then, to form a 95% confidence interval, we [the software] take the median WTP across the bootstrap samples +/- 1.96 times the standard deviation” (Sawtooth Software, 2022). The results also include the standard error, which is the “measure of the expected variation among sample means” (Sawtooth Software, 2022).



Table 23. Willingness-to-Pay by Attribute (In Millions)

Willingness-to-Pay by Attribute (in millions)					
<b>WTP - Tangibles</b>					
	<b>Std. Error</b>	<b>Lower 95% CI</b>	<b>Upper 95% CI</b>	<b>CI Spread</b>	
<b>Low</b>					
<b>Neutral</b>	\$ -	\$ 0.09	\$ (0.17)	\$ 0.20	\$ 0.37
<b>Reasonable</b>	\$ 0.77	\$ 0.18	\$ 0.40	\$ 1.10	\$ 0.70
<b>High</b>	\$ 0.92	\$ 0.12	\$ 0.67	\$ 1.20	\$ 0.53
<b>WTP - Reliability</b>					
	<b>Std. Error</b>	<b>Lower 95% CI</b>	<b>Upper 95% CI</b>	<b>CI Spread</b>	
<b>Low</b>					
<b>Neutral</b>	\$ 0.51	\$ 0.17	\$ 0.16	\$ 0.90	\$ 0.74
<b>Reasonable</b>	\$ 0.96	\$ 0.16	\$ 0.63	\$ 1.30	\$ 0.67
<b>High</b>	\$ 1.00	\$ 0.23	\$ 0.53	\$ 1.50	\$ 0.97
<b>WTP - Responsiveness</b>					
	<b>Std. Error</b>	<b>Lower 95% CI</b>	<b>Upper 95% CI</b>	<b>CI Spread</b>	
<b>Low</b>					
<b>Neutral</b>	\$ 0.24	\$ 0.10	\$ 0.04	\$ 0.44	\$ 0.40
<b>Reasonable</b>	\$ 0.51	\$ 0.17	\$ 0.17	\$ 0.85	\$ 0.68
<b>High</b>	\$ 0.76	\$ 0.20	\$ 0.35	\$ 1.17	\$ 0.82
<b>WTP - Competence</b>					
	<b>Std. Error</b>	<b>Lower 95% CI</b>	<b>Upper 95% CI</b>	<b>CI Spread</b>	
<b>Low</b>					
<b>Neutral</b>	\$ 0.45	\$ 0.14	\$ 0.16	\$ 0.73	\$ 0.57
<b>Reasonable</b>	\$ 0.77	\$ 0.17	\$ 0.43	\$ 1.12	\$ 0.69
<b>High</b>	\$ 1.00	\$ 0.19	\$ 0.61	\$ 1.40	\$ 0.79

At first glance, WTP per level consistently increases for each attribute as the attribute is enhanced from Neutral, to Reasonable, and finally High. The simulation supports the assumption that the value of an attribute increases as its enhanced. Reliability and competence were the two attributes with the highest WTPs at every level. This fits with the findings found in the CBC HB analysis that found these same two attributes had the highest average importance scores.

If the researcher were to look past the limited respondent pool and its impact on the WTP simulation, the results indicate some interesting observations in terms of best value tradeoffs between the levels of each attribute. For example, the reliability and competence attributes findings suggest that respondents are willing to pay at least double



(\$510,000 vs. \$1,000,000) and nearly three times more (\$450,000 vs. \$1,000,000) for the highest level of each attribute. Meanwhile, the respondent data gathered for the attribute of tangibles indicates that they are almost unwilling to pay for a neutral level of the attribute ( $\$0 \pm \$90,000$ ) but will pay a premium of almost \$1,000,000 to ensure they receive a high level of tangibles. Additionally, the attribute of responsiveness shows that respondents WTP increases almost 25% as the attribute level increases (\$240,000 [neutral], \$510,000 [low], \$760,000 [high]). Overall, the simulation showed that respondents were willing to pay anywhere from 5% to 24% more to upgrade all attributes so that they were at least one level higher than the low level. Based off the WTP simulation findings, the researcher can further conclude that respondents do not see the feasibility of the option to accept any offer that includes all low ratings for every attribute, regardless of price, as the aggregate respondent data suggests they would pay an enormous amount or significant premium to avoid the low or neutral levels of all attributes.

The results from this simulation should be analyzed cautiously and further respondent data would be necessary in order to verify the accuracy of this data. The researcher calculated the Confidence Interval (CI) spread to determine whether there was too much of a spread in the simulation results and therefore too much variance in the CBC data itself due to the small respondent pool (See Table 23). The CI spread at each level of the attributes ranges anywhere from \$370,000 to \$970,000. A spread this large suggests that this data cannot be confidently used to predict or extrapolate WTP metrics. With that, the simulation is running with realistic price points in millions of dollars, each with a standard error at every level of the service's attribute. To be comfortable in asserting these data points as accurate WTP values, the study would require further respondents for the CBC.



## V. CONCLUSION

### A. SUMMARY OF FINDINGS

Despite the U.S. government spending almost four trillion dollars a year, with 12.5% of that spent on goods and services alone (GAO, 2017a), there remains a significant absence of scholarly efforts focused on B2G exchanges and government purchasing (Josephson et al., 2019). Additionally, the scholarly research conducted usually sees the government simply as the “regulator of its [the market] activities (e.g., labelling rules, pricing policies, quality, and safety standards)” while omitting the large role the government plays as a customer in that same market (Josephson et al., 2019). In some small way the research conducted in this study, aimed to address this deficiency in B2G research, by contributing some unique insights on DoD buyer behavior and government service quality indicators. The following section addresses the initial research objectives of this study and how well the results of this project achieved said objectives. It then goes on to describe the limitations of the research and finally future areas of research that could be conducted.

#### 1. **Research Objective 1 – Determine the degree of disconnect between stated preferences during pre-award acquisition phase and actual choice behavior in defense acquisition source selections**

In this project, the degree of disconnect between pre-award stated preferences and choice behavior was measured utilizing the data collected in both the CBC choice exercise and the ranked preference exercise all respondents completed. As expounded on within the ‘Results’ portion of this paper, the calculated degree of disconnect was approximated at a rate of 77%, which was more than three times greater than the rate of connection or matches between stated preferences and choice behavior. This research confirmed, in a simulated source selection, that there was the presence of and significant measure of disconnect between the stated preferences and actual choice behavior of government acquisition personnel making value trade-off purchase decisions utilizing proven incentive-aligned methods



This research also produced results that confirm the assertions concluded in Finkenstadt's 2020 PhD dissertation that government personnel are rarely fully capable of predicting the ordered importance of price and non-price factors as they utilize theoretical deduction as opposed to empirical reasoning. With that, the results of this project indicate government personnel do not usually know how they would consider nonprice factors and price when given the choices in a full set of offers or grouped, rather than individualized in list form. As the CBC propelled respondents into a hyper-realistic source selection with practical price points, SSG scale levels, and significant qualitative attributes to evaluate upon, this project asserts that current source selection procedures do not offer a method that shifts personnel away from ineffective evaluation factor determination and the a priori rank order of said evaluation factors.

