



AN ASSESSMENT OF THE AIR FORCE'S RETURN ON INVESTMENT
FOR PRODUCT SUPPORT BUSINESS CASE ANALYSIS PROCESSES

THESIS

Robert E. Tyson, Jr., Capt, USAF

AFIT-ENV-MS-19-M-201

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States Government. Optional: This material is declared a work of the United States Government and is not subject to copyright protection in the United States.

AFIT-ENV-MS-19-M-201

AN ASSESSMENT OF THE AIR FORCE'S RETURN ON INVESTMENT
FOR PRODUCT SUPPORT BUSINESS CASE ANALYSIS PROCESSES

THESIS

Presented to the Faculty

Department of Systems Engineering and Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Cost Analysis

Robert E. Tyson, Jr., BBA

Captain, USAF

March 2019

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

AN ASSESSMENT OF THE AIR FORCE'S RETURN ON INVESTMENT
FOR PRODUCT SUPPORT BUSINESS CASE ANALYSIS PROCESSES

Robert E. Tyson, Jr., BBA
Captain, USAF

Approved:

R. David Fass, PhD (Chairman)

Date

Jonathan D. Ritschel, PhD (Member)

Date

Edward D. White, PhD (Member)

Date

Craig R. Shanske, AFLCMC (Member)

Date

Abstract

There have been many fiscal challenges over the years facing the Department of Defense (DOD). With these challenges, cost savings initiatives have become commonplace. To meet these fiscal challenges head-on, new policies to improve estimating and control costs have been implemented. Senior leaders within the cost analysis community are tasked with managing these changes while continuing to provide timely and accurate cost estimates.

The purpose of this research is to focus on one of the more important cost savings initiatives -- Product Support Business Case Analyses (PS-BCA). Our research questions explore the current cost and impact of this DoD cost saving policy using a mixed methods approach using both quantitative and qualitative data. The quantitative data showed significant improvements in the process in conducting PS-BCA's as they became more standardized after 2016 however, despite this, 60% of programs showed a negative return on investment should their recommendations get implemented. Furthermore the qualitative data collected showed significant concerns regarding the PS-BCA process and that there is a belief that the Air Force is receiving suboptimal ROI in this process. These results were then used to answer our research questions to address these concerns and to also make policy recommendations to improve the PS-BCA process. Our results may assist senior leaders within the cost analysis career field in their decision making and also may be a useful starting point for future research.

Acknowledgments

I would like to express my sincere appreciation to my primary research advisor, Dr. R. David Fass, for his support, guidance, and patience, which made this research project possible. I would also like to thank my committee members, Dr. Jonathan D. Ritschel, Dr. Edward D. White, and Mr. Craig R. Shanske for their expertise and advice which made this endeavor a successful one.

Robert E. Tyson, Jr.

Table of Contents

	Page
Abstract	iv
Acknowledgments.....	v
Table of Contents	v
List of Figures	viii
List of Tables	ix
I. Introduction	1
Overview	1
Background	1
Problem Statement	5
<i>Processes</i>	6
<i>Recommendations</i>	8
<i>Implementations</i>	8
Justification	8
Assumptions.....	9
<i>Cost Assumptions</i>	9
<i>Return on Investment Assumptions</i>	10
Methodology and Data.....	11
Summary	11
II. Literature Review	13
Overview	13
DoD Product Support Business Case Analysis Guidebook	14
Air Force Life Cycle Management Center (AFLCMC) Standard Process for Product Support Business Case Analysis (PS-BCA) Process	15
Attributes of an Effective Product Support Business Case Analysis	16
A New Methodology for Conducting Product Support Business Case Analysis	17
How to Measure Anything	21
Conclusion	21
III. Methodology	23
Overview	23
Nature of the Data and Methods	23
Institutional Review Board	28

Conclusion	28
IV. Analysis and Results.....	29
Overview	29
Quantitative Data	29
Qualitative Data	34
<i>Round One Interviews</i>	35
<i>Round Two Interviews</i>	43
Summary	50
V. Conclusions and Recommendations	52
Overview	52
<i>Question One</i>	52
<i>Question Two</i>	53
<i>Question Three</i>	54
Recommendations	55
Significance of Research.....	56
Future Research.....	56
APPENDIX A – IRB Exemption Letter	58
APPENDIX B – Round 1 Questions	59
APPENDIX C – Round 2 Questions	60
References.....	61

List of Figures

	Page
Figure 1: Product Support BCA Elements.....	4
Figure 2: Communication process in the Delphi Method.....	Error! Bookmark not defined. 6

List of Tables

	Page
Table 1: How the RAND Approach Differs	20
Table 2: Example of SME Response Coding	27
Table 3: Original Quantitative Data Set	30
Table 4: Analyzed Data Set	31
Table 5: Analyzed Data Set Results	32
Table 6: Analyzed Data Set Results	33
Table 7: Emerging Themes.....	35
Table 8: Response Subjects Question 1.1	36
Table 9: Response Subjects Question 1.2.....	37
Table 10: Response Subjects Question 1.3.....	38
Table 11: Response Subjects Question 1.4.....	39
Table 12: Response Subjects Question 1.5.....	41
Table 13: Response Subjects Question 1.6.....	42
Table 14: Response Subjects Question 1.7.....	43
Table 15: Response Subjects Question 2.1	44
Table 16: Response Subjects Question 2.2a	45
Table 17: Response Subjects Question 2.2b.....	46
Table 18: Response Subjects Question 2.3a	47
Table 19: Response Subjects Question 2.3b.....	48
Table 20: Response Subjects Question 2.3c	48
Table 21: Response Subjects Question 2.4.....	49
Table 22: Response Subjects Question 2.5.....	50

AN ASSESSMENT OF THE AIR FORCE'S RETURN ON
INVESTMENT FOR PRODUCT SUPPORT BUSINESS CASE
ANALYSIS PROCESSES

I. Introduction

Overview

In this research project, we attempt to assess the Air Force's Return on Investment (ROI) from Product Support Business Case Analyses (PS-BCA) for new and existing weapon systems. Specifically, we examine the costs and benefits involved in the process of conducting a PS-BCA both organically and contractually. Then we investigate the recommendations/Courses of Action (COAs) presented to decision-makers and whether the savings or mission enhancements associated with the COAs justifies the expense of conducting them. We then offer some recommendations regarding maximizing the Air Force's ROI on Product Support Business Case Analyses and in the end, where to focus the investments so that tax-payer dollars are deployed in the most fiscally responsible manner possible.

Background

The Department of Defense Product Support Business Case Analysis Guidebook defines a Business Case Analysis (BCA) as "both a structured methodology and a document that aids decision making by identifying and comparing alternatives through examining the mission and business impacts (both financial and non-financial), risks, and

sensitivities” (DoD Product Support Business Case Analysis Guidebook, 2014, p. 5). BCAs differ from other decision support analyses due to their all-encompassing viewpoint of interested parties such as key stakeholders and decision makers. Business Case Analyses also seek to provide an all-inclusive evaluation and assessment of the stakeholders impacted by the decision. There are other names for a BCA which are sometimes used interchangeably despite not always meaning the same thing. These other names include, but are not limited to, Economic Analysis (EA), Cost-Benefit Analysis, and Benefit-Cost Analysis. A BCA is any documented, unbiased value analysis examining costs, benefits, uncertainty and risk. (DoD Product Support Business Case Analysis Guidebook, 2014).

