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IMPROVING THE PRICE EFFICIENCY OF U.S. AIR FORCE BASE OPERATING SUPPORT SERVICE CONTRACTS

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The U.S. Air Force spends approximately $6 billion per year on installation services under Base Operating Support (BOS) contracts. For many installations, BOS contracts represent a sizable portion of the annual base Operations and Maintenance (O&M) budget and contain services critical to peacetime and wartime missions. However, the Air Force enterprise lacks a standardized approach toward acquiring these services; service clusters differ across installations, as do acquisition strategies. Implementation of a uniform process would allow prices to be minimized while maximizing the services received and purchasing power held. This research paper conducts a regression and hierarchical cluster analysis that analyzes the commonalities and cost drivers within Air Force BOS contracts. The results of the analysis conclude that the price-per-month of BOS contracts decrease as contract duration increases, leading to the recommendation of securing longer BOS contract duration terms. This research paper gains a better understanding of factors influencing BOS contract pricing that will allow the U.S. Air Force to improve acquisition strategy, capitalize on supplier economies of scale and scope, improve competition, and increase socioeconomic participation.

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IMPROVING THE PRICE EFFICIENCY OF U.S. AIR FORCE BASE OPERATING SUPPORT SERVICE CONTRACTS

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ABSTRACT

The U.S. Air Force spends approximately $6 billion per year on installation services under Base Operating Support (BOS) contracts. For many installations, BOS contracts represent a sizable portion of the annual base Operations and Maintenance (O&M) budget and contain services critical to peacetime and wartime missions. However, the Air Force enterprise lacks a standardized approach toward acquiring these services; service clusters differ across installations, as do acquisition strategies. Implementation of a uniform process would allow prices to be minimized while maximizing the services received and purchasing power held. This research paper conducts a regression and hierarchical cluster analysis that analyzes the commonalities and cost drivers within Air Force BOS contracts. The results of the analysis conclude that the price-per-month of BOS contracts decrease as contract duration increases, leading to the recommendation of securing longer BOS contract duration terms. This research paper gains a better understanding of factors influencing BOS contract pricing that will allow the U.S. Air Force to improve acquisition strategy, capitalize on supplier economies of scale and scope, improve competition, and increase socioeconomic participation.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command
AETC	Air Education and Training Command
AFICA	Air Force Installation Contracting Agency
AFMC	Air Force Material Command
AFSPC	Air Force Space Command
BOS	Base Operations Support Services
CLIN	Contract Line Item Number
CONUS	Continental United States
DBO	Director of Business Operations
EDA	Electronic Database Access
FPDS-NG	Federal Procurement Database System—Next Generation
GAO	Government Accountability Office
JB LE	Joint Base Langley-Eustis
JB MDL	Joint Base McGuire-Dix-Lakehurst
LBC	Large Base Cluster
MAJCOM	Major Command
NTE	Not to Exceed
O&M	Operations and Maintenance
OBC	Operations Based Cluster
OCONUS	Outside of the Continental United States
PSC	Product Service Code
USAFA	United States Air Force Academy

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I. INTRODUCTION

This chapter provides a general overview of Base Operations Support (BOS) service contracts. The chapter covers the details of how BOS contracts are used, their origination, and the current problem that the Air Force is facing with the utilization of BOS contracts. Lastly, the chapter concludes with why this research is significant to the contracting and acquisition community for both the Department of Defense and the United States Air Force.

A. BACKGROUND

BOS contracts enable military installations to outsource vital support services by packaging multiple services, such as minor construction, civil engineering operations, and base maintenance, into one larger service contract (Warren, 1998). BOS contracts are a critical resource for military installations to accomplish their day-to-day missions and vary with their size, scope, and dollar value. Every military installation that utilizes a BOS contract has a unique mission and corresponding reliance on the contractor to accomplish the services that are necessary. Currently, there is no set standard on how agencies and organizations should procure BOS services (Warren, 1998). The Government Accountability Office (GAO) has shed light on the best practices of procuring and utilizing a multi-service contract by releasing an official GAO report in 1998.

The U.S. Air Force spends approximately $6 billion dollars per year on installation support services under BOS contracts (Warren, 1998). For many installations, BOS contracts represent a sizable portion of the annual base Operations and Maintenance (O&M) budget and contain services critical to peacetime and wartime missions. However, the Air Force enterprise lacks a standardized approach toward acquiring these services; service clusters differ across installations, as do acquisition strategies. For example, some MAJCOM's utilize a dedicated unit to procure BOS services for the entire MAJCOM, while other MAJCOM's feature a hands-off approach that gives each installation the ability to award and administer their specific BOS contract. Implementation of a uniform process would allow prices to be minimized while maximizing the services received and

purchasing power held (Warren, 1998). Obtaining a better understanding of factors influencing BOS contract pricing will allow the U.S. Air Force to improve acquisition strategy, capitalize on supplier economies of scale and scope, improve competition, and increase socioeconomic participation. Every Air Force installation that implements a BOS contract varies based on mission, size of scope, and services incorporated within the contract (Warren, 1998). Due to the variety and inconsistency of the BOS contracts, the Department of Defense currently does not fully understand what drives the price of BOS contracts (Warren, 1998). Although BOS contracts are not new to government acquisition, the Air Force lacks consistency regarding the contract's procurement and administration process.

B. PROBLEM DESCRIPTION

BOS contracts are extremely complex and rarely have commonalities among the services that are outsourced, but a common problem that occurs among the service contracts is determining which services should be incorporated and packaged together in a BOS contract. BOS contracts are attractive for military installations due to their flexibility of adding multiple services into one large contract (Warren, 1998). This enables the installation to be able to change to rapidly evolving military environments. Most military installations utilize BOS contracts to outsource their support service functions, such as grounds maintenance, civil engineering operations, real property maintenance, and minor construction projects (Warren, 1998). Due to the breadth that BOS contracts have, this ultimately creates an uncertainty of not fully capitalizing on the resources that are required to maximize the efficiencies of a large multi-service contract, the lack of economies of scale that BOS contracts may offer, or if certain services should be procured as a stand-alone contract.

C. RESEARCH QUESTIONS

The research is organized to explore multiple facets of BOS service contracts that are being utilized across the Air Force. The theoretical output of this research will provide the Air Force Installation Contracting Agency (AFICA) with a solid framework and

understanding of BOS contracts to procure BOS services in a more efficient manner. The following research questions will be explored:

1. What are the commonalities of the twelve BOS contracts and installations implementing BOS contracts?
2. Which cost drivers are the most impactful to the overall price of BOS contracts?

D. BENEFITS OF RESEARCH

Currently, few studies focus on BOS contracts; instead, the literature on BOS contracts revolves around a 1998 GAO report and articles written by practitioners of the field. The GAO report outlined why BOS contracts are utilized, the efficiencies that may arise, the importance of clearly defining the requirement, and the utilization of small businesses as the prime contractor (Warren, 1998).

Conducting research regarding which services should be packaged together within a BOS contract will allow for a more efficient and standardized approach to the procurement of BOS services within the Department of Defense. This research will enhance the productivity and efficiencies as well as reduce costs for future BOS services that are procured. The procuring organizations will be able to fully understand the benefits of packaging services and the consequences of over packaging or consolidating. By knowing which mixture of services and resources that efficiently perform within BOS contracts, military installations will be able to complete missions more effectively while spending less money.

E. LIMITATIONS OF RESEARCH

This research analyzed twelve active BOS contracts from twelve different Air Force installations. These twelve Air Force installations were the only responsive recipients to the data calls conducted. The inputs of this research were limited to active Air Force BOS contracts. All contract modifications of the twelve BOS contracts were not included in the analysis due to a high amount of data and limited time.

Air Force installations outside of the continental United States (OCONUS) that have an active BOS contract were excluded from this research. These OCONUS BOS contracts have a large amount of dissimilarities from the BOS contracts within the continental United States (CONUS), such as being prone to exchange rate risks, additional contingency services, and political instabilities. Although OCONUS BOS contracts have many dissimilarities, they are just as important to military installations in helping accomplish their mission but were not included in this research.

F. ORGANIZATION OF REPORT

In Chapter I, the background of BOS contracts, the problem description, research benefits and limitations, and the research questions are presented. Chapter II reviews the relevant literature to establish a solid understanding of how BOS contracts originated and how they are currently used. This chapter will also provide further details on the inefficiencies, outsourcing and price efficiency decisions. Chapter III discusses a spend analysis of the twelve United States Air Force BOS contracts that are currently being used. This chapter establishes a better understanding of what services are being outsourced and how much the Air Force is spending on certain services. Chapter IV describes the methodology that is used in answering the research questions. Chapter V outlines the results of the analysis and describes the limitations of the research output. Chapter VI provides a summary and conclusion of the research study, as well as areas for further research.

G. SUMMARY

This chapter introduced the research, beginning with the background of BOS contracts and how they are currently utilized within the Air Force. Next, the problem description, research questions, benefits of research, limitations of the research, and organization of the report were discussed. The next chapter will present the literature related to BOS contracts, to include the historical implementation of BOS contracts, reasons for using BOS contracts, the economies of scope within BOS contracts, the inefficiencies in BOS contracts, and concluding with price efficiency and outsourcing decisions surrounding BOS contracts.

II. LITERATURE REVIEW

A. INTRODUCTION

This chapter presents a literature review of the use and implications of BOS contracts. The chapter will discuss the historical use of BOS contracts, to include their origination and how they are currently used. The chapter will also present the benefits and drawbacks that may occur for military installations that utilize a BOS contract, both in the short-term and long-term.

B. DESCRIPTION OF BOS SERVICES

A BOS contract is a form of a contract that packages a variety of commercially available services into one single contract (Warren, 1998). The services that are packaged together within a BOS contract vary from each installation, major command, and by the mission of the installation. Some of the services that are incorporated into a BOS contract include but are not limited to: real property management, minor construction projects, cost accounting, logistics and communications operations (Warren, 1998). Next, the historical implementation section will provide insight into why BOS contracts were first introduced and the progression and expansion of their role in Air Force operations.

C. HISTORICAL IMPLEMENTATION

BOS contracts were originated at installations by either of two routes; by the completion of an A-76 cost comparison study or at the establishment of a military installation. The Executive Office of the President, Office of Management and Budget, released the Circular No. A-76, Performance of Commercial Activities, that identified procedures to be used in conducting managed competitions between the public and private sectors for commercial activities (Tanner, 2014). This analysis led to a decision on whether it was more efficient or costly to outsource government functions. If military installations performed an A-76 study and found it to be more cost efficient to outsource various government functions, then the bases typically did so by the implementation of a BOS contract (Warren, 1998). For the military installations that were not established when the

A-76 circular was released in 1966, the installations had the opportunity to directly outsource certain categories of functions (Warren, 1998). The next section outlines why the Air Force implements BOS contracts and what benefits BOS contracts provide.

D. REASONS FOR USING BOS CONTRACTS

Although many military installations have utilized BOS contracts by transforming a myriad of services into a single contract, there is still a need for single service contracts in base operations (Warren, 1998). A multiple-service contract combines multiple types of services into one contract, each of which might otherwise be procured on its own single-source contract. Many of the installations that utilize a BOS contract depend on single service contracts that are outside the scope of the large multiple service contract. These single service contracts are typically for very specific services, such as medical staff, aircraft maintenance, and engine maintenance. The use of multiple service contracts plays a vital part in the ability for military installations to meet their overall requirements and mission. Therefore, many military installations utilize contractors, civilians, and military personnel to achieve the overall mission of the installation.