Government buyers, acquisition personnel, and, to some degree, the other components of the acquisition team have some of the most unique, rigorous performance implications within the B2G market. Their value proposition doesn't include self-profit, it focuses on public stakeholder interest and societal welfare (Josephson et al., 2019). The close monitoring from U.S. voters and Congress, add distinctive spending pressures not seen in a non-government business or entity (Josephson et al., 2019). With that, their acquisition approach, sourcing strategy, communications, and other various actions are governed not only by U.S. law, but by the regulatory minutia illustrated in policies like the FAR and enforced by agency-specific regulations (Josephson et al., 2019).

One such policy includes the SSG, much of which is augmented by specific FAR parts. Within the SSG, DoD personnel are instructed to:

If using the tradeoff source 2.3.5 selection process, all factors and significant subfactors that will affect contract award and their relative importance shall be stated clearly in the solicitation (see FAR 15.304(d)). The solicitation shall state, at a minimum, whether all evaluation factors other than cost or price, when combined, are (1) significantly more important than cost or price; (2) approximately equal to cost or price; or (3) significantly less important than cost or price (see FAR 15.304(e)) (DoD, 2016b)

As this project and Finkenstadt's dissertation affirm, personnel are often poor at predicting what is important when factors are in list form; however, the very guidance





DoD acquisition personnel use in tradeoff (subjective or VATEP) source selections enforces a procedure that enables them to rank, and promote in the pre-award solicitation, evaluation factors in list form based on their importance to price. Furthermore, such guidance paired with a lack definitive procedures that enforce personnel to utilize empirical reasoning rather than theoretical deduction, leaves room for an acquisition team to a priori rank order the evaluation factors they seek to evaluate. So, while this research's core focus is not to necessarily provide implementable recommendations for this issue, the project and its results have identified a problem resultant from current DoD policies instituted and used today. One of the ways in which this problem could be solved, is to utilize empirical methods, such as CBC, to test evaluation teams relative order of importance on nonprice attributes prior to the SST establishing and releasing a solicitation for a requirement.

## **2. Research Objective 2 – Develop a deep understanding of quality attributes in evaluating logistics-based service acquisitions**

In 2022, U.S. President Joseph R. Biden stated that “we are living in a ‘decisive decade’, one stamped by dramatic changes in geopolitics, technology, economics, and our environment” (DoD, 2022). Such an outlook has led the DoD to reexamine its defense strategy and initiatives as it claims, “in these times, business as usual at the Department is not acceptable” and only transformation, innovation, and efforts to build enduring advantages are the only satisfactory path forward for the organization (DoD, 2022). In its newly released 80-page defense strategy document, the DoD goes on to outline its defense priorities, force planning, and risk management initiatives; however, none are feasible to the organization unless the DoD successfully resources its major undertakings and does not “fail to make the hard choices to align available resources with the strategy’s level of ambition” (DoD, 2022).

Effective resource management is critical to the DoD going forward with its new defense strategy. As discussed in the ‘Introduction’ portion of this paper, bid protests are the antithesis of successful resource management as they, or even the threat of them, diverts time, efforts, funding, and the use of valuable resources to resolve them. Avoiding GAO bid protests is therefore critical for the DoD and this research modestly aids in



combatting the threat of preventable protests by developing a deeper understanding of quality attributes for logistics-based service acquisitions. In understanding what government buyers and DoD acquisition personnel define as true quality in terms of logistics-based services, the DoD could potentially avoid misrepresenting evaluation factors in terms of their importance, develop more relevant evaluation factors for a logistics-based service, and award contracts to those businesses offering what actually matters for the DoD and the warfighter. For this project and through its interviews, it was determined that true quality in logistics-based service means a contractor can provide a high level of competence, reliability, tangibles, and responsiveness.

It is interesting to note that the semi-structured interviews conducted for this highlighted service quality indicators not necessarily associated with the measures and guidance currently used to evaluate logistics-based services and quality. CPARS and PBL metrics and policies offer the SST certain benefits; however, PBL metrics offer evaluation factors that can be used as pass/fail criterion in early, initial evaluations of contractor proposals while CPARS generally offers unreliable, weak past performance information (Black et al., 2014). Again, for this particular issue, this research did not necessarily set out to recommend a direct, implementable solution but it has identified an issue related to how the DoD understands service quality in terms of logistics-based services and how that understanding doesn't automatically produce metrics or information that can aid to generate evaluation factors that get to what is most important to the personnel utilizing these services. Therefore, the researcher recommends that a larger scale study for each major service category in DoD spend to establish the most important nonprice factors for use by future evaluation teams. Future areas of research are discussed within later portions of this paper.

**3. Research Objective 3 – Provide a Choice-Based Conjoint (CBC) framework that the DoD could utilize to enhance source selection criteria development in both logistics and further categories of government spending.**

For the purposes of this research, a framework is defined as “a set of beliefs, ideas, or rules that is used as the basis for making judgements, decisions, etc.” (Oxford, n.d.). The research and methods conducted for this project provide a theoretical



framework, or a foundation in which knowledge is created for potential future research or DoD source selections. While areas of future research will be discussed in a later section of this paper, it's important to discuss here how the processes, knowledge, and results could help the DoD and its source selections in the future. To do so, this CBC framework's ideas and principles must be imbedded in current source selection procedures.

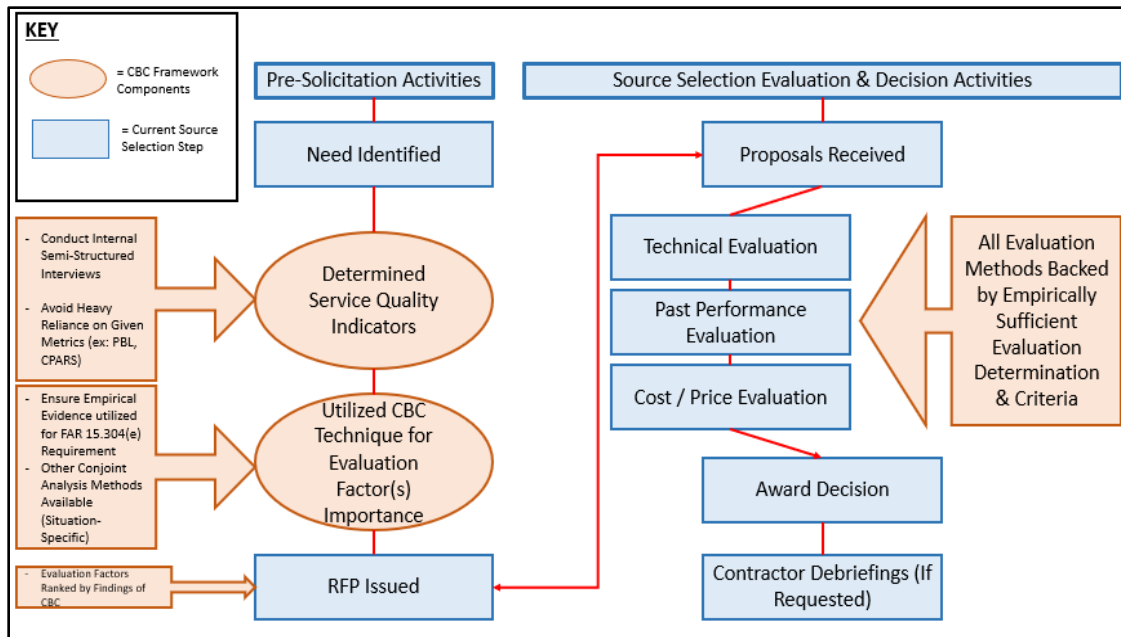
During pre-solicitation activities, the acquisition team is guided to conduct market research to identify capabilities within the market, and outside the organization, that will become "candidate evaluation criteria, which influence the overall source selection process" (DoD, 2016b). Actions like presolicitation notices and industry engagement/industry days are recommended to the acquisition team as methods to assist in developing evaluation criteria (DoD, 2016b). While those are extremely beneficial to the acquisition team and later the SST, these methods offer only an outside view of what is important and what an evaluation factor should be. In order to determine service quality indicators to use for this project's CBC, the researcher had to develop a deep understanding of what is most important to those members acquiring logistic-based services. This understanding came from semi-structured interviews from those closely associated with the services and within the DoD, as opposed to outside the department. This theoretical framework then suggests that the market research methods used to develop evaluation criteria go beyond that outside influence, that reach past metrics already published (i.e., PBL guidebook), and instead focus on direct input from those that know what the requirement truly needs to be as effective as it can be for the warfighter. Understanding quality means to the customer and acquisition team, means evaluating contractors and selecting contractors with the right criteria.