Purpose of a Product Support Business Case Analysis

Product Support Business Case Analyses are conducted because they assist senior leaders in making informed decisions examining a number of possible courses of action. In November 2009, Dr. Ashton Carter, Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)), approved and signed the Weapon Systems Acquisition Reform Product Support Assessment (WSAR-PSA) report and its eight integrated recommendations to improve life cycle product support. One of the eight recommendations included clarifying and codifying policies and procedures pertaining to the use of analytical tools, including requiring the use of business case analysis (BCA) in the life cycle product support decision making process (DoD Product Support Business Case Analysis Guidebook, 2014).

Furthermore, a PS-BCA is not a “one-and-done” undertaking which means that once it is completed for a weapon system, it needs to be revisited periodically. The Product Support Manager (PSM) has the responsibility to revalidate the business case prior to any change in the support strategy or every five years, whichever occurs first (Product Support Manager Guidebook, 2016).

Components of a Product Support Business Case Analysis

Like many new programs and processes, the method used to conduct a PS-BCA has evolved over time. However, the DoD Product Support Business Case Analysis (BCA) Guidebook (released in 2011 in response to the signing of the Weapon Systems Acquisition Reform Product Support Assessment (WSAR-PSA) in 2009), attempts to standardize the process. Its stated purpose is to “provide a standardized process and methodology for writing, aiding decision making, and providing analytical decision support for a Product Support BCA” (DoD Product Support Business Case Analysis Guidebook, 2011, p. 6).

A Business Case Analysis has three major elements: the purpose, process components, and quality foundation (see Figure 1). The *purpose* identifies the problem statement, objectives, and metrics. In the items of this element, the BCA should clearly annotate what issue it is attempting to solve and how success will be measured. The *process components* are those subsections of the BCA that directly execute and report on analytical actions. Finally, the *quality foundation* of the BCA directly affects the quality and completeness of the analysis. Background research, due diligence, governance, and data management and control underlie and support the entire process. Governance

represents the oversight and enterprise wide context that helps to steer the analysis throughout the process. The three elements work together to ensure the BCA targets the relevant subject matter, credibly analyzes and reports the results, and integrates into the organization’s mission and leadership’s vision (DoD Product Support Business Case Analysis Guidebook, 2011).



Figure 1: Product Support BCA Elements (DoD Product Support Business Case Analysis Guidebook, 2011)

Methods of a Product Support Business Case Analysis

Within the DoD and throughout the business world, a business case analysis is best known for its role in business decision support and planning. However, it also serves other purposes.

- The business case provides practical guidance for managing projects, programs, and the asset lifecycle. Here, the BCA reveals critical success factors and contingencies to watch and manage to target levels.
- The BCA sends an early warning to project managers when the risks of schedule slip or cost overruns threaten.
- Also, the BCA provides robust accountability for decision makers and managers. It shows that decisions were made responsibly, in accord with regulations and policies (Schmidt, 2018).

Product Support Business Case Analysis (PS-BCA) process is described as “a structured methodology that aids decision making by identifying and comparing Courses of Action (COA) options by examining the mission and business impacts (both financial and non-financial), risks and sensitivities.” This methodology then concludes with a “recommendation, associated specific actions and an implementation plan to achieve stated organizational objectives and desired outcomes.” (Air Force Life Cycle Management Center (AFLCMC), 2017, p. 4). Decision-makers rely heavily on this analysis to make the best possible and most fiscally responsible decision for a weapon system/program to accomplish the stated objective/mission.

Problem Statement

The objective of this research is to assess and evaluate the Air Force’s Return on Investment (ROI) for Product Support Business Case Analysis (PS-BCA) processes. This research is important because there is a concern among some in

leadership that we are conducting these PS-BCAs simply to meet a requirement and are not optimizing the ROI for their intended purpose. Furthermore, there have been instances in the past where PS-BCAs have gone over their original expected cost and took much longer than the planned duration. Therefore, we seek to address these perceptions/concerns in our analysis of the processes and results to date.

Processes

The process of conducting a PS-BCA can be both costly and time consuming. Different factors go into how much a business case analysis will cost and how long it will take to complete. Depending on program, complexity, importance, and objective, cost and schedule can vary widely on a PS-BCA. From a cost perspective, one of the first decisions is to determine whether the program will conduct the PS-BCA organically (within the DoD) or if it will hire a contractor to perform the analysis. Typically conducting a PS-BCA organically would be less expensive than hiring a contractor; however, other costs/intangibles are not always taken into consideration. For example, many times, if DoD employees are already on the payroll and then asked to conduct a PS-BCA, their salary is considered “sunk cost” because they will get that salary regardless of whether they are working on the BCA or doing other work for the DoD. To get an accurate picture of the true cost in a PS-BCA when conducted organically, this cost should not be considered “sunk cost” but instead be included in the final cost of the PS-BCA.

Furthermore, there is an opportunity cost to having DoD employees conduct a PS-BCA because if not for that duty, they could be working on some other project or assisting elsewhere. This is a much harder cost to quantify because it is not always straightforward or presented in “hard numbers.” However, to ignore the opportunity cost for taking DoD employees off a program and putting them onto conducting a Business Case Analysis would be a mistake as this decision has real-world impacts which could incur additional cost and/or have an impact elsewhere in a Program Office.

When hiring a contractor to conduct a Product Support Business Case Analysis, the cost is easier to quantify. We can see per the contract how much it costs the Department of Defense to have “X” company/contractor to perform the required work. There is no set cost or standard price when having a contractor conduct a PS-BCA. It will vary depending on the company performing the work and the scope of the project.

The time it takes to perform a PS-BCA will also vary depending on the complexity of the project regardless if it is being conducted organically or through a contractor. Is it more efficient to have contractors do it because they are specialized in doing this work and have better processes as opposed to DoD employees who are doing it part-time, periodically, after getting pulled off their primary duties? Or is it worth tasking DoD employees with conducting PS-BCAs because the savings to the tax-payer with doing it organically far outweigh any potential inefficiencies in the process of not having a specialized team dedicated strictly to the BCA process? These are the questions we will seek to answer when addressing the Air Force’s return on investment with the current Product Support Business Case Analysis processes.

Recommendations

The recommendations provided at the end of the PS-BCA process are key to assessing whether the Air Force received sufficient return on the investment. Our research looks at the final recommendations of the completed PS-BCAs to see if there was any proposed change in the way the Air Force was intending to accomplish the mission. If at the end of the BCA process, after spending the time and investment into getting the results briefed, the recommendation is to stay with the status quo, then did the Air Force receive sufficient value from learning that information? On the other hand, if there was a recommendation to change course due to significant savings, was there a change made by the decision-maker?

Implementations

Assessing the Air Force's ROI in Product Support Business Case Analyses is difficult. The strategy behind taking implementations into consideration is that it will indicate whether the PS-BCA requirement is meeting its intended objective. However, the requirement is recent and many COAs have not been implemented yet, therefore, not enough time has passed to conclude if the COAs are adhering to the plan. Therefore, while we will seek to show the real-world results of this data, it is a limitation of our research and may be a subject for follow-on research.