BOS contracts offer many benefits to military installations. Warren (1998) outlined three main benefits from using multiple service contracts instead of single service contracts: a single contractor accountable for performance, greater opportunities for efficiencies, and the opportunity to reduce cost and effort to develop and award one contract instead of multiple. The report also described the efficiency of having one contractor perform and manage multiple services that require integration for successful mission support. Rendon (1998) noted that the use of BOS contracts within the Air Force is an example of a strategic approach instead of a tactical approach. For example, it is easier for one contractor to manage the grounds maintenance around the airfield and spray for bugs after doing so. If each of these functions were in single service contracts, there is a greater possibility that one contractor may be waiting for another contractor to perform their services before they can start work. These delays can be inefficient for the military, as they decrease flexibility to accomplish the mission, e.g., if a military installation cannot

perform its mission, such as flying its aircraft because they are waiting on the contractors to perform their required services.

Although BOS contracts provide a myriad of benefits, an increased level of risk becomes present when utilizing BOS contracts. For example, if the company that was awarded a BOS contract becomes unable to provide the proper services outlined within the BOS contract, due to many reasons such as bankruptcy, lack of capacity, or is closed due to other unknown factors, then all operations and BOS services will come to a halt. This halt can cause large externalities to the mission of the installation, as the installation is not able to provide the support services needed. This risk is not present when support services are procured in single service contracts.

BOS contracts are typically structured with a firm fixed price contract with the possibility of an award fee attached to them (Warren, 1998). Most services incorporated into the contract are locked in at a fixed price, but there are often certain contract line items that are cost reimbursable (Warren, 1998). Some of these cost reimbursable items include but are not limited to; travel reimbursement, permit, and fees reimbursement. Warren (1998) stated that many of the contracting officials that administer the BOS contracts believe that award fees are critical for receiving good performance from the contractor (Warren, 1998). Rendon (1998) explained that superior contractor performance and cost efficiencies are encouraged through the incorporation of an award or incentive fee structure. Specifically, Rendon (2001) noted that an incentivized award structure can be targeted to the areas of contract quality, timeliness, and responsiveness. In relation to contract price, the next section expands upon the difference of economies of scale and scope as well as the impact they have on the overall price of BOS contracts.

An additional reason to utilize BOS contracts is to implement a strategic sourcing initiative. Monczka, Handfield, Giunipero, and Patterson (2011) explained that strategic sourcing is used by firms to decide whom to outsource a service as well as implementing a structure and type of relationship within sourcing. With the inclusion of a cross-functional team, market research, and supplier relationship management, a strategic sourcing strategy ultimately enables an organization to procure services in a more efficient and future-focused way.

E. ECONOMIES OF SCOPE

The government ultimately utilizes BOS contracts to secure economies of scope. Warren (1998) explained that economies of scope refer to the benefits that firms gain by producing a specific combination of outputs, whereas, economies of scale refer to lower costs gained through producing larger quantities of a single type of good. However, if not implemented properly, the government sustains diseconomies of scale that feature increased costs and inefficiencies. Brien and Hine (2015) stated, "Firms offering a set of services can offer economies of scale, meaning a reduction in average costs as the level of service delivery increases" (p. 151).

Ramanujam and Varadarajan (1989) explained the importance of diversification in corporations and how organizations must strategically analyze the outsourcing of services. When outsourcing services, an organization can reap economies of scope through effectively clustering services together that one contractor can complete. Guiltinan (1987) furthered this thought by describing the importance of choosing the right services to package together, instead of contracting a blanket package of unrelated services.

McLaughlin, Buffler, and Gazillo (2017) explained that differentiating between contract bundling and consolidation is vital for contract optimization. McLaughlin et al. (2017) defined bundling as "Grouping two or more requirements for supplies or services, previously provided or performed by a small business under separate small contracts, into a solicitation for a single contract that is likely to be unsuitable for award to a small business concern" (p. 6). In contrast, consolidation is defined as "Soliciting a single contract to satisfy two or more requirements for supplies or services valued in excess of $2M that have been provided to or performed for the Federal Agency under two or more separate contracts lower in cost than the contract for which offers were solicited" (p. 5). It is critical for contracting officers to analyze the procurement of large-service contracts to ensure that an efficient level of services is included.

Kidalov (2012) described how contracting personnel must ensure that they are not "over-bundling" services in large-scope service contracts. Kidalov (2012) provided examples of successful and unsuccessful government contracts that highlighted how over bundling increases the risks of lower competition, small business participation, and

diseconomies of scale. Chu, Leslie, and Sorensen (2011) promoted the idea of optimum bundling by analyzing the effects of over-bundling and under-bundling on price efficiency. As Kidalov (2012) analyzed, the researchers concluded that under-bundling within service contracts causes an organization to incur increased costs while possibly receiving a lower performance output.

Additionally, Gates and Robbert (2000) examined the effect of competitive sourcing on labor costs. Their comparison of multiple BOS contracts concluded that the larger the competition, the larger the amount of cost savings that the government will incur. However, organizations often incur diseconomies of scale when attempting to lower costs through the packaging of services. Brien and Hine (2015) analyzed how a local municipal city outsources a clear majority of their services to one contractor. Their research concluded that diseconomies of scale were incurred by the city from utilizing only one contractor for needed services. This practice can prove costly and inefficient, so proper outsourcing and service packaging processes should be put in place to ensure maximum efficiency and cost savings. In addition to diseconomies of scale, BOS contracts have other notable inefficiencies that will be discussed in the next section.

F. INEFFICIENCIES IN BOS CONTRACTS

Although BOS contracts are implemented because of the simplicity of having one contractor perform a majority of the installation's operations support services, the contracts do not eliminate inefficiencies. Pagell (2004) highlighted the factors that maximize internal and external integration within the procurement department that leads to the success or failure of price efficiency within contracts. The research highlighted the importance of having senior-leader buy-in as well as the integration of all organizational departments which is often overlooked in government acquisition. Rendon (1998) emphasized the importance of partnering relationships within BOS contracts that rely on collaboration and communication to complete mission-critical functions. Rendon (1998) stated that contractors should be "viewed as extensions of the Air Force's internal mission capability" with their relationships being one "based on teamwork, cooperation, and good-faith performance" (p. 20). The Air Force attempts to integrate all involved stakeholders but

does not always do so in the most efficient manner. Lack of communication and integration immediately creates inefficiencies for the contract.

Most BOS contracts are typically high in dollar value, importance, and the breadth of services that are incorporated within them. Due to their overzealous size, BOS contracts may inadvertently cause a lack of buyer power, as the power is shifted from the buyer to the seller. Cox (2001) described the importance of obtaining buyer power in an acquisition. His research discussed how a continuous power perspective can enhance efficient procurement and supply management through understanding the bases of power and business strategy. A power matrix is essential in government procurement for buyers to understand where they stand in the marketplace and what scope exists for them to capitalize on their power relative to suppliers. Oftentimes, government acquisition does not consider buying power and in turn, suffer wasteful price inefficiencies. Additionally, Handfield (2010) asserted that the establishment of supply market intelligence, coupled with an understanding of buyer power, within the procurement process is vital to secure efficiencies. According to Handfield, understanding the market, including available services, market price, and competition allows informed contract decisions to be made as well as determining an organization's buying power stance.

Hand and O'Connor (1984) asserted that large-dollar service contracts can be highly lucrative for defense contractors, but industry competition can often cause the profit margins for the prime contractor to dwindle. Warren (1998) explained that competition is important to the government, by not only helping reduce costs with the larger number of potential offers but also by helping reduce inefficiencies within service contracts. Increased competition can stimulate innovation and allow for future suppliers to break through with new ways of completing the required services and possibly cutting out any redundancies. An example of this includes when a supplier can utilize personnel for multiple jobs and services. This reduces the amount of labor and can increase the productivity within those services. Although the idea of doing more with a smaller number of personnel may seem like an easy task to accomplish, not all services can take advantage of this. Certain services may require certain certifications or training, causing personnel to become specialized

within one certain type of service such as electricians, HVAC, and plumbers (Warren, 1998).

Although BOS contracts may inadvertently incorporate inefficiencies, Warren (1998) noted that even in the presence of price inefficiencies, there are also unmeasurable efficiencies. Warren (1998) stated, "some of the efficiency gains that have been cited included reduced overhead, cross-utilization of contract personnel, and increased flexibility" (p. 4). Although these efficiencies make BOS contracts appear more attractive for installations to incorporate, there may also be a price inefficiency aspect that is attached to a BOS contract. Warren (1998) stated, "although contracting official reported efficiency gains, cost savings from using single contracts for multiple base operations support functions are not documented" (p. 16). To prevent inefficiencies in BOS contracts, contracting specialists must utilize price efficiency analysis to make contracting decisions.

G. PRICE EFFICIENCY DECISIONS

When faced with a shrinking budget and a larger dependency on maintaining readiness, organizations have turned to several cost management tools and resources. Ellram (1996) noted that there is a major difference between the price and cost of an acquisition. Ellram (1996) examined the different tools that procuring organizations should utilize and proposed different approaches that businesses could utilize to control and manage their costs. The different cost management approaches are built around the nature of the buy, as well as the type of supplier relationship that exists between the buyer and seller. These two different dimensions allow for business leaders to view their purchases in a new manner, especially in regard to controlling their costs. Ellram (1996) described the similarities and differences among the four different cost management approaches: cost analysis focus, continuous improvement focus, price analysis focus, and life cycle cost focus. With the four different cost management approaches that Ellram (1996) proposed and believes that by implementing the correct approach, businesses will be able to fully control their costs and have an immediate impact on the effectiveness of the organization, such as boosting profits or increasing their effectiveness.

BOS contracts require a unique supplier relationship, as the supplier will need to meet an evolving military environment and a myriad of uncertainties. Many military installations have a higher operational tempo, requiring the contractor to rapidly respond to unique mission requirements within the services that they cover. Therefore, the military installation and the supplier must work hand in hand to form what Kraljic (1983) described as a strategic partnership. Rendon (2001) furthered the importance of a strategic partnership by stating, "with the contractor now performing long-term, mission-critical functions and the government more dependent on contractors for mission accomplishment, both parties are now motivated to work in a more collaborative mode" (p. 19). Kraljic (1983) described a strategic partnership as an acquisition approach for a product or service that has a high-profit impact as well as a high supply risk. This classification requires developing a long-term supplier relationship to maximize efficiency for both the supplier and procuring agency. On Kraljic's view, although the procurement process includes a variety of potential suppliers, once a contract has been awarded to the winning offeror, the organization is now in a long-term partnership with that supplier. Changing suppliers is possible but is a very costly and timely process which can be avoided if a strong strategic partnership is formed at the beginning. Installations must consider their purchasing power, risk mitigation, and performance impact when they are aligning their objectives with their future BOS contracts. Outsourcing services within a BOS contract requires a strong supplier relationship. Details of outsourcing decisions will be outlined in the next section.

H. OUTSOURCING DECISIONS

A major facet of BOS contracts includes the utilization of outsourcing services, which does not always attribute to immediate cost savings or performance efficiencies. Instead, outsourcing emphasizes the importance of ensuring that the decision being made makes economic sense. Prager (1994) described that instead of outsourcing services to cut costs or increase performance, business leaders need to ensure that by outsourcing, the organization or government is making a critical assessment of the market, the requirement at hand and if economies of scale can even be achieved. BOS contracts are often established to outsource non-core or highly skilled services and in hopes of receiving performance

efficiencies and to cut costs by having one contractor perform the various services instead of either the government or having multiple contractors' complete multiple services.