Prior to an RFP being released, SSTs are advised to essentially rank evaluation factors, in list form, in terms of price (DoD, 2016b). Research Objective 1 of this project revealed that this procedure often leads to weak ranking in terms of an evaluation factors importance and ultimately improper evaluation of contractor proposals, in terms of what the DoD actually needs from the contractor. Therefore, the framework produced from this project, suggests that if SSTs are to rank evaluation factors like this, empirical methods like CBC or other conjoint analysis techniques should be incorporated into the source



selection process. Figure 29 displays how the CBC framework recommended in this project can be incorporated into standard source selection procedures.

Figure 29. Source Selection Process with CBC Framework Incorporated.  
Adapted from (Nicholas, n.d.).



Investigating how acquisition personnel or customers value a particular attribute (evaluation factor) of a service when it's seen in conjunction with the rest of the service's attributes, prior to its RFP ranking, allows its true importance to be recognized and then ranked 'correctly' amongst other factors. In summation, source selection procedures should incorporate and perhaps enforce more stringent investigatory methods to properly rank evaluation factors and conjoint analysis, like CBC, can be the focal method of those procedures.

## B. LIMITATIONS

### 1. Limitation I – Simulated Environment

The simulated, hypothetical nature of the CBC creates an environment in which respondents are not faced with real-life consequences for the choices they make during the choice exercise; therefore, the results garnered from the CBC may or may not be observed in real-life circumstances. As its recommended to introduce salient, incentive-aligned choice exercise conditions, the researcher incorporated expert scrutiny conditions

to the exercise in order to prevent unrealistic, thoughtless choice behavior on behalf of respondents. The expert scrutiny condition helps to mimic the formal source selection review process found in DoD organizations; however, inputting these additional conditions only goes so far and real-life means real dollars, real restraints, and real pressure. Furthermore, based off the ‘Random Respondent’ section of this paper, the quality of respondent results was high, but the researcher could not completely eliminate the notion that some respondents completed the exercise with disinterest and improbable behavior. To potentially combat the consequences of this limitation, future, studies could compare results from hypothetical incentive aligned CBCs with actual field results from real source selections, in an effort to determine or measure any disconnect between the hypothetical source selections and real-life source selections.

## **2. Limitation II – Reliance on Data Entries**

The spend and data analysis results aided the researcher in determining which widely contracted logistics service to center the choice exercise around and discovering hyper-realistic price data to use in the CBC. AFBIT Lite and PMRT EA are extremely useful applications and offer insight into real-world DoD contract information that help enable realistic conditions in the simulated environment of the CBC. However, it should be noted that such data is gathered and consolidated from real people inputting data. Such data should be treated with caution as people make mistakes, input inaccurate information, or omit important, relevant information regarding a transaction or contract. Therefore, the reliance on these data inputs may reduce the validity of the price points selected for this project’s CBC and the decision to center the exercise around RPM.

## **3. Limitation III – CBC Respondent Pool Size**

As mentioned in previous portions of this paper, the 30 respondents of the choice exercise offered enough investigatory insight that allowed the researcher to carry out the research objectives intended for this project. Furthermore, the disconnect level drawn from this respondent pool proves to be on par with what other research, such as Finkenstadt’s PhD dissertation and multiple in-class CBC exercises completed in NPS courses. However, as it was just 30 observations to statistically test and review, there was



not enough data to assert confirmatory, definitive statements in terms of aggregate importance, respondent experience relevancy, and WTP tradeoff findings. While supplemental in terms of the study's core objectives, this information could have offered further insight into respondent choice behavior that would have supplemented the conclusions drawn from this study or lead to further, impactful recommendations for the DoD.

#### **4. Limitation IV – CBC Design**

The final limitation of this study was recognized after the CBC was generated and results were collected. In hindsight, the researcher recognizes that the CBC could have been designed differently so that further specificity could be generated as to respondent demographics and more explicitly, their experience. As the choice exercise allows respondents to select multiple positions, there is no way to pinpoint if and what role(s) in DoD acquisition enable a respondent to have a higher match rate between their stated intentions versus their actual choice behavior. Additionally, the number of years in a specific role could not be determined due to the design of the exercise questions; therefore, the researcher was limited on identifying if a certain position with a certain experience threshold would impact a respondent's match rate. Similar to the previous limitation, this drawback only impacts the additive nature of the study but does not have severe impact on the research objectives of this study.

### **C. AREAS OF FUTURE RESEARCH**

#### **1. Future Research I – Category of Spend**

This study chose to focus on a particular category of spend (transportation and logistics), a specific PSC (R706), and just one actual service (RPM). The central objectives of this project could be recreated to focus on a different category of spend, PSC, or service. As this research and Finkenstadt's PhD dissertation show, conjoint analysis has proven to be an effective method to study buyer behavior in a number of scenarios and circumstances, including those focused on RPM and KBS. A future research project could incorporate the methods and design around the limitations



determined from each of these studies in order to develop further buyer insights in the B2G environment.

## **2. Future Research II – Number of Choice Exercise Observations**

The limiting factor of a small sample size of this project’s choice exercise could be remedied in future studies by opening the choice exercise again for future NPS students or introducing the exercise to DoD organizations and agencies outside of NPS. A larger number of observations would allow future research to confidently confirm this study’s findings or develop new assertions, produce further understanding of aggregate results of the choice exercise, and enhance the supplemental data gathered from this project, like the experience and WTP results. A larger sample size may also allow for further research objectives to be created and achieved in future studies.