Justification

Based on discussions with some in cost leadership and decision-makers, there is a concern that the Air Force runs the risk of not receiving sufficient return on investment

from Product Support Business Case Analyses once it receives the final recommendations. Our research explores if there is a perception among some employees of the DoD that PS-BCA's take away from primary duties, are too expensive, and are both too labor and time intensive to complete according to the current processes. Additionally, once the recommendations are made, and a course of action chosen, are there times that the return is not commensurate with the investment? This study will attempt to address these concerns, answer these questions, and suggest policy or process changes that may lead to more efficient/effective PS-BCAs.

Assumptions

There are several assumptions which revolve around cost and return on investment which will be addressed here.

Cost Assumptions

To sufficiently begin to evaluate the cost of a Product Support Business Case Analysis, we must decide when the PS-BCA is labeled "complete." For the purposes of our research, we consider the cost of a PS-BCA to be complete upon a final recommendation proposed to the decision-maker. We understand that there is residual work and cost that carry on throughout the life of a program, but a limit must be placed on the timeline.

We had to make some assumptions related to organically performed PS-BCAs. First, we assumed that the salary of the employees working on the team was not a "sunk cost." These salaries are real costs incurred to the DoD when an employee is being

paid for completing a job regardless of the task. Secondly, are there other effects happening within the Program Office with employees getting pulled from primary duties to conduct a PS-BCA and making others work longer hours to fill the gap in mission shortfall.

Return on Investment Assumptions

The primary assumption we made when measuring the Air Force's return on investment from a Product Support Business Case Analysis was that the decision maker would implement the recommended Course of Action (COA). This is one of the keys in deciding if the Air Force realized any savings. If the recommendation was simply to maintain the status quo, then the cost of conducting the Product Support Business Case Analysis may be considered a "loss," as the cost of the analysis resulted in no change to project plans. However, dollar cost/benefits should not be the only consideration. There are times that minimizing the life cycle cost of a weapon system is not the primary goal. In one instance, the main objective of the PS-BCA was aircraft availability and to maximize this availability, a much more costly option had to be chosen than the prior COA. Furthermore, the PS-BCA provides valuable information to the decision maker. Senior leaders may use this information to choose a COA with more information and confidence or even defend their decisions to Congress should it be necessary. Therefore, there are potential benefits from a PS-BCA even when no change to project plans is recommended.

If the stated objective of a PS-BCA is not to minimize the cost of a program's life cycle but is instead to attain a mission oriented goal like aircraft availability, costs and

returns must be measured in a different manner. Traditional quantitative methods may not be accurate in this scenario. This will be discussed in more detail in Chapter III.

Methodology and Data

Due to the nature of our data, the methodology for our research is multifaceted. The source of our data comes from a database provided by AFLCMC which includes information regarding PS-BCAs. Additionally, we have the physical PS-BCAs from which data was collected by reading each of the finalized versions of the PS-BCA to allow us to identify the most pertinent information for our research. The final source of our data comes from interviews with subject matter experts that worked on different programs. Therefore our methodology is a mixed-method approach incorporating both descriptive statistics and subject matter expert interviews to gain insight into the current process and how best to optimize the Air Force's return on investment.

Summary

This chapter outlines the importance of our research effort, some initiatives that drove the research effort, and the importance of evaluating how the process has evolved. With this information, we seek to answer our research questions, provide insight into the current process, and finally make recommendations on how best to optimize the return on investment. With this in mind, our research questions are as follows:

1. *What are the costs (Time/money/effort) of a PS-BCA and do the recommended benefits to the Air Force (Monetary/Non-monetary) outweigh these costs?*

2. *What is the average ROI the Air Force receives when doing a PS-BCA?*
3. *What changes to the current PS-BCA processes/guidance are necessary for the Air Force to receive optimal ROI?*

The next chapter will further discuss how the PS-BCA process has evolved and additional ways value can be measured.

II. Literature Review

Overview

For critics of the defense acquisition community, it is not a difficult case to make that weapon systems are too expensive, take too long, and are too complicated. While criticism may be warranted, the acquisition community has made great strides in its efforts to improve its processes. These improvements should not be discounted but instead built upon with further evaluation of processes and improvements. This continual process of improvements will allow for the DoD to optimize its investment dollars to best posture our Nation's defense in an ever changing and increasingly complex international environment.

There are many useful methods for analyzing complex problems, including Multiattribute Utility Theory (Dyer, Fishburn, Steuer, Wallenius, & Zionts, 1992), Analytic Hierarchy Process (AHP) (Saaty, 1980), Value-Focused Thinking (Keeney, 1992), and expert elicitation (Slottje, Sluijs, & Knol, 2008). The following books, reports, and articles are a brief sample of some of the most pertinent information on the history and process of Product Support Business Case Analyses (PS-BCA) and its evolution. Due to the recent focus on PS-BCAs and the nature of these processes, the majority of our samples are contemporary, but the DoD's efforts in getting the most "bang for the buck" is not a new concept.

DoD Product Support Business Case Analysis Guidebook

In 2008, the Assistant Secretary of Defense for Logistics and Materiel Readiness ASD(L&MR) established a group of representatives and experts among government, industry, and academia called the Product Support Assessment Team (PSAT) to drive the Department of Defense's effort to continue to improve product support, with a specific focus on increasing readiness and enabling better cost control. In 2009, the Weapon Systems Acquisition Reform Product Support Assessment (WSAR-PSA) was approved and signed by Dr. Ashton Carter, then Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)). The WSAR-PSA included many recommendations to improve life cycle product support including clarifying and codifying policies & procedures pertaining to the use of analytical tools, such as business case analysis (BCA) (DoD Product Support Business Case Analysis Guidebook, 2011).

The DoD Product Support BCA Guidebook is an additional step in the PSAT effort and supports Dr. Carter's memorandum on "Better Buying Power" from November 2010. This guidebook lays out a uniform approach for accurate, consistent, and effective support of value-based decision making, while improving the alignment of the acquisition and life cycle product support procedures. The guidebook also standardizes the DoD BCA process used to conduct analyses of costs, benefits, and risks. Subject matter experts from a variety of areas embedded their knowledge and expertise into this guidebook to help BCA practitioners serve their primary customers -- the warfighter and the taxpayer. This guidebook is considered a living document that will be updated in the future with new best practices and methodologies from lessons learned to continue to

provide overall guidance for conducting a Product Support Business Case Analysis (DoD Product Support Business Case Analysis Guidebook, 2011).

The DoD Product Support BCA Guidebook is organized into two primary sections. The first section is an *introduction to the Product Support BCA*. This section provides the background, people, roles and responsibilities, and the data management involved in creating a PS-BCA. This is important because the PS-BCA process is a relatively new requirement and, as such, is a new concept to many within the Department of Defense. The second primary section is *the product support BCA process*. This section provides the method of preparing the Product Support BCA, including research, data analyses, and delivery of a Product Support BCA report (DoD Product Support Business Case Analysis Guidebook, 2011). Once again, because of the relatively new requirements with PS-BCAs, there has not been a standard process in providing the reports to decision-makers.

The DoD Product Support BCA Guidebook is of paramount importance when it comes to explaining these new federal requirements to existing DoD employees and leadership. For the PS-BCA process to be successful, sufficient explanation of roles, responsibilities, and expectations is required to realize the ultimate goal of fiscally responsible mission success. The guidebook attempts to provide this explanation.

Air Force Life Cycle Management Center (AFLCMC) Standard Process for Product Support Business Case Analysis (PS-BCA) Process

In 2017, Air Force Life Cycle Management Center (AFLCMC) released the latest version of its standard process for Product Support Business Case Analysis (PS-BCA).