To capitalize on the economies of scale that BOS contracts may provide, procuring organizations must fully understand what resources are needed to accomplish their mission. Wernfelt (1984) stated that, "The use of a single resource in several businesses is the diversification pattern most often considered in business policy" (p. 176). Many military installations may view the resource(s) most critical to their mission as their most important resources. For example, a military installation that is focused on pilot training may view their airfield and its operations as its most important resource. Wernerfelt (1984) stated, "The optimal growth of the firm involves a balance between exploitation of existing resources and development of new ones" (p. 178). Military installations and the procurement organizations for those installations need to ensure that they are maximizing their resources and products to their fullest.

One method for an organization to truly understand what resources are required to accomplish their mission is to produce a resource-product matrix. Wernerfelt (1984) described this new approach by having organizations review how they operate in terms of their resources instead of their products. When doing so, organizations can view their resources in a more strategic manner. Wernerfelt (1984) described a resource as "assets which are tied semi-permanently to the firm" (p. 172). For many organizations, their resource may be reproducing, such as customer loyalty or production experience. Although this research expands on finding the commonalities and cost drivers within Air Force BOS contracts, it is important to understand where the Air Force is spending their money within BOS contracts. A clear understanding of the spend on certain support services can be achieved through a spend analysis.

This research will conduct a spend analysis of twelve Air Force BOS contracts, in order to understand where the Air Force is spending their money on the support services within BOS contracts. Pandit and Marmanis (2008) examined the importance of performing a spend analysis of a single organization or group of organizations. Their book, *Spend Analysis: The Window into Strategic Sourcing*, outlined the process in which organizations should utilize a spend analysis to understand what they are spending within

categories of a procurement. The following Spend Analysis section outlines the spend analysis conducted for the BOS contracts being implemented within the United States Air Force which highlights price inefficiencies.

I. SUMMARY

This chapter outlined the literature related to BOS contracts, to include the historical implementation of BOS contracts, reasons for utilizing BOS contracts, the economies of scale and scoped obtained using BOS contracts, the inefficiencies in BOS contracts, and outsourcing decisions surrounding the use of BOS contracts. The next chapter will introduce the concept of a spend analysis and will outline the use of a spend analysis for the twelve Air Force BOS contracts. The chapter will begin by introducing the background of the spend analysis. The chapter will cover the methodology of the conducted spend analysis and will analyze the spend analysis results.

III. SPEND ANALYSIS

A. INTRODUCTION

The purpose of this chapter is to conduct a spend analysis of the active CONUS BOS contracts. A spend analysis is conducted to fully understand where the Air Force is spending money on BOS contracts. Pandit and Marmanis describe a spend analysis as "the starting point of strategic sourcing and creates the foundation for spend visibility, compliance, and control" (Pandit & Marmanis, 2008, p. 5). Therefore, the following research details each of the contract line items in a sample of twelve active BOS contracts. The line items were broken down into two phases, starting with a broad category and then classified into a specific type of service.

B. METHODOLOGY

Twelve Air Force BOS contracts were included in the spend analysis, as only twelve contract administrators responded to the data calls. The spend analysis was conducted by Captain Patrick Enslen, Captain Peter Van Remmen, and Captain Kyle Gagnon within the NPS MN3306 course, Strategic Sourcing. If conducted by another contracting officer, similar results would be found but different categories for the individual services may be selected.

The spend analysis was conducted by transferring all the contract data from each of the twelve BOS contracts into a pivot table. Each of the contract line item information, to include the quantity, unit price, and CLIN type was transferred. Each line item was categorized into one of four main categories: real property, operations, energy, and minor construction projects. The line item categorization was based on its nature and the work that was outlined in the contract's respective performance work statement. Each of the four main categories was then broken down one step further into the type of service, which consisted of twelve different types of services categories. The twelve different types of services were grouped into four categories, outlined in Table 1.

Table 1. Type of Service Categorization

Operations	**Real Property**	**Energy**	**Projects**
Base Operations Support	Facilities Management	Environmental Services	Minor Construction Projects
Civil Engineering Operations	Housing		
Communication Services			
Airfield Management			
Transportation			
Supply			
Weather			
Military/Civilian Personnel Support Function			

Key cost drivers within each contract are identified by categorizing the individual contract line items of the twelve BOS contracts. The data from the spend analysis allows for further research to be conducted to not only understand the cost drivers but to be able to make critical decisions on the services that have higher total expenditures.

A pivot table was used for this spend analysis which allowed a greater amount of analysis to be performed by having the ability to view the inserted data in different ways. Doing so allows us the ability to "slice and dice" the data creating a more detailed analysis of the data.

C. TOTAL SPEND BY MAJCOM

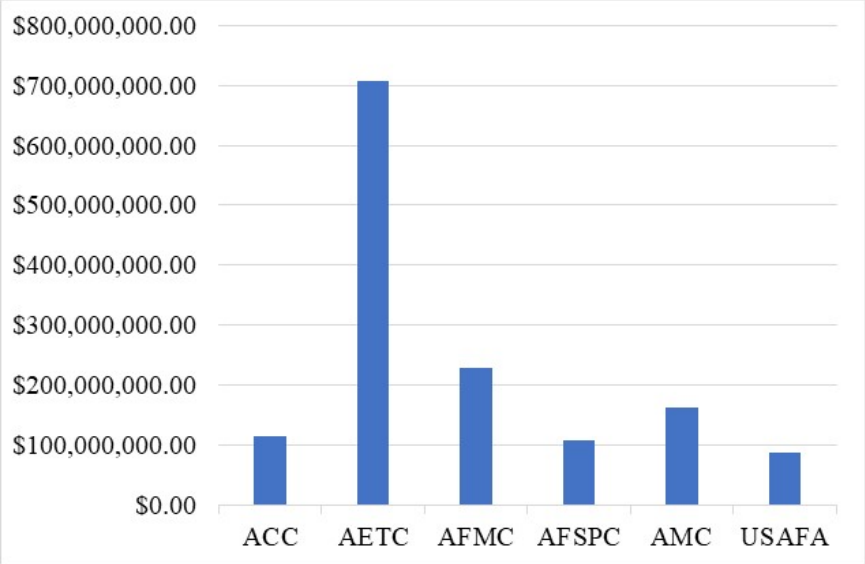
Starting from a ten-thousand-foot view, the spend analysis began with how much each of the major commands (MAJCOM) were spending on BOS contracts. The pivot table was filtered to sum the contract totals and separated by the individual MAJCOMs. The Air Education and Training Command (AETC) clearly has the largest total value with $707,403,976.53 from all its current BOS contracts. AETC is also the only MAJCOM that has a centralized organization for procuring all their BOS contracts. Once the contracts are

awarded, the installation administers the BOS contract. The remaining MAJCOMs procure and administer the BOS contracts at the installation level. Table 2 outlines the spending per MAJCOM, and Figure 1 provides a visual representation of the spending levels.

Table 2. Dollar Amount of BOS Contract Spending by each MAJCOM

MAJCOM	Total Spend
ACC	$ 113,769,236.33
AETC	$ 707,403,976.53
AFMC	$ 229,080,681.00
AFSPC	$ 108,056,259.94
AMC	$ 162,851,926.42
USAFA	$ 86,576,593.00
Grand Total	**$ 1,407,738,673.22**

Figure 1. Total Spend by MAJCOM

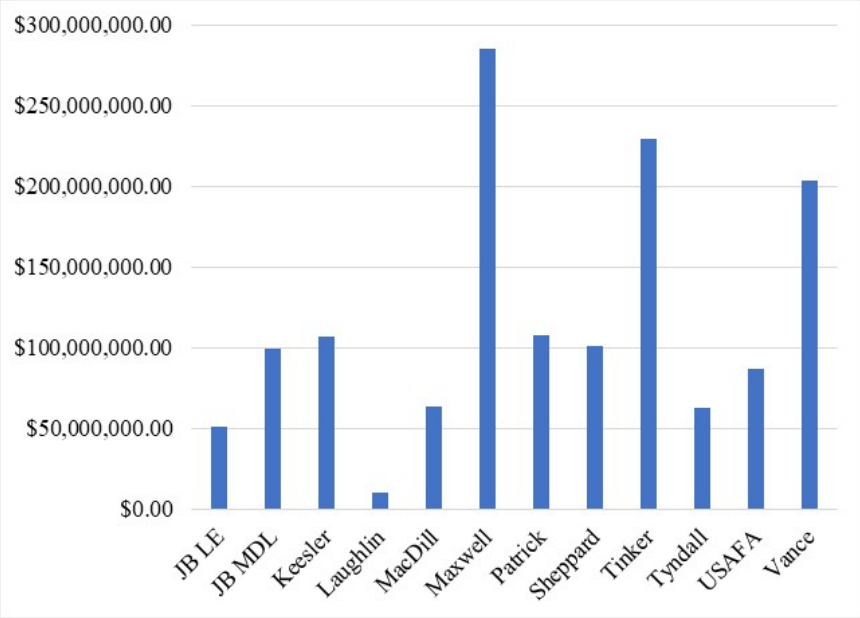


D. TOTAL SPEND BY EACH MILITARY INSTALLATION

After analyzing the total amount of expenditures on BOS contracts by MAJCOM, the next step drilled down to analyze how much is being spent at the installation level. Each of the BOS contracts that were analyzed in this research consisted of the current active

BOS contract that was in place. Each of the BOS contracts varied in length, especially Laughlin Air Force Base, which is currently operating on a bridge contract. Laughlin's bridge contract is currently two years in length; therefore, they appear to have a smaller BOS contract, but it may be larger than it appears. Refer to Figure 2 for an illustration on the total spend by each military installation.

Figure 2. Total Spend by Military Installation



E. YEARLY COST OF EACH MILITARY INSTALLATION

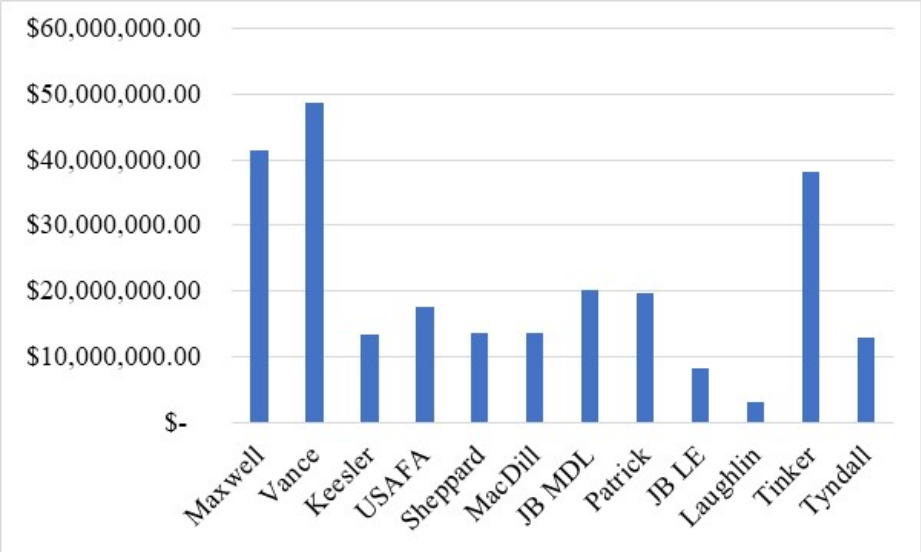
Due to the variance among the duration of each BOS contract, the average yearly cost of each BOS contract was analyzed. This was done by summing the total number of months of each individual contract then dividing the total cost of the contract by the contract duration. This monthly cost was then multiplied by twelve to get an average yearly cost of the BOS contract. This eliminated any discrepancies among the number of years that the contract lasted for, to get a better understanding of the actual cost at each individual base. Maxwell Air Force Base, which appeared to be the costliest contract when viewed as the total cost of the contract, does not have the highest average yearly cost. Instead, Vance Air Force Base has the largest average annual cost of all active BOS contracts. Refer to

Table 3 for a detailed list of yearly contract costs and Figure 3 for a chart summarizing the yearly cost by military installation.