## **3. Future Research III – Unique Research Objectives**

The data that can be generated from conjoint analysis, sawtooth software, and other applications utilized in this study could potentially be engineered to review further problems in the DoD acquisition process or develop unique understandings of the B2G buyer and their choice behavior. For example, future studies could focus on respondent experience to definitively conclude whether experience truly matters in a respondent’s understanding of what matters most to them. Furthermore, a tightened research focus on WTP and the tradeoff values respondents’ choice behavior creates could enable researchers to develop the ‘perfect’ service or product mix in terms of their attributes. This would mean introducing possible and essential insight into what acquisition customers truly need, how financial agencies can better budget for these requirements, and where contractors can shift their capacities, resources, and abilities to better meet a government requirement.

## **D. IN SUMMATION**

The DoD is operating in an environment of limited resources, shifting geopolitical powers, capricious economic turmoil, and accelerated technological change. In the midst of this uncertain environment, the DoD recognizes its need to rapidly adjust in order to continue its original mission to protect and defend the United States of America and our



democratic values (DoD, 2022). The research conducted for this project originally set out to discover knowledge that could help resolve some of the resource management issues that stem from poorly selected and estimated source selection evaluation criteria, ill-conceived notions of what quality means in a B2G service, and the consequential nature of an avoidable bid protest. What this project can now do for the DoD is offer a path of opportunities to enhance future acquisition evaluation criteria, reduce the burdens of unnecessary protests, and better utilize its already constrained resources. At its core, and to some minor degree, this project offers a piece of the essential support needed by the DoD to embark on the recognized change their operating environment requires of them.





# APPENDIX A. CBC CHOICE EXERCISE

## Introduction

The United States Transportation Command (USTRANSCOM) would like your help in improving the way that the Department of Defense (DoD) evaluates and acquires services aimed at supporting their logistic-focused mission to provide full-spectrum global mobility solutions and enabling capabilities to their customers. We would like to solicit your voluntary response to a survey that will help us better understand how you value quality in these types of services. Previous respondents took an average of 10 minutes to complete this survey.

The results of this survey will be used to develop new ways of soliciting and evaluating contractor performance and selection criteria. Interviews and a thorough review of past research by our team has provided insight into how quality is measured when selecting supplies and services in support of logistic-based military operations. Now we are working to determine how much each factor matters relative to each other. Your participation in this choice survey is completely voluntary.

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## Definitions

The following information is provided to facilitate your understanding of this topic:

- USTRANSCOM serves as the single manager of America's global defense transportation system. It is a unified, functional combatant command which provides transportation and logistics support to other combatant commands, military services, defense agencies, and other government organizations.

- USTRANSCOM Directorate of Acquisition (TCAQ) serves as the command's acquisition hub, acquiring all transportation and logistic capabilities the command, and its components, need.

Examples of the capabilities TCAQ acquires include: Transportation (air, sea, trucking), warehousing, storage, logistics consulting services, facilities support services, etc.

- **Real Property** is defined as any interest in land, together with the improvements, structures, and fixtures located thereon under the control of any Federal agency.

- **Maintenance** is defined as the upkeep of property only to the extent necessary to offset serious deterioration; also, such operation of utilities, including water supply and sewerage systems, heating, plumbing, and air-conditioning equipment, as may be necessary for fire protection, the needs of interim tenants, and personnel employed at the site, and the requirements for preserving certain types of equipment.

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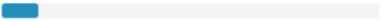
### Background Inquiry

Where are you taking this survey?

- Naval Postgraduate School
- NCMA World Congress

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### Background Inquiry

Have you worked within an organization that acquires Real Property Maintenance services like those purchased by TCAQ?

*As a reminder, Real Property is defined as any interest in land, together with the improvements, structures, and fixtures located thereon under the control of any Federal agency. Maintenance is defined as the upkeep of property only to the extent necessary to offset serious deterioration; also, such operation of utilities, including water supply and sewerage systems, heating, plumbing, and air-conditioning equipment, as may be necessary for fire protection, the needs of interim tenants, and personnel employed at the site, and the requirements for preserving certain types of equipment.*

- Yes
- No

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**Background Inquiry**

How would you describe the position(s) in which you held within that organization? (Select All that Apply)

- Contracting Officer
- Contracting Manager/Administrator
- Contracting Officer Representative/Quality Assurance Personnel
- Program Manager
- Customer
- Other. Please Specify:

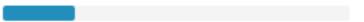
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How many years of experience do you have within the Logistics-supported position(s) selected in the previous question?

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0%  100%



### Background Inquiry

Have you held any of the following position(s) within a government organization?  
(Select All that Apply)

- Contracting Officer
- Contracting Manager/Administrator/Specialist
- Contracting Officer Representative (COR)
- Quality Assurance Personnel
- Program Manager
- Customer
- None of the Above. Please Specify Current Government Position Title:

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How many years of experience do you have within the specified position(s) selected in the previous question?

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Next



USTRANSCOM spends over \$4.4 Billion a year on supplies and services enabling their logistic-focused mission. Many of its programs with industry partners are thoroughly tracked and publicly advertised by USTRANSCOM. Each contract value ranges from hundreds of thousands of dollars to hundreds of millions of dollars. Furthermore, much of the contract activity USTRANSCOM TCAQ initiates includes high spend activity that requires the best possible solutions for the taxpaying public and the warfighter.

With that, please treat the following survey as a real-world example. Make your choices as realistic as possible and answer to the best of your ability. Due to the impact the results will have in potentially changing DoD acquisition methods or policy, the results from your survey will be evaluated by public procurement/acquisition experts to determine response reliability.

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#### Scenario

Imagine that you are the lead evaluator on a source selection evaluation team within USTRANSCOM TCAQ. You have been asked by the Source Selection Authority (SSA) to make a best value recommendation using price performance tradeoffs related to a logistics service source selection. The evaluation criteria state that price and non-price factors are equally important.

This source selection is for Real Property Maintenance (RPM) Service Calls for the USTRANSCOM Headquarters installation, Scott Air Force Base. The contractor selected from this source selection must respond to non-recurring service calls and provide such services as pest control, pavement clearance, facilities management, grounds maintenance and other RPM support services specified within the Performance Work Statement.

The contract will be a firm-fixed price contract with a 12-month base period and four 12-month option periods. The total price shown also includes pricing for a 6-month extension of service clause if necessary.

Government Estimate \$4,300,000.00 - \$5,200,000.00

Government Budget is \$5,300,000.00

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#### Choice Explanation

You will see different scenarios. In each scenario you will see a set of three offers and an option for "NONE: I wouldn't choose any of these". The offers within each scenario will include four service quality indicators that are taken from each firm's past performance record and the total price offered.

Please choose what you feel is the best value decision in each of these scenarios by clicking the "SELECT" button for that choice profile. The four indicators include the following:

1. Tangibles - RPM firm demonstrated they have the facilities, equipment, personnel, and communication materials needed to complete the service.
2. Reliability - RPM firm demonstrated an ability to perform dependably and accurately on previous contracts.
3. Responsiveness - RPM firm demonstrated a willingness to help customers and provide prompt service on previous contracts
4. Competence - RPM firm's employees applied existing and innovative best practices to execute requirements on past contracts.