This guide builds and improves upon previous guidance on PS-BCAs like the DoD Instruction 5000.02, which first called out the need for a BCA to be done, the AFI 65-101 which specifically called out the need for a PS-BCA, and the AFPAM 63-123 which instructed program offices on “what to do.” However, the AFLCMC Standard process guide consolidates all of the previous guidance and improves upon it by detailing the “how/when” with PS-BCAs in an easy to follow, step by step guide for Program Offices to follow. This guide details what order each item of the PS-BCA should be in and what data are required for each section. This allows for each PS-BCA that is completed for AFLCMC to have a standard layout with specific information to meet the expectations of the decision-maker(s) (Air Force Life Cycle Management Center (AFLCMC), 2017).

Attributes of an Effective Product Support Business Case Analysis

Joseph Murphy, a senior financial analyst in the Office of the Secretary of Defense at the time, released a journal article in 2012 to explain the Department of Defense’s mindset/motivations behind the focus on PS-BCAs, clear up any confusion as to the intent of the DoD Product Support BCA Guidebook, and summarize what kind of characteristics make up an effective PS-BCA. He begins by describing that the April 2011 DoD Product Support Business Case Analysis Guidebook “represents the harvested fruit of many years of difficult, complicated efforts in establishing and understanding the product support related decision-making processes and materials through which DoD senior leaders maneuver” (Murphy, 2012, pp. 53-54). He further explains that this guidebook was necessary because the development and execution of major weapons

systems' sustainment strategies is one of the most complex and impactful decisions within the Acquisitions Community (Murphy, 2012).

The basics of a Business Case Analysis (BCA) performed by the DoD has the same fundamental structures and attributes consistent with any professional analytical study performed in the private sector. Simply stated, a BCA is any unbiased and transparent analysis of the benefits, costs, and risks of multiple courses of action that seek to best solve in a satisfactory manner any problem statement. The BCA must integrate analyses across multiple fields while also being comprehensive and strategic in order to best inform the decision maker. Ultimately, information is key and better decisions can be made when pertinent information is available to the decision maker (Murphy, 2012).

A New Methodology for Conducting Product Support Business Case Analysis

An article from the RAND Corporation brings a new perspective to conducting Product Support Business Case Analyses (PS-BCA). It focuses on the F-22 program, illustrating how the PS-BCA was completed and contrasting that with its recommended methods. The original F-22 BCA was conducted in 2009 and based on its findings, the Secretary of the Air Force decided to transition most functions from sustainment contractors to the government in an effort to save on life cycle cost (Camm, Matsumura, Mayer, & Siler-Evans, 2017). The fiscal year 2010 National Defense Authorization Act requires revalidation of PS-BCAs for major weapon systems at least every five years. So, in 2014, the F-22 System Program Office began a second PS-BCA for both the F-22 air vehicle and the F119 engine. This time, they asked RAND Project AIR FORCE to provide additional support. The subsequent BCA included a review of the Air Force's

progress in employing the recommendations from the 2009 Product Support BCA, identification of additional F-22 sustainment strategies that could be moved to organic support in 2018 and beyond, and an assessment of an assortment of alternative support strategies (Camm, Matsumura, Mayer, & Siler-Evans, 2017).

During this support for the F-22 Product Support Business Case Analysis, RAND engineered a new method to assessing and comparing the courses of action (COAs) that a BCA uses to define policy alternatives. This approach does not represent the way the Air Force traditionally conducts PS-BCAs but it is compliant with the Office of Management and Budget and U.S. Department of Defense policy. It proposes a new way to recognize and evaluate risk that can delay or even prevent the execution of a decided course of action. The RAND methodology incorporates the assessment of risk with cost analysis in a way that allows the user to categorize each COA in terms of dollars of net present value (NPV). The approach also seeks to capture the full risk effects of competing COAs. The resulting dollar-based figure of merit makes it easier for senior decision makers to compare COAs and to consider COA adjustments as they move toward decisions about product support (Camm, Matsumura, Mayer, & Siler-Evans, 2017).

To summarize the most important differences between the RAND approach and the traditional PS-BCA approach, please see Table 1. RAND believes that their approach offers three significant improvements compared to the traditional approach:

1. Uses dollar measures as opposed to using measures of value based on theoretical “scoring and weighting.” This avoids many of the possible issues associated with scores and weights in the current system.

2. Offers a natural way to incorporate thinking about risks with thinking about benefits and costs and uses standard project evaluation tools commonly used throughout the government and private industry.
3. Offers a natural way to integrate COA implementation challenges with information about COA benefits and costs. This is because many senior leaders have little interest in COAs that will result in significant difficulty putting into practice. This informs them upfront about implementation challenges and the effect on the value of a COA (Camm, Matsumura, Mayer, & Siler-Evans, 2017).

Table 1: How the RAND Approach Differs from That Typically Used in Product Support BCAs

(Camm, Matsumura, Mayer, & Siler-Evans, 2017)

Table 1. How the RAND Approach Differs from That Typically Used in Support BCAs	
RAND Approach	Traditional Approach
Provide a fully integrated assessment of the costs, benefits, and risks relevant to each COA. Use the standard cost-benefit guidance of OMB Circular A-94 to treat each COA as a formal investment alternative.	Assess costs, benefits, and risks separately. State cost in dollar terms. Summarize the probability and impact associated with each individual source of risk. Report subjective inputs in a summary five-by-five matrix that associates each source of risk with one of five levels of probability and one of five levels of impact.
Formally recognize the pervasive presence of uncertainty about the future. Capture this by presenting a subjective probability distribution for NPV for each COA.	Develop point estimates of cost and benefit. Rely on assessments of the probability and impact associated with each individual source of risk to convey implications of uncertainty.
Use sensitivity analysis to explore idiosyncratic uncertainties not likely to be captured in the subjective probability distribution for each COA.	Use sensitivity analysis to explore discrete uncertainties relative to some base case.
Focus on ensuring that every COA achieves a threshold target associated with the primary benefit highlighted in the BCA ground rules. Monetize the cost of ensuring that each COA achieves the threshold. Provide a framework to inform decisionmakers of the monetary cost of pursuing secondary benefits by preferring any COA other than the one that offers the highest NPV while achieving the primary threshold	Identify several—potentially many—benefits. Elicit information on their relative importance to decisionmakers. Score each COA on each benefit using scales normalized to be compatible with the measures of relative importance used. Identify the COA with the highest weighted score. Do not consider risks when calculating this score.
Use formal risk assessment methods to elicit any subjective inputs in a way that minimizes the opportunity for introducing bias. Use formal, transparent, repeatable methods to translate these inputs into quantitative figures of merit.	Guidance focuses on seeking inputs that properly reflect the scores and scales used to calculate a weighted score for each COA. It does not address methods that could unintentionally bias these inputs.

The RAND Corporation Report presented a case for conducting PS-BCAs differently in the future, including an argument that the value of the information presented to decision-makers would increase should such changes be implemented.

How to Measure Anything

Of course, minimizing cost is not the only objective for the Department of Defense. When other primary objectives come into play, like mission accomplishment, aircraft availability, troop readiness, leadership effectiveness, and protecting the lives of our service men and women, there is a need to find ways to measure intangibles. Without the tools to measure these intangibles, many decision makers could potentially be “flying blind” as they are unable to see the whole picture. Hubbard (2014) argues that anything can be measured regardless of how impossible it may seem. He goes on to claim that “if something can be observed in any way at all, it lends itself to some type of measurement method. No matter how ‘fuzzy’ the measurement is, it’s still a measurement if it tells you more than you knew before” (Hubbard, 2014).