Table 3. Yearly Cost by Military Installation

Base	FPDS $ Amount	Contract Duration (months)	Monthly Cost	Yearly Cost
Maxwell	$ 285,553,358.00	82.5	$ 3,461,252.82	$ 41,535,033.89
Vance	$ 203,287,102.00	50	$ 4,065,742.04	$ 48,788,904.48
Keesler	$ 107,174,360.00	96	$ 1,116,399.58	$ 13,396,795.00
USAFA	$ 86,576,593.00	59	$ 1,467,399.88	$ 17,608,798.58
Sheppard	$ 84,337,698.33	74	$ 1,139,698.63	$ 13,676,383.51
MacDill	$ 107,304,749.77	95	$ 1,129,523.68	$ 13,554,284.18
JB MDL	$ 99,039,579.21	59	$ 1,678,636.94	$ 20,143,643.23
Patrick	$ 108,383,456.38	66	$ 1,642,173.58	$ 19,706,082.98
JB LE	$ 40,852,767.46	59	$ 692,419.79	$ 8,309,037.45
Laughlin	$ 2,240,661.92	9	$ 248,962.44	$ 2,987,549.23
Tinker	$ 229,310,488.00	72	$ 3,184,867.89	$ 38,218,414.67
Tyndall	$ 62,716,911.07	58.5	$ 1,072,083.95	$ 12,865,007.40

Figure 3. Yearly Cost by Military Installation



F. SMALL BUSINESS PARTICIPATION

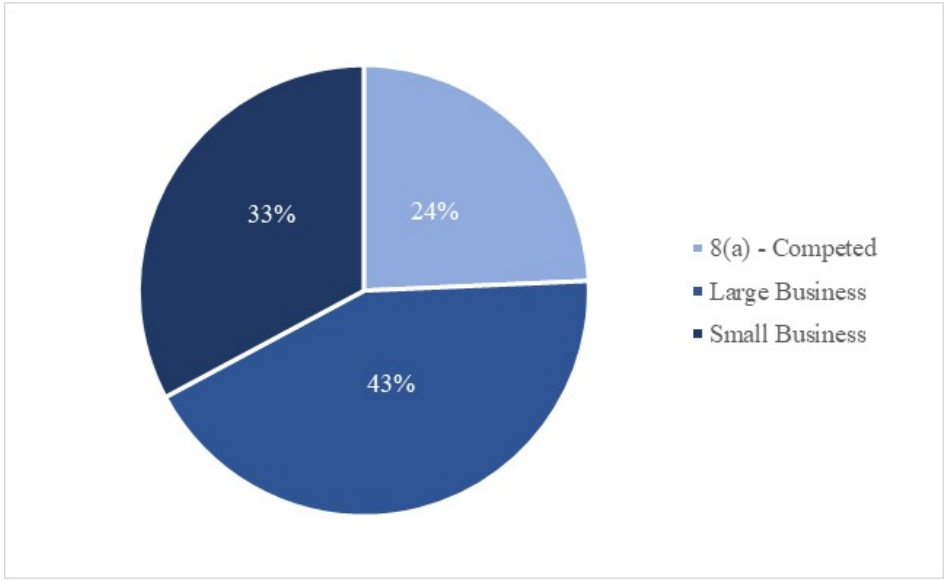
Small business participation is a vital piece of every acquisition, especially regarding BOS contracts. With the current BOS contracts that are in place, fifty-seven percent of the value is directed toward a small-business as the prime contractor. Twenty-four percent of the entire value was set-aside as an 8 (a) competed requirement, with the remaining thirty-three percent being set-aside as a one-hundred percent small business set-aside. Although small-businesses play an important role as the prime contractor for BOS contracts, the proportionality of which MAJCOMs conduct small-business set-asides is not uniform. AETC, which contains the largest value of all MAJCOMS with BOS contracts, does not set aside a large percentage of their contracts to small businesses. The Air Mobility Command (AMC) is the only other MAJCOM outside of AETC that has a prime contractor who is not a small business. Therefore, if AETC were to implement a change to utilize more small-businesses as their prime contractors, then the total dollar amount for small businesses would increase dramatically.

Although the values in Table 4 show the dollar values for small business participation for contracts that have a small-business as the prime contractor, the values do not take into factor the number of small businesses involved as subcontractors. Many BOS contracts, especially within AETC, have small-business participation subcontracting goals. These goals are all handled internally with the administration of the BOS contract. The local program manager and administrative contracting officer ensure that the prime contractor is meeting these goals through performance measurement metrics. Although the small-business subcontracting goals exist for many BOS contracts that have a large business as their prime contractor, the necessary date was not able to be received to analyze the scope and dollar value of the subcontracting goals from each base. Figure 4 provides a visual chart regarding the percentage of total small business participation within BOS contracts.

Table 4. Small Business Participation

Small Business Category	ACC	AETC	AFMC	AFSPC	AMC	USAFA	Grand Total
8(a) - Competed	$113,769,236.33		$228,248,701.00				$342,017,937.33
Large Business		$504,116,874.53			$99,039,579.21		$603,156,453.74
Small Business		$203,287,102.00	$831,980.00	$108,056,259.94	$63,812,347.21	$86,576,593.00	$462,564,282.15
Grand Total	**$113,769,236.33**	**$707,403,976.53**	**$229,080,681.00**	**$108,056,259.94**	**$162,851,926.42**	**$86,576,593.00**	**$1,407,738,673.22**

Figure 4. BOS Contract Small Business Participation



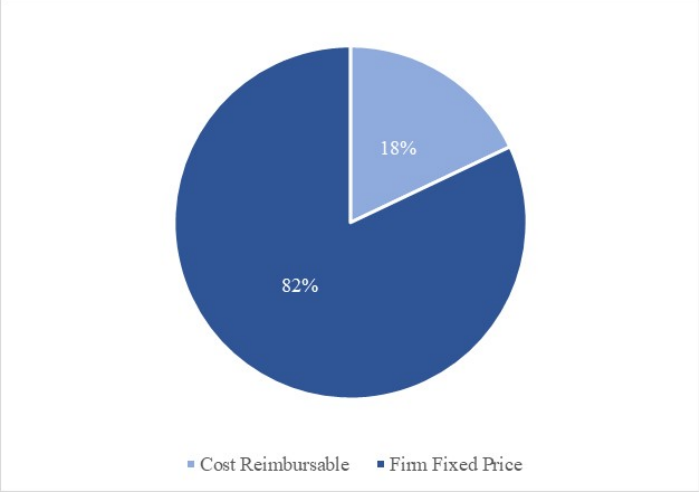
G. TOTAL SPEND BY CONTRACT LINE ITEM TYPE

Although every BOS contract is structured as a firm-fixed-price contract, there are still many contract line items that are cost reimbursable. These cost type line items vary on the nature of them, as well as the not to exceed (NTE) value. Approximately eighty-two percent of the contract line items among all the BOS contract line items are firm-fixed-price, while the remaining are cost reimbursable. By having most of the contract line items being firm fixed price, the government can have the assurance of not having any fluctuations or cost adjustments from the contractor. This shifts the risk and full responsibility to the contractor, as they now must ensure that they can control the costs while ensuring they are meeting the expectations outlined in the contract. Table 5 provides a breakdown of the total spend by CLIN type and Figure 5 provides a chart outlining the use of cost reimbursable and firm fixed price line items.

Table 5. Total Spend by CLIN Type

CLIN Type	Total Spend
Cost Reimbursable	$ 252,616,210.81
Firm Fixed Price	$ 1,155,122,462.41
Grand Total	**$ 1,407,738,673.22**

Figure 5. Total Spend by CLIN Type



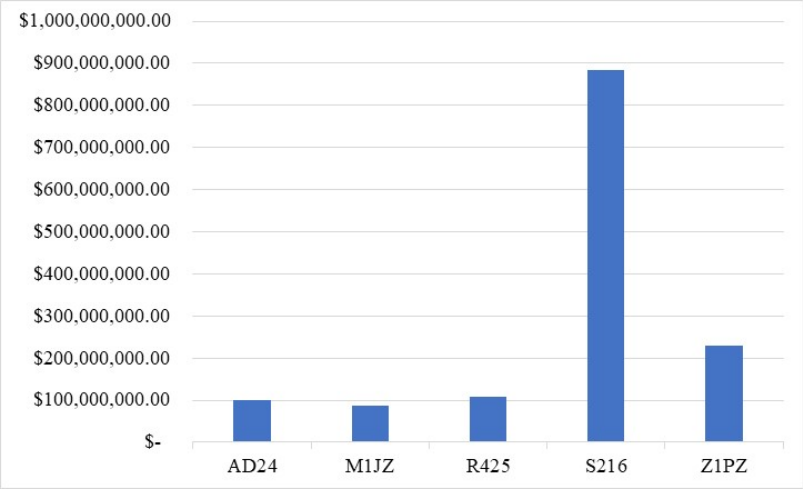
H. TOTAL SPEND BY PRODUCT SERVICE CODE (PSC)

Within the pivot table, each of the BOS contracts were able to be filtered by their PSC code, to show the total dollar value of each of the PSC codes used. Analyzing how each BOS contract is labeled by their PSC allows for a further analysis on the commonalities among all BOS contracts. The PSC S216, housekeeping-facilities operations support, was the most common PSC with a total value of almost $900,000,000. Although the PSC S216 is the most commonly used PSC, the remaining PSC codes used are relatively similar in dollar value. Table 6 provides a table covering the Product Service Code descriptions and Figure 6 consists of a chart outlining the total spend by PSC.

Table 6. Total Spend by PSC

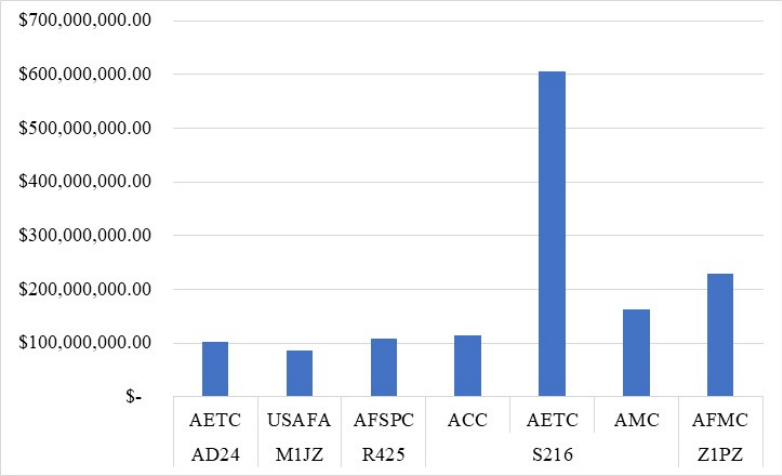
PSC	Description
AD24	Services (engineering)
M1JZ	Operation of misc. buildings
R425	Support professional engineering/technical
S216	Housekeeping-facilities operations support
Z1PZ	Maintenance of other non-building facilities

Figure 6. Total Spend by PSC



After filtering each of the PSC codes by MAJCOMs, it becomes apparent that multiple MAJCOMs utilize the S216 PSC. By adding this additional filter, the true breakdown of which MAJCOMs utilize the PCS codes can be identified. As earlier discussed, AETC contains the largest value within all BOS contracts and they procure their BOS services centrally. By having their services centrally procured allows for less variability of the PSC that is used. AETC does not utilize one PSC for all their BOS contracts, but they have a better control on labeling the PSC to each of the BOS contracts. Figure 7 displays a chart with the total MAJCOM spend by PSC.