The weighted importance of each attribute is not given. You are to assume that you have autonomy in selecting the best value profile. Each attribute is simply a reflection of perceived quality rated by past customers. It is your job to identify which areas of perceived quality matter the most to you in selecting a knowledge-based service provider. The evaluation criteria state that price and non-price factors are equally important.

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#### Assumptions

1. All offers presented have already been screened as responsive to the solicitation and technically acceptable.
2. All offer prices have been determined to be realistic based on the offer details.
3. You will be making a final recommendation based on a tradeoff between price and the five service quality attributes that are taken from each firm's past performance record.

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**DoD Source Selection Ratings Scale**

The past performance records evaluated during this source selection are rated using a streamlined scale based on the DoD Source Selection (SS) Guide Table 5

Streamlined Scale Rating	Adjectival Rating from DoD SS Guide Table 5	Description
High	Substantial Confidence	Based on the offeror's recent/relevant performance record, the Government has a <b>high</b> expectation that the offeror will successfully perform the required effort.
Reasonable	Satisfactory Confidence	Based on the offeror's recent/relevant performance record, the Government has a <b>reasonable</b> expectation that the offeror will successfully perform the required effort.
Low	Limited Confidence	Based on the offeror's recent/relevant performance record, the Government has a <b>low</b> expectation that the offeror will successfully perform the required effort.
Neutral	Neutral Confidence	No recent/relevant performance record is available or the offeror's performance record is so sparse that no meaningful confidence assessment rating can be reasonably assigned. The offeror may not be evaluated favorably or unfavorably on the factor of past performance.

If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(1 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.12M	\$5.09M	\$5.09M
Tangibles	Low	Reasonable	Neutral
Reliability	Reasonable	High	Reasonable
Responsiveness	Low	Neutral	Neutral
Competence	High	Reasonable	High
	<input type="button" value="Select"/>	<input type="button" value="Select"/>	<input type="button" value="Select"/>

**Option 4**

NONE: I wouldn't choose any of these.



If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(2 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$5.14M	\$4.94M	\$5.09M
Tangibles	Low	Low	Reasonable
Reliability	Low	Reasonable	Reasonable
Responsiveness	High	Reasonable	Neutral
Competence	Neutral	Reasonable	Low
	Select	Select	Select

**Option 4**

NONE: I wouldn't choose any of these.

Select

If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(3 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.12M	\$5.14M	\$4.37M
Tangibles	High	Neutral	Low
Reliability	High	Low	Reasonable
Responsiveness	Reasonable	Reasonable	High
Competence	Neutral	Reasonable	Low
	Select	Select	Select

**Option 4**

NONE: I wouldn't choose any of these.

Select





If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(4 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.94M	\$4.12M	\$4.12M
Tangibles	High	Neutral	Low
Reliability	Reasonable	High	Neutral
Responsiveness	Neutral	High	Neutral
Competence	Reasonable	Reasonable	Low

**Option 4**

NONE: I wouldn't choose any of these.

Select

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Next

If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(5 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.12M	\$4.12M	\$4.94M
Tangibles	Neutral	Neutral	High
Reliability	Neutral	Neutral	Neutral
Responsiveness	Neutral	High	Reasonable
Competence	Neutral	Low	Reasonable

**Option 4**

NONE: I wouldn't choose any of these.

Select

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Next



If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(6 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$5.09M	\$5.14M	\$4.37M
Tangibles	High	Neutral	Reasonable
Reliability	Neutral	High	High
Responsiveness	Reasonable	High	Neutral
Competence	Neutral	Reasonable	High

**Option 4**

NONE: I wouldn't choose any of these.

If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(7 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.37M	\$4.37M	\$5.09M
Tangibles	Reasonable	High	Low
Reliability	High	High	Neutral
Responsiveness	Low	Low	High
Competence	High	High	Reasonable

**Option 4**

NONE: I wouldn't choose any of these.



If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(8 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$5.09M	\$5.09M	\$5.14M
Tangibles	Neutral	Reasonable	Neutral
Reliability	Reasonable	Low	Low
Responsiveness	Low	Low	Low
Competence	High	Low	Low

**Option 4**

NONE: I wouldn't choose any of these.

If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(9 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.12M	\$4.12M	\$4.37M
Tangibles	High	Reasonable	High
Reliability	Low	Reasonable	Low
Responsiveness	High	Low	High
Competence	Neutral	Reasonable	Low

**Option 4**

NONE: I wouldn't choose any of these.



If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(10 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.37M	\$4.12M	\$5.09M
Tangibles	Neutral	Neutral	High
Reliability	Reasonable	High	Reasonable
Responsiveness	Reasonable	Neutral	High
Competence	High	Reasonable	Reasonable
	<input type="button" value="Select"/>	<input type="button" value="Select"/>	<input type="button" value="Select"/>

Option 4
NONE: I wouldn't choose any of these.
<input type="button" value="Select"/>

If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(11 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$5.14M	\$5.09M	\$4.94M
Tangibles	High	Reasonable	High
Reliability	Low	Neutral	High
Responsiveness	Low	Neutral	Low
Competence	Low	Neutral	Reasonable
	<input type="button" value="Select"/>	<input type="button" value="Select"/>	<input type="button" value="Select"/>

Option 4
NONE: I wouldn't choose any of these.
<input type="button" value="Select"/>



If these were your only options, which would you choose? Note: You can hover over ALL attributes (left) to review definitions of each.

(12 of 12)

	Contractor 1	Contractor 2	Contractor 3
Price	\$4.94M	\$5.09M	\$4.12M
Tangibles	High	Low	Neutral
Reliability	Neutral	Neutral	High
Responsiveness	Low	Reasonable	High
Competence	Neutral	High	High

**Option 4**

NONE: I wouldn't choose any of these.

The team is interested to know what you believe are the most important aspects of selecting a logistics-based service provider in a price performance tradeoff. Below are (7) responses that include five (5) perceived quality attributes, price, and an option for "Other option not listed". Please place each item in order of importance from 1-Most important to 7-Least Important.