To begin to measure these intangibles, we must start by asking the right questions. While his book is geared toward the private sector, the principles certainly apply to the Department of Defense as well. We should care about these measurements because they help “inform decisions” (Hubbard, 2014). With decision makers working with imperfect information, methods must be developed to analyze intangibles that help reduce uncertainty. Dr. Hubbard’s book provides valuable insight on how to capture these intangibles, use his modeling tools to measure them, and to help remove a degree of the uncertainty which plagues decision makers when courses of action must be chosen.

Conclusion

It is clear that there has been no shortage of effort and attention brought to bear on the problems surrounding the expense of fielding and sustaining weapon systems in a

complex and fiscally constrained environment. While most of these efforts surrounding Product Support Business Case Analyses have been concentrated in the last few years, clearly rapid revisions from lessons learned have been implemented to further improve the process. However, the question still remains if the Air Force is receiving sufficient return on investment in these policy decisions and implementations and through our research we have not found a definitive study exploring this area. Our research will attempt to measure the value the taxpayer is receiving for such a significant investment of time and money going into PS-BCAs.

III. Methodology

Overview

This chapter presents the methods and processes used in this research to determine the return on investment (ROI) for Product Support Business Case Analyses (PS-BCA) to include both monetary and non-monetary benefits. This chapter discusses the nature of the data and clarifies our approach in evaluating this data. A *mixed methods* approach taking advantage of both quantitative and qualitative data was used in our research. Primarily descriptive statistics were used to characterize the quantitative data. For the qualitative data, we solicited subject matter experts (SME) from different programs to interview and gain insight into commonalities and potential trends in the PS-BCA process.

Nature of the Data and Methods

The data is both quantitative and qualitative in nature. There are three different sources from which our research analyzed. First, we began by collecting data from twenty-four different product support business case analyses. Second, Air Force Life Cycle Cost Management Center (AFLCMC) provided a database with quantitative information about each PS-BCA. Finally, we collected our qualitative data by interviewing select Subject Matter Experts (SME) that were most closely tied to various weapon system programs.

The quantitative data was gathered from both the product support business case analyses and the AFLCMC database. By reading through each of the finalized PS-BCAs,

we were able to identify the most pertinent information for each case. Furthermore, the database provided other key information such as the cost of the PS-BCA, ACAT level, who conducted it, how long it took and more. After sorting through this information, we used descriptive statistics on this data as a way to order/rearrange the data set to find emergent themes and possible trends.

As previously mentioned, the qualitative data came from two rounds of interviews with subject matter experts within the Acquisitions career field. These were semi-structured, face-to-face interviews which lasted from 45-90 minutes each. The first round had seven questions with six interviewees. These questions were exploratory, in an effort to find common themes to focus the second round of interviews. We were able to expand the number of subject matter experts in the second round of interviews to eight and we asked them five multi-part questions. It should be noted that everyone that participated in the first round also participated in the second round. Although the interviews were not transcribed verbatim, extensive notes were taken, with only irrelevant side conversations left out.

To best organize and analyze the data, we used multiple techniques. One of which is called The Delphi Method and then we further built upon that method using a grounded theory approach in coding the language in these interviews to find emerging themes, which will be discussed in more detail later. As for the Delphi Method, this involves collecting opinions from Subject Matter Experts (SME) through a series of iterative questionnaires, with a goal of converging on a consensus among the group. Since its development in the 1950's by the RAND Corporation, several refinements and

modifications have been made, such as specific strategies for different fields including business, government, and healthcare (Dufresne, 2017).

Many variants of the Delphi Method have been used in practice. Despite this, Linstone and Turoff have captured common characteristics in the following description:

Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this “structured communication” there is provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or view; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses (Linstone & Turoff, 1975, p. 3).

The Delphi Method can be a valuable research process when there is no way to know the true/knowable answer in an area, such as decision-making, policy, or long-term forecasting. This can include multiple opinions that vary widely -- useful to prevent reliance on a single expert -- which could lead to bias (Dufresne, 2017).

An example of the communication process in the Delphi Method can be observed in Figure 2. For our research, we selected Subject Matter Experts closely tied to several Weapon System Product Support Business Case Analyses within AFLCMC. We conducted our first round of interviews to elicit their responses regarding if the Air Force is receiving sufficient return on investment (ROI) for the time and costs involved with these PS-BCAs. We analyzed their responses and conducted a second round of questioning, focusing on non-monetary benefits, data driven decision-making, and the leadership perspective.

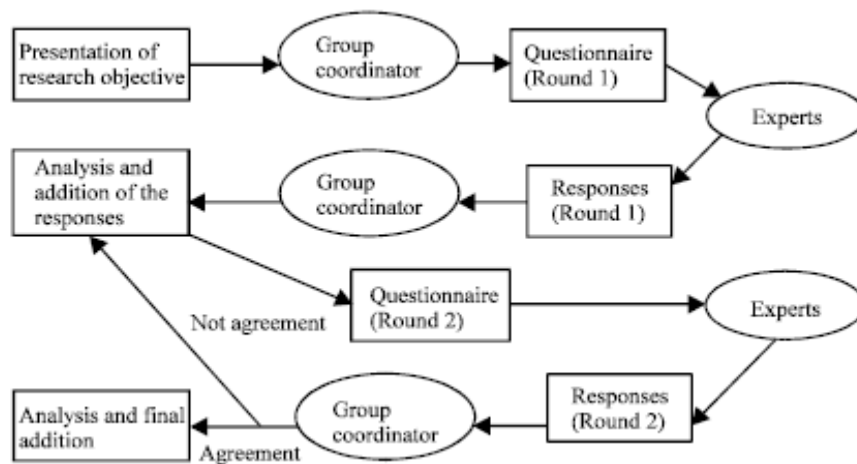


Figure 2: Communication process in the Delphi Method (Chang & Yang, 2011)

In our research, we used a mixed methods approach to best utilize our varying data sets to find the emerging themes and trends. To help identify these emerging themes and trends with the qualitative data, we analyzed every response provided to our research questions and “coded” the language into categories which best described the intent of the respondent. These codes were then “rolled up” to higher level codes which captured more overall themes to allow for trends to emerge. An example of this coding of responses can be observed in Table 2.