Figure 7. MAJCOM Spend by PSC



I. TOTAL SPEND BY CATEGORY

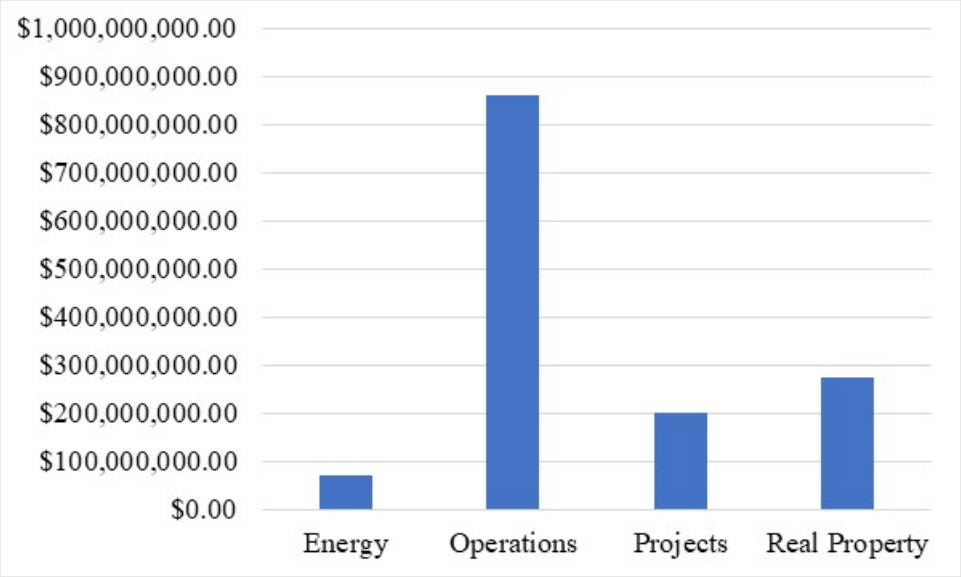
After reviewing the scope, complexity, and nature of each contract line items within the twelve BOS contracts, all line items were categorized into one of the four main spend categories. The four main spend categories included: energy, non-energy related real property, base operations, and minor construction projects.

These four spend categories are very broad and include a vast array of services. Analyzing these individual categories allows for a very detailed view of where money is spent within BOS contracts. The four categories originally stemmed from analyzing the

statements of work (SOW) for each of the BOS contracts. Most of the SOW's have a trend of categorizing the different services in the format of the SOW.

After all contract line items were properly categorized, it was very apparent that the operations spend category was the main cost driver for the BOS contracts in this spend analysis. Figure 8 refers to the total amount of spending per contract service category.

Figure 8. Total Spend by Service Category

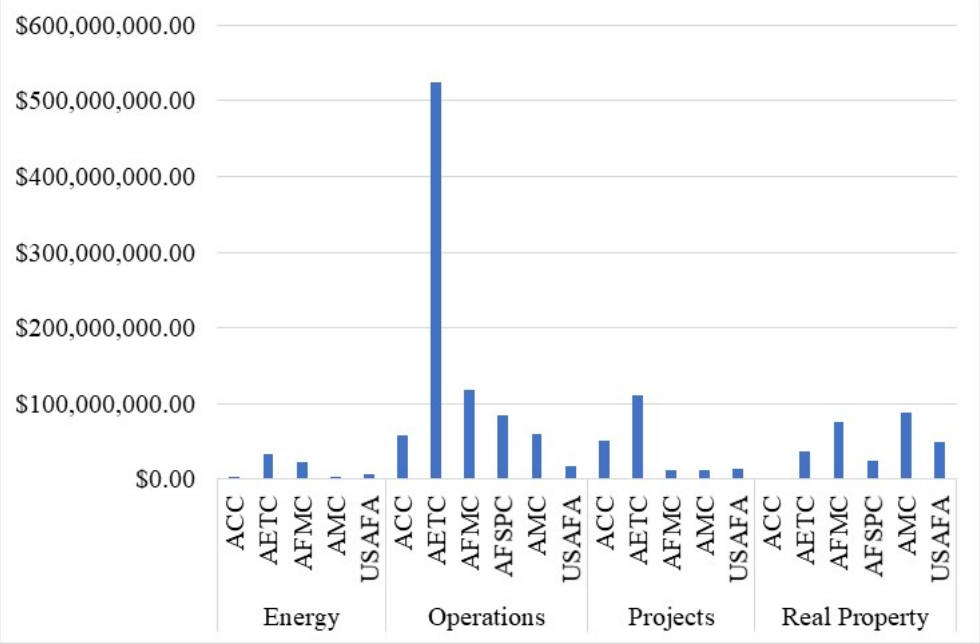


J. MAJCOM SPEND BY CATEGORY

After categorizing each of the contract line items into the four broad spend categories, it is vital to drill down one step further to analyze how much each of the MAJCOM's are spending on each of these categories. It is apparent that the operations within AETC is the largest cost driver within this spend analysis. The AETC operations spend category is approximately 37.31 percent of the total spend with a total of $525,185,234.18. This shows that the installations within the AETC MAJCOM are outsourcing a large majority of their support services. This could be the result of these military installations having a focus and mission on training and educating instead of focusing on being deployable. Due to the dependence on not deploying, these military installations may view the installation support services as a great opportunity to be

outsourced, instead of being done in-house. Figure 9 shows a breakdown of total MAJCOM spending by spend category.

Figure 9. Total MAJCOM Spend by Category



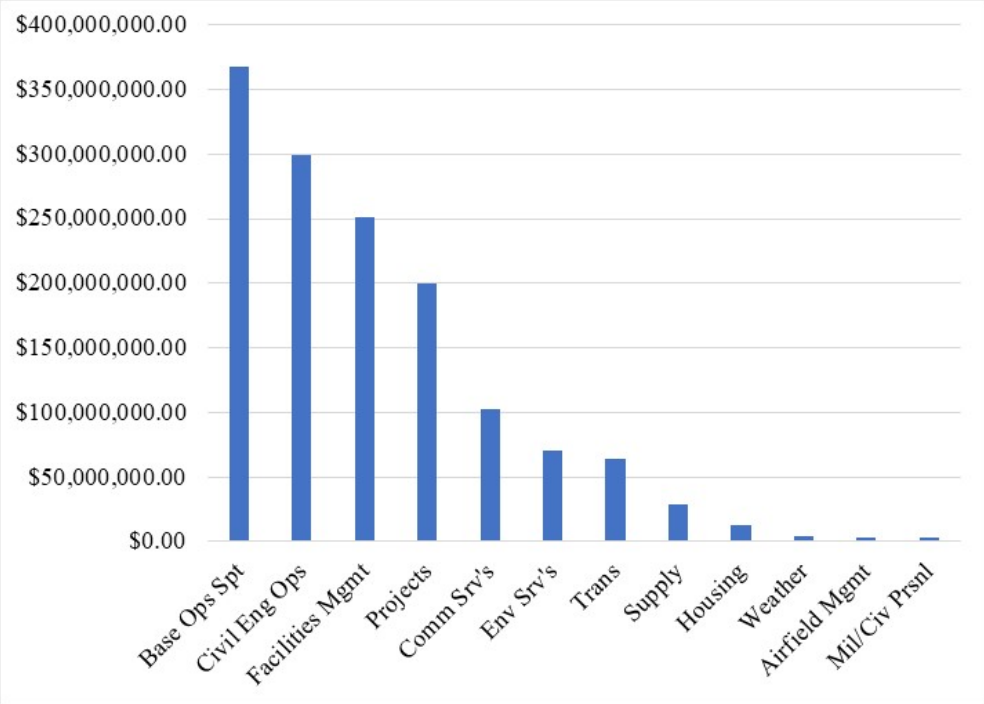
K. SPEND BY TYPE OF SERVICE

After thoroughly labeling every contract line item within all BOS contracts, these contract line items were then further labeled into the type of service. Each of the contract line items fell into one of the twelve "types of service" categories. The twelve types of services include: base operations support, civil engineering operations, facilities management, projects, communication services, engineering services, transportation, supply services, housing operations, weather services, airfield management, and civilian and military personnel oversight services. These twelve types of services originated after reviewing all the contract line items and determining if there were any commonalities among the different services incorporated within each of the BOS contracts.

Base operations support was the main cost driver, as it contained approximately 26.12 percent of the total spend of all twelve types of services. Civil engineering operations was the second largest type of service with approximately 21.26 percent of total spend.

With almost half of the total spend being spent on these two types of services, it is easy to understand what is driving the cost within the types of services that are procured in a BOS contract. Although these two types of services are the main cost drivers, they are also the broadest types of services. For example, base operations include a myriad of services such as road clearance, grounds maintenance, and pest control. Figure 10 broke down the total spend by type of service.

Figure 10. Total Spend by Type of Service



L. MAJCOM SPEND BY TYPE OF SERVICE

Previously, all the contract line items were categorized into four broad spend categories. To fully understand what services each of the twelve BOS contracts consist of, we must drill down one step further. In doing so, each of the contract line items were further analyzed to determine the type of service. Each of the four broad spend categories now contains subcategories, for a total of twelve total subcategories across all four of the spend categories. These subcategories are types of services that better outline the nature and scope of the contract line item and service being procured. The operations spend category has

eight subcategories that include: base operations support services, civil engineering operations, communication services, transportation services, supply services, weather operations, airfield management, and military and civilian personnel support services. The real property spend category includes three types of services: real property management, base housing support services, and facilities management. The energy spend category consisted of only the environmental services. The minor construction projects spend category was not broken down into any further subcategories, as this category is already very well defined with a narrow scope.