Items to Rank	Most Preferred
Price	
Firm has the facilities, equipment, personnel, and communication materials needed to complete the service.	
Firm demonstrates an ability to perform dependably and accurately.	
Firm has a willingness to help customers and provide prompt service.	
RPM firm's employees applied existing and innovative best practices to execute requirements on past contracts.	
Other Option Not Listed.	
	Least Preferred



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## APPENDIX B. INDIVIDUAL RESPONDENT CBC RESULTS

Respondent 1	1	2	3	4	5
CBC	Competence	Reliability	Responsiveness	Price	Tangibles
Rank	Competence	Price	Reliability	Tangibles	Responsiveness
# Matched	1 of 5	Partition(s) Held: Customer w/out RPM or USTRANSCOM-Related Svc. (28 Years)			
% Match	20%				
Respondent 2	1	2	3	4	5
CBC	Price	Reliability	Competence	Tangibles	Responsiveness
Rank	Price	Reliability	Tangibles	Responsiveness	Competence
# Matched	2 of 5	Partition(s) Held: Program Manager w/out RPM or USTRANSCOM-Related Svc. (18 Years)			
% Match	40%				
Respondent 3	1	2	3	4	5
CBC	Tangibles	Competence	Price	Reliability	Responsiveness
Rank	Responsiveness	Tangibles	Price	Reliability	Competence
# Matched	2 of 5	Partition(s) Held: Contracting Manager/Administrator/Specialist (2 Years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	40%				
Respondent 4	1	2	3	4	5
CBC	Responsiveness	Competence	Reliability	Tangibles	Price
Rank	Competence	Responsiveness	Price	Tangibles	Reliability
# Matched	1 of 5	Partition(s) Held: Contracting Officer and Customer (16 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 5	1	2	3	4	5
CBC	Reliability	Price	Tangibles	Competence	Responsiveness
Rank	Reliability	Responsiveness	Price	Competence	Tangibles
# Matched	2 of 5	Partition(s) Held: Other: Assistant Research Professor (15 Years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	40%				
Respondent 6	1	2	3	4	5
CBC	Reliability	Tangibles	Price	Competence	Responsive
Rank	Responsiveness	Price	Reliability	Tangibles	Competence
# Matched	0 of 5	Partition(s) Held: Other: OSI Agent (4 Years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 7	1	2	3	4	5
CBC	Reliability	Competence	Responsiveness	Tangibles	Price
Rank	Competence	Responsiveness	Tangibles	Reliability	Price
# Matched	1 of 5	Partition(s) Held: Contracting Officer and Contracting Manager/Administrator/Specialist (3 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 8	1	2	3	4	5
CBC	Competence	Reliability	Price	Responsiveness	Tangibles
Rank	Price	Tangibles	Responsiveness	Competence	Reliability
# Matched	0 of 5	Partition(s) Held: Contract Manager/Administrator (7 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 9	1	2	3	4	5
CBC	Price	Reliability	Tangibles	Competence	Responsiveness
Rank	Responsiveness	Reliability	Price	Competence	Tangibles
# Matched	2 of 5	Partition(s) Held: Contracting Officer and Contracting Manager/Administrator/Specialist (4 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	40%				
Respondent 10	1	2	3	4	5
CBC	Tangibles	Price	Reliability	Competence	Responsiveness
Rank	Responsiveness	Price	Tangibles	Reliability	Competence
# Matched	1 of 5	Partition(s) Held: Contracting Officer, Contracting Manager/Administrator/Specialist, and Customer (4 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	20%				



Respondent 11	1	2	3	4	5
CBC	Responsiveness	Competence	Reliability	Tangibles	Price
Rank	Reliability	Tangibles	Price	Responsiveness	Competence
# Matched	0 of 5	Parition(x) Hold: Contracting Officer and Contracting Manager/Administrator/Specialist (2 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 12	1	2	3	4	5
CBC	Competence	Reliability	Responsiveness	Price	Tangibles
Rank	Competence	Responsiveness	Tangibles	Reliability	Price
# Matched	1 of 5	Parition(x) Hold: Contracting Officer, Contracting Manager/Administrator/Specialist, and Program Manager (6 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 13	1	2	3	4	5
CBC	Competence	Price	Reliability	Tangibles	Responsiveness
Rank	Reliability	Responsiveness	Price	Competence	Tangibles
# Matched	0 of 5	Parition(x) Hold: Contracting Officer and Contract Manager/Administrator (11 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 14	1	2	3	4	5
CBC	Reliability	Competence	Responsiveness	Tangibles	Price
Rank	Responsiveness	Reliability	Price	Competence	Tangibles
# Matched	0 of 5	Parition(x) Hold: Contracting Officer (9 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 15	1	2	3	4	5
CBC	Reliability	Price	Competence	Responsiveness	Tangibles
Rank	Reliability	Competence	Price	Tangibles	Responsiveness
# Matched	1 of 5	Parition(x) Hold: Contracting Officer and Contract Manager/Administrator (6 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 16	1	2	3	4	5
CBC	Responsiveness	Reliability	Competence	Tangibles	Price
Rank	Competence	Price	Tangibles	Reliability	Responsiveness
# Matched	0 of 5	Parition(x) Hold: Contracting Officer (3 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 17	1	2	3	4	5
CBC	Competence	Reliability	Responsiveness	Tangibles	Price
Rank	Competence	Responsiveness	Reliability	Tangibles	Price
# Matched	3 of 5	Parition(x) Hold: Other: Company Commander (2 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	60%				
Respondent 18	1	2	3	4	5
CBC	Price	Reliability	Tangibles	Competence	Responsiveness
Rank	Price	Tangibles	Reliability	Competence	Responsiveness
# Matched	3 of 5	Parition(x) Hold: Contract Manager/Administrator (3 Years) w/RPM or USTRANSCOM-Related Svc.			
% Match	60%				
Respondent 19	1	2	3	4	5
CBC	Competence	Reliability	Responsiveness	Tangibles	Price
Rank	Competence	Responsiveness	Price	Reliability	Tangibles
# Matched	1 of 5	Parition(x) Hold: Contracting Officer and Contracting Manager/Administrator/Specialist (3 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 20	1	2	3	4	5
CBC	Price	Tangibles	Competence	Reliability	Responsiveness
Rank	Responsiveness	Competence	Price	Reliability	Tangibles
# Matched	1 of 5	Parition(x) Hold: Contracting Officer and Contracting Manager/Administrator/Specialist (4 years) w/out RPM or USTRANSCOM-Related Svc.			
% Match	20%				