Question #	Respondent Code	Higher Level Code	SubCode Level	Response
1	1	Communication	Education Gap	People don't seem to know what a PS-BCA even is or the goal of one. Contractors being paid to conduct them included.
1	2	Process Concern	Box Checking	So often it is a "box-checker" when leadership already knows that they aren't going to change.
1	3	Value of Information	Informed Decision Maker	It brings into spotlight the problems that exist in a program - See the CRH as an example, it said to build a depot but it goes against DSOR (A-4) policies but it let leadership know there is a problem in the process.
2.1	6	Process Concern	Govt Resource Drain	Contractor did help in conveying the story of the program but lots of effort still on the government.
2.1	5	Roll-up	Process Improvement	Having a dedicated team dramatically shortens the learning curve
2.2	6	Roll-up	Removes bias	Someone unbiased and that can look across platforms
3.1	2	Buy-in issue	Process Concern	Have leadership buy-in and implement the recommendations.
3.1	3	Evolving for Better	Improving	Guidance is good and continues to improve.
3.1	5	Suboptimal ROI	Process Improvement	Need smaller group for vector checks. Too many people involved to get anything done (30+ people).
3.2	2	Evolving for Better	Improving	Transparency of the standard process that can be followed/traceable. Everyone was able to be on the same page and understand.
3.2	1	Value of Information	Removes bias	Allows for using objectivity to help remove bias when making decisions
3.3	5	Evolving for Better	Improving	Not much lacking now as process has improved.
4	3	Suboptimal ROI	Govt Resource Drain	The length of time it takes to complete the coordination process really draws the timeline out.
4	5	Process Concern	Govt Resource Drain	How long it takes to complete. You lose team members over the course of one (PCS, promotions, etc) before completed. Having to explain/rehash same conversations with new leadership/people. Inefficient.
5	5	Roll-up	Resource Gap	Higher level can drop money quicker as opposed to losing opportunity/savings by delaying activations.
5	5	Roll-up	Process Improvement	DoD/SAF doing PS-BCAs Can optimize across platforms and then implement quicker.

From these codes, we then sorted and organized those codes for each separate question asked to our subject matter experts and clustered those codes into specific themes for the individual questions. This allowed us to have two different levels of emergent themes; one coded at a higher level and one coded at the question level. The analysis and results of this data will be discussed in more detail in Chapter IV.

Institutional Review Board

This research contains a Delphi study that, by its nature, involves working with human subjects. Therefore, the research is subject to the oversight of the Institutional Review Board (IRB) as required by the Code of Federal Regulations (CFR), Title 32, Part 219. The purpose of this oversight is to protect the individuals involved in the study and their rights. Specifically, the individuals are to be protected from reprisal or from damage to their financial standing, employability, or reputation. Additionally, this oversight ensures that Personally Identifiable Information (PII) for these individuals is protected and not inadvertently released (32 CFR 219.101, 2014).

At the beginning of this research, a plan for the study was presented to the IRB for review. This plan outlined the method for protecting the rights of the individuals who participated in the study and the manner in which their rights and PII would be safeguarded. The IRB reviewed this plan and made a determination that the research was exempt from human experimentation requirements as defined in 32 CFR 219 paragraph (b) (2) on 13 August 2018. This determination memorandum is included in Appendix A.

Conclusion

This chapter has presented the methodology utilized in this research to provide insight into the significant factors which allow for assessing the Air Force's Return on Investment for Product Support Business Case Analyses. The Delphi study conducted along with the participants, and the descriptive statistics used for this research were described. The results of these methods are presented in Chapter IV.

IV. Analysis and Results

Overview

The previous chapter presented the research methodologies used in this thesis. This chapter discusses the analysis and results found by the research team during this study. The methodologies outlined the processes designed to ascertain if the Air Force is receiving sufficient return on investment from its conducting of required Product Support Business Case Analyses. The Delphi study as described in Chapter III was conducted between August and December of 2018. The results of each round of this study and an analysis of these results are presented in this chapter. Additionally, this chapter also analyzes the results from the quantitative data gathered from the AFLCMC database. Finally, we will explain the results of all scoring and consensus building to answer our research questions.

Quantitative Data

As discussed in the previous chapter, the quantitative data was gathered from the finalized product support business case analyses and also a database provided by AFLCMC. The original database included 24 different programs with various ACAT designations and all at different stages in the process and can be viewed in Table 3 below.

Table 3: Original Quantitative Data Set							
Program Name/Platform	ACAT	Milestone	BCA Start Date	Estimated Completion Date	Organic or Contract	Total Estimate Cost of PS-BCA	Completion Date thru Step 1.11 (MDA Approval)
Program A	ACAT IC	Post MS-C	3/11/2013	1/31/2014	Organic	\$ -	7/22/2014
Program B	ACAT IAD	MS B	9/25/2013	4/30/2014	Contract	\$ 4,500,000	8/21/2014
Program C	ACAT II	Post MS-C	1/22/2014	12/31/2014	Organic	\$ 65,000	4/21/2015
Program D	ACAT II	Post MS-C	1/22/2014	12/31/2014	Organic	\$ 65,000	4/21/2015
Program E	ACAT ID	MS C	3/20/2014	4/17/2015	Contract	\$ 2,100,000	5/11/2015
Program F	ACAT ID	Post MS-C	5/1/2014	5/29/2015	Contract	\$ 1,257,000	5/29/2015
Program G	ACAT IAC	MS B	2/10/2015	6/1/2015	Organic	\$ 33,657	6/1/2015
Program H	ACAT ID	MS A	3/6/2015	6/30/2015	Contract	\$ 345,000	6/30/2015
Program I	ACAT IAD	MS B	9/5/2014	8/24/2015	Contract	\$ 456,000	7/7/2015
Program J	ACAT ID	Post MS-C	5/6/2014	9/30/2015	Contract	\$ 3,330,366	9/30/2015
Program Ja	""	""	""	""	""	""	
Program Jb	""	""	""	""	""	""	
Program K	ACAT IAD	MS B	7/2/2012	8/21/2015	Contract	\$ 6,359,646	9/30/2016
Program L	ACAT IC	Post MS-C	7/29/2014	1/28/2016	Contract	\$ 2,748,772	12/15/2015
Program M	ACAT IC	Post MS-C	9/15/2015	9/15/2016	Contract	\$ 3,200,000	12/16/2016
Program N	ACAT II	MS B	7/1/2016	12/31/2016	Contract	\$ 600,000	8/10/2017
Program O	ACAT IC	MS C	5/1/2015	2/17/2017	Contract	\$ 438,000	8/10/2017
Program P	ACAT IC	Post MS-C	4/1/2016	7/31/2017	Contract	\$ 757,408	11/2/2017
Program Q	ACAT IC	Post MS-C	10/4/2016	1/3/2018	Contract	\$ 2,260,589	
Program Qa	""	""	""	""	""	""	
Program Qb	""	""	""	""	""	""	
Program Qc	""	""	""	""	""	""	
Program R	ACAT IC	MS B	7/11/2016	12/8/2017	Contract	\$ 2,104,745	
Program S	ACAT IC	MS C	8/15/2017	5/1/2018	Contract	\$ 1,020,000	
Program Sa	""	""	""	""	""	""	
Program Sb	""	""	""	""	""	""	
Program T	ACAT I	Post MS-C	12/5/2017	12/4/2018	Contract	\$ 3,098,584	
Program U	ACAT II	MS A	1/9/2017	4/6/2018	Contract	\$ 1,800,000	
Program V	ACAT IC	Post MS-C			Contract		
Program W	ACAT IC	Pre MS-C					
Program X	ACAT ID	MS-A			Contract		

Prior to 2016, there was no standard format for conducting Product Support Business Case Analyses. Therefore, all programs prior to that year were eliminated from our data set as the data was inconsistent and unreliable for our analysis. Furthermore, of the dataset, five other programs were in the middle of their PS-BCAs so without any final data to analyze, we eliminated them from our analysis. This left us with a sample size of seven. While this sample size is too small to draw any concrete conclusions, it may help

us gather some insight into possible trends and items of interest. The final data set can be viewed in Table 4 below. All COA values are in BY2018 dollars.