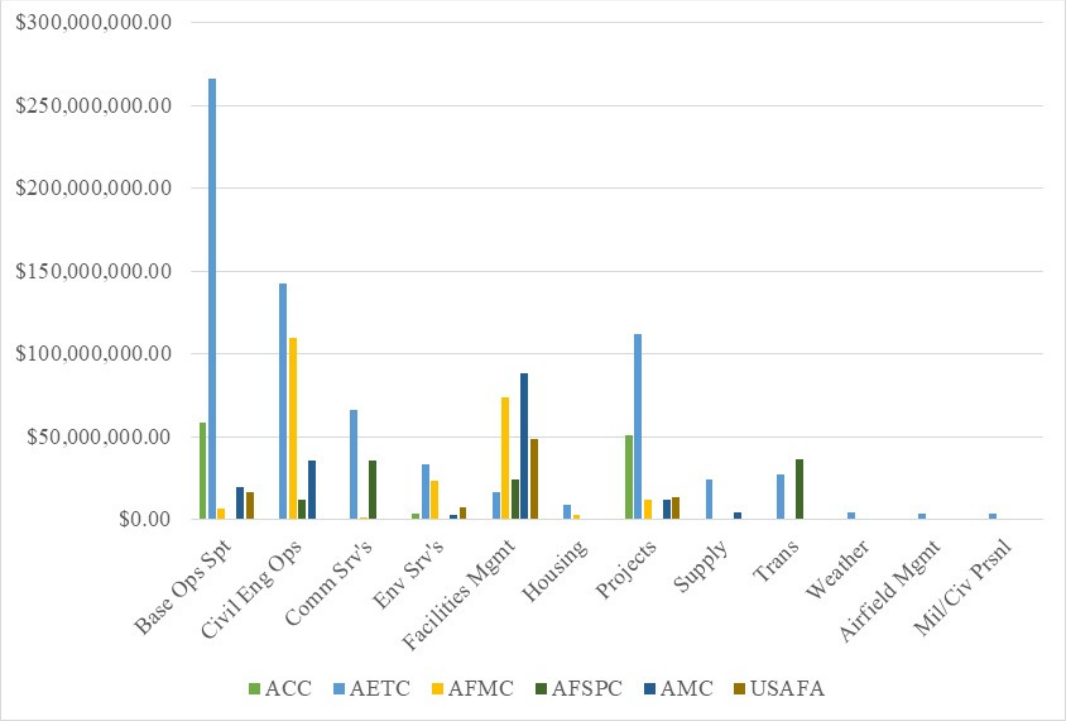
After reviewing the results of drilling down one step further, the base operations support services and civil engineering operations categories consist of nearly half of the total spend. Although these two types of services may be broader then other categories, it is still expected that support services are the cost driver for a contract that is used for outsourcing support services. With this analysis, military installations that are procuring BOS services need to ensure that they are clearly defining their requirements regarding the support services. If not clearly written, these support services may lead to larger cost overruns or administrative burden on the military installation.

Although the base operations support services and civil engineering operations are the two largest types of service regarding the total dollar amount spent, it should not be overlooked on the types of services that have a smaller amount of total spend. The military and civilian personnel services, airfield management, weather operations, and base housing support services each consist of less than one percent of the total spend in this analysis. These types of services are not very common among military installations and each of these types of services may be unique to one military installation.

Going one step further with analyzing the spend on the different types of services, it is important to understand how much each of the MAJCOM's are spending on the twelve different types of services. Each MAJCOM has a unique perspective and mission, therefore will most likely require different services to be outsourced within their military installations. By analyzing the dollar amount and number of services that each MAJCOM is outsourcing, similarities are identified and outliers within the types of services are identified.

As expected with the previous analysis, AETC is the largest spender in all but two of the types of services. AETC is not only the largest spender in total, but most of their spending within the BOS contracts in this spend analysis are toward the base operations support services. As stated earlier, this is a broad category, but due to the ease of efficiency in this spend analysis, it is expected. This signifies that AETC is outsourcing a large majority of their support services, to include the base operations and the civil engineering services. AETC has a lower deployment tempo due to the nature of their mission, which is to train and educate airmen. Since these airmen are currently enduring some aspect of training, they are typically not deployable and will have a high turnover with new students continually being brought in for various classes. With the instability of a high turnover on base, it is easy to assume that AETC wants the stability of outsourcing their support services to fully manage their mission. Figure 11 illustrates the total MAJCOM spending levels by type of service.

Figure 11. Total MAJCOM Spend by Type of Service



M. LIMITATIONS OF SPEND ANALYSIS

The main limitation to this spend analysis is that it was entirely subjective in regard to categorizing each of the contract line items. Each contract line item categorization was done to the best of our ability, but each contract line item may be interpreted and categorized differently. Not only can each of the contract line items be categorized differently, but the reviewer may use different categories that they deem appropriate.

Another limitation to this spend analysis is the fact that only twelve BOS contracts were analyzed. Sixteen total bases were contacted, but only these twelve bases responded and provided the appropriate contract information. The four bases that did not respond were contacted a number of times but failed to respond to any of the correspondence. It should be noted that this spend analysis would have been conducted the same as it was if the remaining four bases would have responded, but there would have been a larger number of contract line items analyzed. If all CONUS BOS contract information was available, the spend analysis would have had a more accurate and strategic outlook. The results that were derived from this spend analysis may have changed if the other four Air Force bases were able to provide their BOS contract information.

N. SUMMARY

This chapter introduced the concept of conducting a spend analysis, as well as conducting as spend analysis on the BOS services in twelve Air Force BOS contracts. The chapter begins with introducing the background of the spend analysis of the BOS services. Next, it covers the methodology of how the spend analysis was conducted. The results of the spend analysis are then analyzed to include the myriad of ways that the data was "sliced-and-diced." The next chapter will cover the methodology to answering the research questions.

IV. METHODOLOGY

The purpose of this chapter is to explain the methodology of the data collection and how it will be analyzed to answer to research questions. The contract data was collected from two main sources, the Electronic Database Access (EDA) and the Federal Procurement Database System – Next Generation (FPDS-NG). This data assesses the similarities and differences among the services that are packaged together within the BOS contracts and the duration trends of the BOS contracts.

A. SAMPLE

The unit of analysis for this research consisted of the overall price of BOS contracts, the variety of cost drivers of BOS contracts, and the various support services that are incorporated within a BOS contract. A sample of twelve BOS contracts were examined based on the units of analysis to provide results regarding the overall BOS contract price.

Sixteen Air Force bases were identified by the Air Force Installation Contracting Agency (AFICA) as having an active BOS contract. The most senior members of each of the local Contracting Squadrons, such as the construction flight chief and director of business operations (DBO) were contacted in a data call. These members were contacted in an attempt to obtain the proper contract identification information, such as the contract number and the respective performance work statement (PWS). Twelve of the sixteen military installations responded and provided the necessary contract information. Once this information was collected from the responsive installations, the details of the contracts were able to be collected from the Electronic Database Access (EDA) and the Federal Procurement Database System – Next Generation (FPDS-NG). The three bases that did not respond to the multiple inquiries were Los Angeles Air Force Base, Kirtland Air Force Base, and Peterson Air Force Base.

The EDA system allowed for all the contracts and the details of them to be collected, such as the information for each of the contract line items with the respective price, quantity, and description. The FPDS-NG system pulled all of the post-award

information, such as the number of offerors, whether the contract was a small-business set-aside, the North American Industry Classification System, and the product service code (PSC) used for the contract. The information that was available within both systems was entered into a Microsoft Excel spreadsheet. By doing so, this allowed for all information and data to be stored in one single location.

Data was collected from other sources to assist in answering the research question. Some of this additional data included the locality wage rates from the Department of Labor, population data from the 2010 consensus report, and data from the fiscal year 2015 Base Structure Report.

The Department of Labor provided the locality wage rates of each of the metropolitan areas surrounding the twelve military installations. Although there is a myriad of wage categories to choose from, the wage category "00-000 – All Occupations" was chosen for each of the twelve metropolitan areas. Due to the complexity and diversity of the occupations within each of the twelve BOS contracts, this wage category was chosen as it would be very difficult to compare each of the wage categories among each of the contracts. This established a standardized and neutral approach for a baseline of the wage rates for all BOS contracts. Not every BOS contract will have each of the specialized wage categories, nor have many of the exact same categories. The "All Occupations" wage category was chosen as it allowed for the simplest comparison among the areas.

Data was collected from the 2010 census report that was conducted from the U.S. Census Bureau. The total population of the metropolitan areas surrounding the twelve military installations was extracted from the 2010 census report. This data allows for a thorough understanding of the total amount of available labor in the surrounding metropolitan area. By using this data, we will be able to have a better understanding of whether the size of the population affects the number of suppliers, which would directly affect the amount of competition that would be received for the acquisition.

The Department of Defense Base Structure Report for the fiscal year of 2015 was used to provide the infrastructure data for each of the military installations. This report

provided the square footage of all buildings on base, the number of acres within the military installation, and the total number of personnel that work within the military installations. These three data sets allowed for a better understanding of how large each of the military installations are. This data allows for a better analysis on whether larger military installations in these three dimensions have a large effect on the overall price of a BOS contract. Large military installations may be costlier, as the prime contractor will have to provide more support and labor to cover the larger area.

Due to the small sample size of the active Air Force BOS contracts, a two-step approach was used to answer the research questions. The first step in answering the research questions is performing a hierarchical cluster analysis of the services within the BOS contracts. The second step performs a regression analysis on the price of BOS contracts.

B. HIERARCHICAL CLUSTERING ANALYSIS

Hierarchical cluster analysis is the process of building a binary tree of data that can merge similar groups of points together (Greenacre, 2008). These groups can be clustered together to create larger groups of data that are similar. The results of the clusters illustrate a dendrogram, which allows for a better visualization of the similarities between the data points. Although the exact number of clusters varies for every analysis, the number of clusters that the observer determines significant can vary from one person to another. Determining the appropriate number of clusters in a hierarchical cluster analysis requires a quantitative approach, as the results may be interpreted differently.

For this research, Ward's Method for Hierarchical Cluster Analysis is used. This method is chosen as it the most commonly used hierarchical cluster analysis approach. No other hierarchical cluster analysis approaches were deemed as a more appropriate fit, as the other approaches are for more specific purposes within research. Greenacre (2008) explained that the Ward's Method consists of the distance between two clusters, A and B, is how much the sum of squares will increase when we merge them. The Ward's Method analyzes a variance problem, instead of simply utilizing metrics of distance of measures of

association. This hierarchical clustering method is most appropriated used for quantitative variables instead of binary variables. The use of Ward's Method minimum variance criterion minimizes the total within-cluster variance using Euclidean distance (Greenacre, 2008).

Greenacre (2008) stated that "the Euclidean distance between two points in either the plane or 3-dimensional space measures the length of a segment connecting the two points. It is the most obvious way of representing distance between two points" (Greenacre, 2008).

The Ward's Method of hierarchical cluster analysis was chosen because it is the most commonly used method. This method was the most relevant to the research and most fitting because of its common usage. Utilizing another method for the hierarchical cluster analysis could yield weaker results, but due to the small sample size, the Ward's Method was pursued.

The results of the hierarchical cluster analysis will be encoded and numbered in order to be utilized in the regression analysis. Upon completion of the hierarchical cluster analysis, each of the clusters will be categorized numerically. These results will be used as an explanatory variable, which will be described in the next section.

C. OPERATIONALIZATION OF VARIABLES

Analyzing the overall price drivers of BOS controls required the identification of response and explanatory variables. Additionally, statistical controls were required in obtaining an accurate regression analysis. Overall, this section will outline the variables used within the regression analysis and the statistical control.

1. Response Variables

The purpose of performing a regression analysis within this research is to determine how the explanatory variables affects the overall price of BOS contracts. The response variables of the regression analysis included the overall price of the twelve BOS contracts.

The response variable in the regression equation is the price-per-month for BOS services at a given base, at the time of award. A natural log transformation was taken to account for potential non-linearities with the explanatory variables, due to skewness and to improve the interpretability of coefficient estimates.

2. Explanatory Variables

The explanatory variables that represent and affect the overall price of BOS contracts include contract price per month, square footage of the military installations, mean salary of the local metropolitan area, hierarchical cluster analysis results, contract duration, and the interaction between the mean salary and square footage of the installation. The variables of contract duration and building square footage were log-transformed to account for skewness. Additionally, the building square footage was used as a proxy for the size of the installation.

To eliminate large variances among certain explanatory variables, a natural logarithm transformation was applied to the price per month, duration, and square footage variables. By doing so, the possibility of heteroscedasticity within these variables will be eliminated. Heteroscedasticity can invalidate the statistical tests of significance within the ordinary least squares regression analysis, which is prevented (Kaufman, 2013).