Respondent 21	1	2	3	4	5
CBC	Reliability	Competence	Price	Tangibles	Responsiveness
Rank	Competence	Price	Tangibles	Responsiveness	Reliability
# Matched	0 of 5	Parition(r) Hold: Contracting Manager/Administrator/Specialist (6 Years) u/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 22	1	2	3	4	5
CBC	Reliability	Competence	Price	Responsiveness	Tangibles
Rank	Tangibles	Reliability	Price	Responsiveness	Competence
# Matched	2 of 5	Parition(r) Hold: Other: Senior Lecturer (8 Years) u/RPM or USTRANSCOM-Related Svc.			
% Match	40%				
Respondent 23	1	2	3	4	5
CBC	Reliability	Price	Responsiveness	Tangibles	Competence
Rank	Reliability	Responsiveness	Price	Tangibles	Competence
# Matched	3 of 5	Parition(r) Hold: Contracting Officer, Contracting Manager/Administrator/Specialist, COR, Curtamer, and Program Manager (18 years) u/RPM or USTRANSCOM-Related Svc.			
% Match	60%				
Respondent 24	1	2	3	4	5
CBC	Reliability	Competence	Responsiveness	Tangibles	Price
Rank	Responsiveness	Competence	Tangibles	Reliability	Price
# Matched	3 of 5	Parition(r) Hold: Contract Manager/Administrator (1 Year) u/RPM or USTRANSCOM-Related Svc.			
% Match	60%				
Respondent 25	1	2	3	4	5
CBC	Price	Reliability	Tangibles	Responsiveness	Competence
Rank	Tangibles	Competence	Price	Reliability	Responsiveness
# Matched	0 of 5	Parition(r) Hold: Other: Ship Division Officer (4 Years) u/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 26	1	2	3	4	5
CBC	Price	Reliability	Tangibles	Competence	Responsiveness
Rank	Price	Tangibles	Reliability	Responsiveness	Competence
# Matched	1 of 5	Parition(r) Hold: Contracting Officer, Contracting Manager/Administrator/Specialist, and COR (10 years) u/RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 27	1	2	3	4	5
CBC	Reliability	Competence	Responsiveness	Price	Tangibles
Rank	Competence	Tangibles	Price	Reliability	Responsiveness
# Matched	0 of 5	Parition(r) Hold: Program Manager, Curtamer and COR (19 years) u/RPM or USTRANSCOM-Related Svc.			
% Match	0%				
Respondent 28	1	2	3	4	5
CBC	Reliability	Competence	Responsiveness	Tangibles	Price
Rank	Reliability	Responsiveness	Competence	Tangibles	Price
# Matched	3 of 5	Parition(r) Hold: Other: NPS Faculty (32 Years) u/RPM or USTRANSCOM-Related Svc.			
% Match	60%				
Respondent 29	1	2	3	4	5
CBC	Competence	Reliability	Tangibles	Responsiveness	Price
Rank	Tangibles	Price	Reliability	Responsiveness	Competence
# Matched	1 of 5	Parition(r) Hold: COR/Quality Assurance Personnel (1 Year) u/RPM or USTRANSCOM-Related Svc.			
% Match	20%				
Respondent 30	1	2	3	4	5
CBC	Competence	Reliability	Responsiveness	Tangibles	Price
Rank	Reliability	Responsiveness	Tangibles	Price	Competence
# Matched	0 of 5	Parition(r) Hold: Contracting Officer and Contracting Manager/Administrator/Specialist (11 years) u/RPM or USTRANSCOM-Related Svc.			
% Match	0%				



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## LIST OF REFERENCES

- Air Force Installation Contracting Center Strategic Plans and Strategic Communications Division. (2022). *AFBIT lite (Air Force business intelligence tool)* [federal contracting spend]. <https://public.tableau.com/app/profile/afbit>
- Air Force Life cycle Management Center. (2022). *PMRT (project management resource tool)* [acquisitions analytic app]. <https://pmrt.altess.army.mil/portal/all-apps>
- American Research and Development Corporation. (n.d.). *Military logistics*. Rand Corporation - Objective Analysis. Effective Solutions. Retrieved April 7, 2022, from <https://www.rand.org/topics/military-logistics.html>
- Apte, U., Kang, K. (2006). *Lean six sigma for reduced life cycle costs and improved readiness* [Technical Report, Naval Postgraduate School]. Defense Technical Information Center. <https://apps.dtic.mil/sti/citations/ADA459746>
- Army Sustainment Command Public Affairs. (2019, April 15). *LOGCAP V performance contractors selected*. [https://www.army.mil/article/220353/logcap\\_v\\_performance\\_contractors\\_selected](https://www.army.mil/article/220353/logcap_v_performance_contractors_selected)
- Assay, S. D. (2018, 13 April). *Class deviation - micro-purchase threshold, simplified acquisition threshold, and special emergency procurement authority* [Memorandum]. Department of Defense. <https://www.acq.osd.mil/dpap/policy/policyvault/USA000919-18-DPAP.pdf>
- Banerjee, A., Lucker, F., Ries, J.M. (2021). An empirical analysis of suppliers' trade-off behavior in adopting digital supply chain financing solutions. *International Journal of Operations & Production Management*, 41(4), 313–335. <https://doi.org/10.1108/IJOPM-07-2020-0495>
- Black, S., Henley, J., Clute, M. (2014). *Determining the value of Contractor Performance Assessment Reporting System (CPARS) narratives for the acquisition process* [Thesis, Naval Postgraduate School]. Defense Technical Information Center. <https://apps.dtic.mil/sti/citations/ADA606848>
- Butler, P. (2014). *Key case law rules for government contract formation*. Management Concepts.
- Chitturi, P., Carides, A. (2020). Experimental design issues in choice-based conjoint applied to patient choice in healthcare. *Journal of Comparative Effectiveness Research*, 9(2), 141–147. <https://doi.org/10.2217/ce-2019-0115>



- Defense Acquisition University (2022). *CON 0072 source selection* [Lecture]. Distance Learning. <https://dau.csod.com/ui/lms-learning-details/app/curriculum/4988fe16-aac5-45de-bb5f-989fc54f567c>
- Defense Acquisition University (2022). *Glossary of defense acquisition acronyms and terms* [Fact Sheet]. <https://www.dau.edu/glossary/Pages/Glossary.aspx>
- Department of Defense. (2016a). *Performance Based Logistics (PBL) guidebook - a guide to developing performance-based arrangements*. [https://www.dau.edu/pdfviewer?Guidebooks/Performance-Based-Logistics-\(PBL\)-Guidebook.pdf](https://www.dau.edu/pdfviewer?Guidebooks/Performance-Based-Logistics-(PBL)-Guidebook.pdf)
- Department of Defense. (2016b, March 31). *Source selection procedures* (DFAR Supplement 215.3). [https://www.dau.edu/pdfviewer/Source/Guidebooks/DoD-Source-Selection-Procedures-\(SSP\).pdf](https://www.dau.edu/pdfviewer/Source/Guidebooks/DoD-Source-Selection-Procedures-(SSP).pdf)
- Department of Defense. (2019, February). *Advisory panel on streamlining and codifying acquisition regulation*. [https://permanent.fdlp.gov/gpo132449/Sec809Panel\\_Roadmap\\_DEC2019.pdf](https://permanent.fdlp.gov/gpo132449/Sec809Panel_Roadmap_DEC2019.pdf)
- Department of Defense. (2022). *National defense strategy of the United States of America*. <https://www.defense.gov/National-Defense-Strategy/>
- Ding, M., Grewal, R., Liechty, J. (2005). Incentive-aligned conjoint analysis. *Journal of Marketing Research*, 42(1), 67–82. <https://doi.org/10.1509/jmkr.42.1.67.56890>
- FAR 15.1, Source Selection Process and Techniques (2022). [https://www.acquisition.gov/far/part-15#FAR\\_Subpart\\_15\\_1](https://www.acquisition.gov/far/part-15#FAR_Subpart_15_1)
- FAR 15.3, Source Selection (2022). [https://www.acquisition.gov/far/part-15#FAR\\_Subpart\\_15\\_3](https://www.acquisition.gov/far/part-15#FAR_Subpart_15_3)
- FAR 45.1, Government Property General (2022). [https://www.acquisition.gov/far/part-45#FAR\\_Subpart\\_45\\_1](https://www.acquisition.gov/far/part-45#FAR_Subpart_45_1)
- Finkenstadt, D., & Hawkins, T. (2016). *#eVALUate: monetizing service acquisition trade-offs using the quality-infused price© methodology* [Technical Report, Naval Postgraduate School]. NPS Archive: Calhoun. <https://calhoun.nps.edu/handle/10945/56388>
- Finkenstadt, D. (2020). *Essays on perceived service quality and perceived value in business-to-government knowledge-based services* [PhD Dissertation, University of North Carolina]. University Libraries: Carolina Digital Repository. <https://cdr.lib.unc.edu/concern/dissertations/8910k095g>