Table 4: Analyzed Data Set									
Program	Estimated Cost of PS-BCA	COA1	COA2	COA3	COA4	COA5	COA6	COA7	Proposed COA
Program M	\$ 3,200,000	\$ 4,897,709,280.00	\$ 3,285,804,960.00	\$ 3,195,910,296.00	\$ 3,135,980,520.00	\$ 3,047,119,128.00	\$ 4,312,877,328.00	\$ 4,456,502,136.00	COA4
Program N	\$ 600,000	\$ 22,680,320.40	\$ 43,666,074.72	\$ 19,818,156.96	\$ 22,680,320.40	X	X	X	COA4
Program O	\$ 438,000	\$ 125,169,359.91	\$ 139,842,930.14	\$ 150,150,373.21	\$ 169,200,642.35	\$ 179,434,083.26	X	X	COA4
Program P	\$ 757,408	\$ 6,618,224,000.00	\$ 6,704,584,000.00	\$ 6,767,576,000.00	X	X	X	X	COA1
Program Q	\$ 2,260,589	Below	Below	Below	Below	Below	X	X	See Below
Program Qa	""	\$ 288,000,000.00	\$ 468,000,000.00	\$ 492,000,000.00	\$ 475,000,000.00	\$ 499,000,000.00	X	X	COA1
Program Qb	""	\$ 774,000,000.00	\$ 905,000,000.00	\$ 771,000,000.00	\$ 656,000,000.00	\$ 522,000,000.00	X	X	COA5
Program Qc	""	\$ 202,000,000.00	\$ 371,000,000.00	\$ 371,000,000.00	\$ 381,000,000.00	\$ 381,000,000.00	X	X	COA1
Program R	\$ 2,104,745	\$ 1,085,494,400.00	\$ 1,320,942,240.00	\$ 1,332,920,880.00	X	X	X	X	COA2
Program S	\$ 1,020,000	Below	Below	Below	Below	X	X	X	See Below
Program Sa	""	\$ 298,886,880.00	\$ 235,458,000.00	\$ 272,978,880.00	\$ 388,853,680.00	X	X	X	COA3
Program Sb	""	\$ 89,997,280.00	\$ 74,706,480.00	\$ 98,633,280.00	X	X	X	X	COA2

Since 2016, all PS-BCAs have been conducted by various contractors. The costs of these paid to the contractor ranged from \$438,000 to \$3,200,000 to complete, totaling a cost to the tax payer of \$10,380,742 over seven Product Support Business Case Analyses. The average cost of these PS-BCAs is \$1,482,963 with a median of \$1,020,000. In the analysis of alternatives section of the PS-BCA, COA 1 is traditionally labeled as the Status Quo or Baseline. This means that all alternative COAs compare to that standard when it comes to the analysis. Two of the seven PS-BCAs had multiple parts of the weapon system being evaluated. So, while there is a price for just one PS-BCA paid to the contractor, it was examining two and three parts/items of the weapon system respectively. While examining these seven PS-BCAs, in actuality, this gave us 10 data points to evaluate when looking at the potential savings. In examining these seven PS-BCAs with 10 different items, the status quo was recommended three different times or 30% of the time, meaning after the expense and time to complete the PS-BCA, there was no change recommended to leadership.

Table 5: Analyzed Data Set Results						
Program	Estimated Cost of PS-BCA	Proposed COA	Alternative COA Cost Avg	Avg Alternative COA Cost Savings	Proposal Savings	If implemented, Savings less PS-BCA Cost
Program M	\$ 3,200,000	COA4	\$ 3,572,365,728.00	\$ 1,325,343,552.00	\$1,761,728,760.00	\$ 1,758,528,760.00
Program N	\$ 600,000	COA4	\$ 28,721,517.36	\$ (6,041,196.96)	\$ -	\$ (600,000.00)
Program O	\$ 438,000	COA4	\$ 159,657,007.24	\$ (34,487,647.33)	\$ (44,031,282.44)	\$ (44,469,282.44)
Program P	\$ 757,408	COA1	\$ 6,736,080,000.00	\$ (117,856,000.00)	\$ -	\$ (757,408.00)
Program Q	\$ 2,260,589	See Below				\$ 249,739,411.00
Program Qa	""	COA1	\$ 483,500,000.00	\$ (195,500,000.00)	\$ -	
Program Qb	""	COA5	\$ 713,500,000.00	\$ 60,500,000.00	\$ 252,000,000.00	
Program Qc	""	COA1	\$ 376,000,000.00	\$ (174,000,000.00)	\$ -	
Program R	\$ 2,104,745	COA2	\$ 1,326,931,560.00	\$ (241,437,160.00)	\$ (235,447,840.00)	\$ (237,552,585.00)
Program S	\$ 1,020,000	See Below				\$ 40,178,800.00
Program Sa	""	COA3	\$ 299,096,853.33	\$ (209,973.33)	\$ 25,908,000.00	
Program Sb	""	COA2	\$ 86,669,880.00	\$ 3,327,400.00	\$ 15,290,800.00	
	\$10,380,742		\$13,782,522,545.93	\$ 619,638,974.38	\$1,775,448,437.56	\$ 1,765,067,695.56

In the above Table 5, one may observe that of the recommended COAs, which are all in BY2018 dollars, if all the recommended changes were implemented (also subtracting out the contractor cost of the PS-BCA), the Air Force would save approximately \$1.765B. However, it is worth noting that one program alone saved the Air Force over \$1.75B should the recommendations be implemented, so this instance certainly skewed the data. To guard against the outliers, we removed the program that gave the most savings and the program that would cost the most to implement which may be observed in Table 6 below.

Table 6: Analyzed Data Set Results						
Program	Estimated Cost of PS-BCA	Proposed COA	Alternative COA Cost Avg	Avg Alternative COA Cost Savings	Proposal Savings	If implemented, Savings less PS-BCA Cost
Program N	\$ 600,000	COA4	\$ 28,721,517.36	\$ (6,041,196.96)	\$ -	\$ (600,000.00)
Program O	\$ 438,000	COA4	\$ 159,657,007.24	\$ (34,487,647.33)	\$ (44,031,282.44)	\$ (44,469,282.44)
Program P	\$ 757,408	COA1	\$ 6,736,080,000.00	\$ (117,856,000.00)	\$ -	\$ (757,408.00)
Program Q	\$ 2,260,589	See Below				\$ 249,739,411.00
Program Qa	""	COA1	\$ 483,500,000.00	\$ (195,500,000.00)	\$ -	
Program Qb	""	COA5	\$ 713,500,000.00	\$ 60,500,000.00	\$ 252,000,000.00	
Program Qc	""	COA1	\$ 376,000,000.00	\$ (174,000,000.00)	\$ -	
Program S	\$ 1,020,000	See Below				\$ 40,178,800.00
Program Sa	""	COA3	\$ 299,096,853.33	\$ (209,973.33)	\$ 25,908,000.00	
Program Sb	""	COA2	\$ 86,669,880.00	\$ 3,327,400.00	\$ 15,290,800.00	
	\$ 5,075,997		\$ 8,883,225,257.93	\$ (464,267,417.62)	\$ 249,167,517.56	\$ 244,091,520.56