Additionally, the cluster analysis variable was transformed into categorical data. By doing so, this controls the variability of the regression by ensuring that the data is not ran as a continuous variable. The cluster analysis variable in the regression will be numbered based on the output of the hierarchical cluster analysis once completed. By indicating that this variable is a categorical variable, the regression will know that there is a limited number of possible values within that category.

D. MODEL SPECIFICATION

Figure 12 specifies the model utilized for this research.

Figure 12. Regression Model

$$Y_{LOG\_PPM} = \beta_0 + \beta_1 X_{CLUSTER} + \beta_2 X_{LOG\_DURATION} + \beta_3 X_{MEANSALARY} + \beta_4 X_{LOG\_SQFT} + \beta_5 X_{INTER}$$

LOG_PPM = Contract Price per Month
CLUSTER = Hierarchical Cluster Analysis Results
LOG_DURATION = Contract Duration
MEANSALARY = Mean Salary of Metropolitan Area
LOG_SQFT = Square Footage of Military Installation
INTER = Interaction

E. SUMMARY

The purpose of this research is to identify the similarities between BOS contract service consolidation and to conclude relevant cost drivers of BOS contracts. First, this chapter described the method used to establish a sample, including data collection. Second, hierarchical clustering analysis was discussed in regard to the Ward's Method being utilized. Third, the operationalization of variables was outlined including the use of response variables, explanatory variables, and controls. The following chapter will analyze the results of the data from the cluster analysis and regression analysis.

V. RESULTS AND FINDINGS

In this chapter, the results of the hierarchical cluster analysis and regression analysis are explained. The results presented below were concluded using the data collected from Air Force BOS contracts. The cluster and regression analysis presented various cost drivers and commonalities of the support services packaged together within BOS contracts.

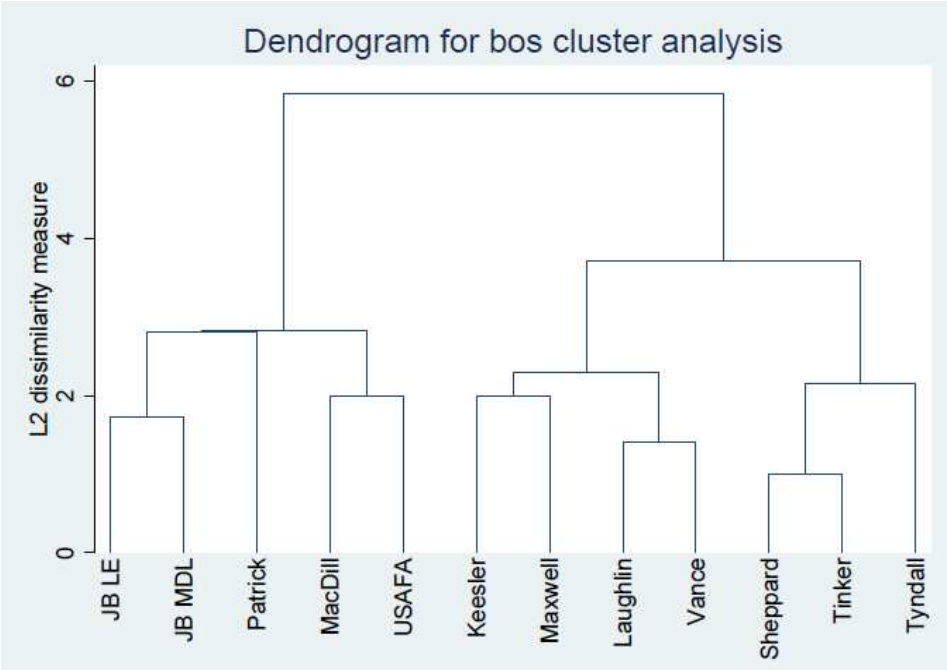
A. ANALYSIS OF RESULTS

This section outlines the initial results of the hierarchical cluster and regression analysis that was performed.

1. Initial Hierarchical Cluster Analysis Results

The hierarchical cluster analysis that was performed derived the dendrogram outline presented in Figure 13. The dendrogram outlines a myriad of cluster group possibilities based on similarity strength. It was determined that there are three main cluster groups within Figure 13 which was made on the basis that having any less than three clusters would not describe commonalities as the groupings would be too broad. A similar determination was made with limiting the maximum amount of clusters; if too many clusters are chosen, the results would be too narrow and there would be no ability to find commonalities. For simplicity, the three clusters that were chosen were named Operations Based Cluster, AETC Cluster, and Large Base Cluster. Next, the three cluster groupings outlined in Figure 13 will be individually described.

Figure 13. Hierarchical Cluster Analysis Dendrogram



a. Cluster 1: Operations Based Cluster

The Operations Based Cluster (OBC), which consists of five military installations: Joint Base Langley-Eustis, Joint Base McGuire-Dix-Lakehurst, Patrick Air Force Base, MacDill Air Force Base, and the United States Air Force Academy, includes many commonalities. The largest commonality, which drives the name of the cluster, is that these BOS contracts are mainly operations based, meaning that the BOS contracts for these military installations are focused on operations services. Four out of the five BOS contracts within this cluster have the operations type of service included in the BOS services procured. Additionally, four out of five OBC BOS contracts were competed and were awarded to small businesses. All five of the military installations within the OBC are outside of the AETC MAJCOM, therefore the BOS services are procured from a decentralized standpoint.

The OBC leads the other two clusters with the amount of competition received for the BOS contracts. This cluster has an average number of bids submitted of 7.8 with the

inclusion of a bridge contract which did not receive any competition. When the bridge contract, utilized by Joint-Base McGuire-Dix-Lakehurst, is removed from the average of the remaining BOS contracts in this cluster, the average number of bids submitted increases to 9.5 bids.

Another major commonality within this cluster grouping is the low number of support services that are procured. The OBC has an average of 4.6 services contained within the five contracts that are incorporated within this cluster. This is the smallest amount of the three clusters.

b. Cluster 2: AETC Cluster

The second cluster, the AETC cluster, is a cluster that consists of four military installations that are all part of the AETC MAJCOM. The four bases include Keesler AFB, Maxwell AFB, Laughlin AFB, and Vance AFB. As mentioned previously, the AETC MAJCOM is the only MAJCOM that has centralized procurement for their BOS services. Only one of the four BOS contracts within the AETC cluster, Vance AFB, was set-aside for a small business as the prime contractor.

The AETC cluster's most prominent commonality among the four BOS contracts is the size of the military installations. These four military installations have the lowest average number of buildings, number of personnel that work on base, and the square footage and acreage of the military installation. Refer to Figure 889 for the breakdown of the size variables listed above for the contracts within the AETC cluster.

The BOS contracts within the AETC cluster had the least amount of competition, with an average of five bids with the Laughlin AFB bridge contract included. The AETC cluster installations have the most BOS services included in the contract, with an average of 10.95. Additionally, the BOS contracts within the AETC cluster have the shortest BOS contract duration of the three clusters, with an average of 58.63 months.

c. Cluster 3: Large Base Cluster

The Large Base Cluster (LBC) includes Sheppard AFB, Tinker AFB, and Tyndall AFB. The main commonality of this cluster includes the magnitude of the installations regarding number of buildings, building square footage, and number of base personnel. All BOS contracts within the LBC were competed and two out of three contracts were awarded to small businesses. Most of the installations are outside of the AETC with only Sheppard AFB being part of the AETC MAJCOM. The BOS contracts within the LBC had the longest contract duration, with an average of 71.17 months.

2. Regression Analysis

The purpose of the regression analysis is to determine the impact that contract variables have on contract price. The regression analysis is based on the price-per-month of the individual BOS contracts instead of the total contract price. The regression analysis of twelve BOS contracts (shown in Figure 14) shows a statistically significant relationship between the contract duration and contract price as well as cluster analysis and contract price. The R-Squared value of 0.9073 indicates that the model explains 90.73 percent of the variation in price-per-month for BOS services.

Figure 14. Regression Analysis Results

Source	SS	df	MS	Number of obs	=	12
				F(6, 5)	=	8.15
Model	8.85030531	6	1.47505089	Prob > F	=	0.0180
Residual	.904538144	5	.180907629	R-squared	=	0.9073
				Adj R-squared	=	0.7960
Total	9.75484346	11	.886803951	Root MSE	=	.42533

log_ppm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cluster						
2	1.04477	.3570199	2.93	0.033	.127021	1.962519
3	.723743	.4146479	1.75	0.141	-.3421433	1.789629
log_duration	-.5175942	.245376	-2.11	0.089	-1.148353	.1131649
meansalary	-10.96834	4.088426	-2.68	0.044	-21.47797	-.4587033
log_sqft	-15.45807	5.640461	-2.74	0.041	-29.95733	-.9588007
interaction	.7170281	.2658909	2.70	0.043	.0335337	1.400522
_cons	247.9734	86.086	2.88	0.035	26.68234	469.2645

a. Contract Duration

The contract duration variable has a marginally statistically significant relationship with BOS contract price due to the P-value being relatively close to 0.05. The contract duration, which is in terms of log months, has a coefficient of -0.5176, which means that a one percent increase in contract duration is associated with a 0.52 percent decrease in price per month. This result is very drastic and may be due to the inclusion of BOS bridge contracts from Laughlin AFB and Joint Base McGuire-Dix-Lakehurst.

The BOS contracts at MacDill AFB and Keesler AFB have the longest duration of all sample BOS contracts in this research with a contract duration of nine-five and ninety-six months, respectively. Both of these installations exercised the authority outlined in the Air Force Federal Acquisition Regulation Supplement (AFFAR) section 5317.204 "Options." This section outlines the ability for a contract to be extended in excess of five years with the approval from the acquisition plan approval authority. By extending the duration of the BOS contract, military installations are able to have a greater continuity of services, the ability to maintain a mutually beneficial relationship with the contractor and allows contractors to make process improvements and capital investments which may lead to lower overall costs to the Government due to a greater amortization schedule.

b. Excessive Cost of Bridge Contracts

The 2015 GAO report "Sole Source Contracting—Defining and Tracking Bridge Contracts Would Help Agencies Manage Their Use" outlines the effect that bridge contracts have on the efficiency and price of large service contracts. This report defines a bridge contract as "an extension to an existing contract beyond the period of performance (including option years), or a new, short-term contract awarded on a sole-source basis to an incumbent contractor to avoid a lapse in service caused by a delay in awarding a follow-on contract" (Mackin, 2015, p. 4). Although there is only one bridge contract within the sample of BOS contracts in this research, it important to understand the effect of utilizing a bridge contract has on the overall price of the contract.

The GAO report claims that many governmental agencies "had limited or no insight into their use of bridge contracts" and are often over utilized (Mackin, 2015, p. 6). Many

contracts within the GAO report had a duration of longer then twelve months, with some contracts lasting as long as 42 months (Mackin, 2015). The report outlines the reasons for utilizing a bridge contract, such as time constraints, lack of a properly defined requirement, and poor acquisition planning (Mackin, 2015).

As previously described, a main cost driver with BOS contracts is the duration. The regression analysis provided results that the longer contract durations provide better overall price efficiencies. Procuring contracting officers should ensure that they are making critical decisions when choosing the duration of the BOS contract.

c. Cluster Analysis

A statistically significant relationship exists between the variable of "Cluster Analysis" and contract price because the P-values for Cluster 2 and 3 are relatively close to 0.05.