- Finkenstadt, D. (2020). *Uncovering value in knowledge-based services: monetizing latent service quality indicators for source selection* [Technical Report, Naval Postgraduate School]. NPS Archive: Calhoun.  
<https://calhoun.nps.edu/handle/10945/65995>
- Government Accountability Office. (2013). *GAO bid protest annual report to Congress for fiscal year 2012*. <https://www.gao.gov/products>
- Government Accountability Office. (2014a). *Contractor performance: actions taken to improve reporting of past performance (Report No. GAO-14-707)*. Washington, DC: Author.
- Government Accountability Office. (2014b). *GAO bid protest annual report to Congress for fiscal year 2013*. <https://www.gao.gov/products>
- Government Accountability Office. (2015). *GAO bid protest annual report to Congress for fiscal year 2014*. <https://www.gao.gov/products>
- Government Accountability Office. (2016). *GAO bid protest annual report to Congress for fiscal year 2015*. <https://www.gao.gov/products>
- Government Accountability Office. (2017a). *Contracting data analysis: assessment of government-wide trends*. <https://www.gao.gov/assets/gao-17-244sp.pdf>
- Government Accountability Office. (2017b). *GAO bid protest annual report to Congress for fiscal year 2016*. <https://www.gao.gov/products>
- Government Accountability Office. (2018a). *GAO bid protest annual report to Congress for fiscal year 2017*. <https://www.gao.gov/products>
- Government Accountability Office. (2019). *GAO bid protest annual report to Congress for fiscal year 2018*. <https://www.gao.gov/products>
- Government Accountability Office. (2020). *GAO bid protest annual report to Congress for fiscal year 2019*. <https://www.gao.gov/products>
- Government Accountability Office. (2021). *GAO bid protest annual report to Congress for fiscal year 2020*. <https://www.gao.gov/products>
- Government Accountability Office. (2018b). *Bid protests at GAO: a descriptive guide*. <https://www.gao.gov/products/gao-18-510sp>
- Hauser, J. R., Eggers, F., Selove, M. (2019). The strategic implications of scale in choice-based conjoint analysis. *Marketing Science*, 38(6), 1059–1081.  
<https://doi.org/10.1287/mksc.2019.1178>



- Independent Media Associates, Inc. (n.d.). mean difference / difference in means (MD). Retrieved October 22, 2022, from <https://www.statisticshowto.com/>
- Josephson, B. W., Lee, J., Mariadoss, B.J., & Johnson, J.L. (2019). Uncle Sam rising: performance implications of business-to-government relationships. *Journal of Marketing*, 83(1), 51–72.  
<https://journals.sagepub.com/doi/epub/10.1177/0022242918814254>
- Khan Academy (n.d.). *Correlation coefficient review*. Retrieved October 22, 2022, from <https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/scatterplots-and-correlation/a/correlation-coefficient-review>
- Levy, L. (2018). AFSC: the readiness engine for the U.S. Air Force. (2018). *Defense News: Military Logistics*. <https://defensenews.com>
- McQuarrie, E. F. (2016). *The market research toolbox: a concise guide for beginners*. SAGE Publications, Inc. <http://dx.doi.org/10.4135/9781483398228.n12>
- The MITRE Corporation. (n.d.). *Contract protest diagnostic tool*. MITRE. Retrieved May 27, 2022, from <https://aida.mitre.org/protest-tool/>
- Naval Sea Logistics Center Detachment Portsmouth (2011, October). *User manual for contractor performance assessment reporting system (CPARS)*.  
<https://acqnotes.com/Attachments/CPARS%20User%20Manual.pdf>
- Nicholas, R. E. (n.d.). *Source selection* [Presentation]. Oklahoma City Air Logistics Center. <https://www.slideserve.com/odelia/source-selection>
- Orme, B. (2020). *Getting started with conjoint analysis - strategies for product design and pricing research* [PDF version]. <https://sawtoothsoftware.com/>.
- Oxford. (n.d.). Framework. In *The Oxford learner's dictionaries*. Retrieved October 30, 2022, from <https://www.oxfordlearnersdictionaries.com/us/definition/english/framework?q=framework>
- Rao, V. R. (2014). *Applied conjoint analysis*. Springer Berlin Heidelberg.  
<https://doi.org/10.1007/978-3-540-87753-0>
- Raghavarao, D., Wiley, J. B., & Chitturi, P. (2011). *Choice-based conjoint analysis: models and designs*. CRC Press, Taylor & Francis.
- Real Property Policies, 41 CFR § 102–71.20 (2022).  
<https://www.law.cornell.edu/cfr/text/41/102-71.20>



- Sawtooth Software. (2022). *Lighthouse studio help* [Digital Handbook].
- Section 809 Panel. (2019). *A roadmap to the Section 809 Panel reports*.  
[https://permanent.fdlp.gov/gpo132449/Sec809Panel\\_Roadmap\\_DEC2019.pdf](https://permanent.fdlp.gov/gpo132449/Sec809Panel_Roadmap_DEC2019.pdf)
- Section 809 Panel. (2017). *Advisory panel on streamlining and codifying acquisition regulations: Section 809 Panel interim report*.  
[https://permanent.fdlp.gov/gpo132347/Sec809Panel\\_Interim-Report\\_May2017.pdf](https://permanent.fdlp.gov/gpo132347/Sec809Panel_Interim-Report_May2017.pdf)
- Taylor, C. (2019, January 6). *Example of bootstrapping*. ThoughtCo.  
<https://www.thoughtco.com/example-of-bootstrapping-3126155#:~:text=Bootstrapping%20is%20a%20powerful%20statistical%20technique.%20It%20is,assuming%20a%20normal%20distribution%20or%20a%20t%20distribution.>
- United States Census Bureau (2022). *North American industry classification system* [Fact Sheet]. <https://www.census.gov/naics/>
- United States General Services Administration. (2022, August 12). *Contractor performance assessment reporting system*. <https://www.cpars.gov/>
- Vadakkanmarveetil, J. (2021, March 4). *Bootstrap sampling – a simple guide in 3 easy points*. Jigsaw Academy. <https://www.jigsawacademy.com/blogs/ai-ml/bootstrap-sampling/>
- Wind, J., Green, P.E., Shifflet, D., Scarbrough, M. (1989). Courtyard by Marriott: designing a hotel facility with consumer-based marketing models. *Interfaces*, 19(1), 25–47. <https://www.jstor.org/stable/25061184>
- Zeithaml, V. A. (2009). *Delivering quality service*. Free Press.











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