Cluster 1, the Operations Based Cluster, is the baseline meaning that the results of Cluster 2 and 3 are based off of Cluster 1. Cluster 2, the AETC Cluster, and Cluster 3, the Large Base Cluster, show a difference in price by a percentage. The coefficient of variation for Cluster 2 is 1.0447, which means that the price of Cluster 2 is 104.47 percent higher than the baseline cluster, Cluster 1. Cluster 3 has a coefficient of variation of 0.7237, but has a p-value of 0.14, which does not provide evidence that it differs from a value of zero in the population.

Therefore, this does not mean that Cluster 1 is the least expensive cluster and should be imitated across the Air Force when procuring BOS services. Cluster 1 is its own unique cluster with commonalities and traits that are not necessarily like the other two clusters. Each cluster has different characteristics in which price will fluctuate to meet the needs of the specific cluster.

B. LIMITATIONS OF FINDINGS

A major limitation of the research project included the small number of observations of Air Force BOS contracts, due to the limited use of BOS contracts within Air Force installations. Additionally, vague service parameters such as what types of

services are being performed within BOS contracts and to what extent they are being performed cause the research findings to be limited. Although the regression analysis was able to find two explanatory variables that were statistically significant, the analysis was limited in a manner that two other explanatory variables were not able to be interpreted. The other two variables that were uninterpretable, the mean salary and installation building square footage, have an interaction between them. Sweet and Grace-Martin (2012) explain that an interaction within a regression analysis refers to a third variable influence on the relationship between an independent and dependent variable. The interaction between the mean salary and installation building square footage makes the regression data more complex and harder to analyze. Due to this interaction, the effects of the explanatory variables on the overall price of BOS contracts was limited to just the duration and cluster analysis variables.

The effect of local wage rates (mean salary) on BOS price per month depends on base size (log_sqft), such that there is an amplifying effect ($\beta = 0.72$; $p = 0.04$). This finding is not surprising given that provisioning base operating services on large installations is likely to necessitate additional personnel in managerial, dispatch and coordination roles, due to increasing complexity of operations. Thus, for larger bases, it may not only be that labor costs account for a greater share of total contract costs than they do on smaller bases, but that the resource mix itself differs. Because of this, those extrapolating prices from one base to another (e.g., to examine the fairness and reasonableness of prices) should take care to perform an "apples-to-apples" comparison of similar bases.

C. SUMMARY

This chapter described the results of the research, which described the commonalities and cluster groupings of the sample military installations that utilize BOS contracts and the effects of the main cost drivers on the overall price of BOS contracts. In the next chapter, the research questions are answered, and a conclusion is provided.

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VI. SUMMARY, CONCLUSIONS, AND AREAS FOR FURTHER RESEARCH

A. SUMMARY

Base operations support services (BOS) contracts enable military installations to outsource vital support services by packaging multiple services, such as minor construction, civil engineering operations, and base maintenance, into one larger service contract (Warren, 1998). BOS contracts are a critical resource for military installations to accomplish their day-to-day missions and vary with their size, scope, and dollar value. The U.S. Air Force spends approximately $6 billion dollars per year on installation support services under BOS contracts (Warren, 1998). For many installations, BOS contracts represent a sizable portion of the annual base Operations and Maintenance (O&M) budget and contain services critical to peacetime and wartime missions. However, the Air Force enterprise lacks a standardized approach toward acquiring these services; service clusters differ across installations, as do acquisition strategies.

The purpose of this research is to identify commonalities among the services that are procured within BOS contracts and to determine relevant contract inputs that affect overall BOS contract price. Overall, it is concluded that there are three relevant cluster groupings that have commonalities in terms of services that are outsourced, base characteristics, and geographical data. Additionally, a regression analysis was performed that identified two main explanatory variables that were statistically significant. The two explanatory variables that provided insight to the BOS contracts were the cluster groupings and contract duration. In the next section, the research questions will be answered. The report will conclude with recommendations for further research.

B. CONCLUSION

The purpose of the research was to answer two overall questions regarding the price efficiency of BOS contracts. The findings of this research have the potential to improve future acquisitions of BOS services through the identification of contract commonalities and cost drivers. In terms of utility of results, the effect of duration on BOS contract price-

per-month offers insight for the Air Force regarding obtaining BOS contract price efficiency. The two original research questions presented at the beginning of the research project can now be answered to provide the Air Force a clearer understanding of BOS contract price efficiency.

1. What are the commonalities of the twelve BOS contracts and installations implementing BOS contracts?

The hierarchical cluster analysis concluded that there are three identifiable cluster groupings of BOS contract installations that feature notable commonalities. First, the Operations Based Cluster (OBC) consists of five military installations that are focused on operations services. The most notable commonality included the type of support services that were packaged within the five BOS contracts. Additionally, the OBC included BOS contracts that received the most competition with an average of 7.8 bids submitted. Second, the AETC cluster was made up of four Air Force installations within the AETC MAJCOM. The main commonality besides the installation mission includes the size of the military installations. The AETC Cluster consisted of military installations with the lowest average number of buildings, number of base personnel, building square footage, and military installation acreage. Third, the Large Base Cluster (LBC) consisted of the three largest bases in terms of number of buildings, building square footage, and number of base personnel. Additionally, the LBC BOS contracts had the longest contract duration, with an average of 71.17 months.

2. Which inputs are the most impactful to the overall price of BOS contracts?

The regression analysis indicated a statistically significant relationship between the variable of contract duration on BOS contract price. This relationship indicates that the longer the contract duration, the lower the BOS contract price per month. This was the only input, or explanatory variable, that was found within this research to be significant on the overall BOS contract price. Based on the cluster and regression analysis, BOS contract service packages (clusters), local wage rates, installation size, and contract duration influence the price-per-month of BOS contracts. Procuring Contracting Officers (PCO)

should seek to extend the length of BOS contracts to maximize the price efficiency and economies of scale.

C. RECOMMENDATIONS

Based on the research findings, two recommendations were concluded for future BOS contract implementation. First, it is recommended that the Air Force establishes a centralized database for storing and disseminating BOS contract information. By having a centralized interface for BOS contract implementation, the Air Force will be able to understand the extent of support services that are being outsourced and the associated price. A BOS contract database will ultimately allow the Air Force to establish a better strategic sourcing initiative within BOS services. The shared data will allow the Air Force to procure BOS services on a larger scale while capitalizing on economies of scale and other benefits that were previously outlined.

Additionally, the second recommendation to the Air Force regarding the procurement of BOS services is to secure longer duration terms for BOS contracts. The regression analysis outlined a direct relationship between contract duration and price-per-month. As outlined in GAO Report16-15, bridge contracts should be avoided due to their short-term nature that leads to a much higher price-per-month. It is recommended that members of the acquisition team, to include requiring activities, utilize proper acquisition planning and forward-thinking to avoid time constraints which lead to the need for bridge contracts.

D. AREAS FOR FURTHER RESEARCH

A critical area for further research is to include all military service BOS contracts in the hierarchical cluster analysis and regression analysis. By including all Air Force BOS contracts and similar BOS contracts within the United States Army and Navy in future research, a larger sample size will allow for more variables to be included in the regression analysis and for more precise clusters to be formed. By having a better understanding of more variables that affect the price of BOS contracts, the procuring agencies of BOS contracts will be able to further identify relevant inputs to maximize BOS contract price efficiency.

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LIST OF REFERENCES

Brien, S. T., & Hine, L. L. (2015). Complex products and comprehensive service agreements: A case study of outsourcing in contract cities. *Journal of Public Procurement, 15*(2), 150–176. https://doi.org/10.1108/JOPP-15-02-2015-B002

Chu, C. S., Leslie, P., & Sorensen, A. (2011). Bundle-Size Pricing as an Approximation to Mixed Bundling. *American Economic Review, 101*(1), 263–303. doi:10.1257/aer.101.1.263

Cox, A. (2001). Understanding buyer and supplier power: A framework for procurement and supply competence. *Journal of Supply Chain Management, 37*(2), 8. https://doi.org/10.1111/j.1745-493X.2001.tb00094.x

Ellram, L. M. (1996). A structured method for applying purchasing cost management tools. *International Journal of Purchasing and Materials Management, 32*(4), 11–19.

Gates, S. M., & Robbert, A. A. (2000). *Personnel savings in competitively sourced DoD activities* (Master's thesis). Retrieved from RAND Database. (Accession No. 20001121 002)

Greenacre, M. (2008). Hierarchical cluster analysis. Retrieved from http://www.econ.upf.edu/~michael/stanford/

Guiltinan, J. P. (1987). The price bundling of services: A normative framework. *Journal of Marketing, 51*(2), 74–85. https://doi.org/10.2307/1251130

Hand, J. B., & O'Connor, D. J. (1984). *How winners win: Lessons learned from contract competitions in base operations support* (Unpublished master's thesis). Logistics Management Institute, Tysons, VA.

Handfield, R. (2010) Supply market intelligence: Differently, gain an edge. *Supply Chain Management Review, 14*(6). 42–49.

Kaufman, R. L. (2013). *Heteroskedasticity in regression: Detection and correction*. Thousand Oaks: Sage.

Kidalov, M. V. (2012). *Impact of contract bundling and consolidation on defense acquisition system and defense industrial base—The case of the U.S. Department of the Navy*. Retrieved from Calhoun: Institutional Archive of the Naval Postgraduate School Database. (Accession No. NPS-CM-12-037)

Kraljic, P. (1983). Purchasing must become supply management. *Harvard Business Review, 61*(5), 109–117.

Mackin, M. (2015) *Sole source contracting: Defining and tracking bridge contracts would help agencies manage their use.* (Report No. GAO-16-15) Washington, DC, General Accounting Office.

McLaughlin, M., Buffler, J., & Gazillo, M. (2017, April 3). Contract Consolidation & Bundling. Retrieved from https://business.defense.gov/Portals/57/Documents/Consolidation and Bundling.pdf

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2011). *Purchasing and supply chain management* (5th ed.). Mason, OH: Cengage Learning.

Pagell, M. (2004). Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics. *Journal of Operations Management, 22*(5), 459–487. https://doi.org/10.1016/j.jom.2004.05.008

Pandit, K., & Marmanis, H. (2008). *Spend analysis: The window into strategic sourcing*. Fort Lauderdale, FL: J. Ross Publishing.

Prager, J. (1994). Contracting out government services: Lessons from the private sector. *Public Administration Review, 54*(2), 176. https://doi.org/10.2307/976527

Ramanujam, V., & Varadarajan, P. (1989). Research on corporate diversification: A synthesis. *Strategic Management Journal, 10*(523), 523–551. https://doi.org/10.1002/smj.4250100603

Rendon, R. G. (2001, January 1). Outsourcing base operations support functions: The Laughlin experience. *Program Manager*, 16–20.

Rendon, R. G. (1998, February). The changing face of operational contracting. *Contract Management*, 18–21.

Sweet, S. A., & Grace-Martin, K. (2012). *Data analysis with SPSS: A first course in applied statistics* (4th ed.). Boston: Pearson.

Tanner, G. (2014, March 14). Federal privatization and the expensive philosophy of the circular A-76 process. Retrieved from https://truthout.org/articles/federal-privatization-and-the-expensive-philosophy-of-the-circular-a-76-process/

Warren, D. R. (1998). *Base operations: DoD's use of single contracts for multiple support services* (Report No. GAO-NSIAD-98-82). Washington, DC: General Accounting Office.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 8*(171), 171–180. https://doi.org/10.1002/smj.4250050207

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