Of the remaining programs, if the recommendations are implemented, the Air Force could realize over \$244M (BY2018) life cycle cost savings averaging approximately \$48.8M per program. With these remaining 5 programs, 3 of them, or 60%, would have cost more money in comparison to the status quo with a median of - \$600,000. The only two programs left that were in the positive were the two that had multiple parts of the weapon system being evaluated in a single Product Support Business Case Analysis. One saved the Air Force nearly \$250M and the other saved over \$40M. As mentioned previously, one must be cautious not to draw any concrete conclusions based on such a small sample size. In taking the entire sample size in consideration (see Table 5 above), approximately 70% of the Product Support Business Case Analyses will either cost the Air Force more money to implement over the status quo or no change was recommended after spending the resources to conduct them. It is also clear that one “homerun” of a PS-BCA which saves the Air Force nearly \$2B if implemented can skew the entire data set and suggest that it is always worth doing regardless of circumstances,

even if all the other PS-BCAs are cost prohibitive to conduct. Lastly, when examining the dataset, the other piece worth mentioning is that once the outliers were removed, the only two PS-BCAs with a positive return on investment were the ones that had combined multiple requirements of a weapon system. This, at a minimum, lends credence to the line of thinking that combining requirements could potentially save the Air Force more money and get a better return on investment. We will explore this as a potential course of action in more detail in the following sections.

Qualitative Data

As discussed earlier, the goal of the Delphi Method is to solicit opinions from Subject Matter Experts (SME) through a series of semi-structured interviews and/or questionnaires, with a goal of converging on a consensus among the group. Upon asking our questions to the SMEs we recorded their answers and coded each sentence from their answers in a manner consistent with the sample in Chapter III, and reviewed the data to see what trends emerged. Table 7 shows the trends that emerged from our language coding throughout our two rounds of interviews.

Table 7: Emerging Themes	
Suboptimal ROI	75
Process Concern	72
Roll-up	40
Value of Information	34
Evolving for Better	27
Communication	21
Too Early	14
Other	2

Out of a possible 285 different responses, our coding procedure showed that the top emerging trends revolved around concern for the PS-BCA process followed closely by the Air Force receiving suboptimal return on investment with these current processes. To get a better idea of the context for these coding responses, we separated each code by question asked for each round. We then clustered those codes around similar themes to apply to each question asked of our subject matter experts. Therefore, the following section is divided into two parts, one for each round of interviews. We will show the question and the clustered responses below and then conclude with a summary.

Round One Interviews

The first round of interviews was with select participants within the acquisitions community that had personal experience working on or overseeing Product Support Business Case Analyses. In this round, we had six initial interviews with responses to each of the seven questions. The initial round the researchers took an exploratory approach with the questions which are purposely broad to establish a path toward more direct questions in the second round. We took the highest similarly clustered responses from our coding, posted them in each table, and used these responses to establish

common themes for each initial investigative question. For example, the topics discussed by participants in response to the first question appear in Table 8. These responses are not all-inclusive but instead are the top emerging themes from the replies to show consensus around the specific interview question asked. The right column in each table contains the number of experts that had responses that were clustered together as similar responses from the coding procedure. It is important to note that this is not the number of respondents that responded to the question, but rather the number of responses that were clustered together as the same/similar in context to the question asked.

Table 8: Response Subjects Question 1.1

Based on your experience in conducting Product Support Business Case Analyses (PS-BCA), what are the most significant opportunities and challenges of current policy requirements?	
Response: Opportunities	# of Expert Responses
The Process is improving/evolving for the better.	4
PS-BCAs do provide some value to decision makers	3
Response: Challenges	
Lack of understanding why we do them/Being done to "check a box"	5
Bias/Fear of Bias/Subjective inputs	4
The way it is done now is not providing optimal ROI	4

The responses in Table 8 show that the participants strongly believe that the processes around conducting Product Support Business Case Analyses are improving with each iteration. Furthermore, there were several responses from the experts that a PS-BCA provides some value to the decision maker. This value may not always be found in cost savings, but instead could be found in the value of information, a more informed decision being made, or simply knowing that the current course of action is

optimal. On the other hand, when it came to the challenges of the PS-BCA, there was near unanimous mention that the purpose is unclear or that the effort is a “checking a box” exercise. There is a prevailing feeling that the BCAs are not taken seriously by leadership: that nothing will ever change, and are simply doing them because they “have to.” Furthermore, there is a perception of predetermined outcomes. Consciously or unconsciously, leadership may signal a course of action they anticipate from the PS-BCA and engineer the subjective weights and measurements to elicit that outcome. Lastly, across the board, there was a theme that the way we are conducting PS-BCAs currently, while having some value, does not provide the Air Force with optimal return on investment. The process either takes too long, is too expensive, or is too inefficient. Alternatively, the recommendations are simply not executable.

Table 9 below presents the responses to question 2 of the first round. It focused on the simple concept of what the respondents believed was the most effective way to measure the ROI on PS-BCAs.

Table 9: Response Subjects Question 1.2

In your view, what is the most effective way to measure the Return on Investment (ROI) on PS-BCAs?	
Response	# of Expert Responses
Too Early to tell/TBD	7
Value of information	6

The responses were fell into two categorical clusters. From the dollar value standpoint of ROI, it is “To Be Determined.” The current processes are too new to draw any concrete conclusions and no system has yet entered a second PS-BCA using these processes. Ultimately, we will need to wait and see. However, most respondents

mentioned that there is value in solely in the information provided from a product support business case analysis. Some followed up with the fact that regardless of the recommendations, just having more information than was previously available was most certainly a good thing for the decision maker. Also mentioned in the interviews was that we should be cautious not to just measure “dollars” as they do not tell the whole story. For example, suppose a weapon system’s management is reviewing ways to minimize downtime for repairs. If the PS-BCA concludes that the best way to achieve this is to build an expensive new depot, it would appear that this PS-BCA had a negative ROI. However, if the recommendation is implemented, it could be argued this weapon system would have successfully achieved its stated goal/purpose. Therefore, it is important to be mindful of the goal of each PS-BCA when measuring the return on investment.

Table 10 shows the responses to the more direct question to our subject matter experts regarding if they believed the Air Force is receiving sufficient return on investment from conducting Product Support Business Case Analyses.

Table 10: Response Subjects Question 1.3

Do you find/feel that the Air Force is receiving sufficient ROI from PS-BCA’s? Why or why not?	
Response:	# of Expert Responses
Yes	1
No	3
Undecided	2
Response:	
Top Reason for Yes: "High ROI on the information to decision makers"	1
Top Reason for No: "Recommendations not implemented"	2
Top Reason for Undecided: "Too early to tell for sure"	1

Most responses for this question were either “No” or “Undecided.” The top reason for “No” was “recommendations not implemented” lending credence to the perception that this documentation is may not really matter regardless of the recommendations. Many believe that they are just “checking a box” and if that is the initial perception going in and feeling that leadership doesn’t value their efforts to come up with a better way to do things, and then many could see the recommendations not being implemented as “confirmation” of their perception. The “undecided” mostly leaned on the “too early to tell for sure” which makes sense as this is a new process in its current, more standardized iteration. Only one of our SMEs said it was worth it due to the value of information to the decision-maker. This SME also mentioned that even if we don’t implement the recommendations, the fact that leadership has more data than they did prior to the PS-BCA, makes it worth the efforts alone.

The fourth question of round 1 asked our experts about how often the Product Support Business Case Analysis recommends a change to the status quo or baseline and how often those changes, if recommended, are implemented.

Table 11: Response Subjects Question 1.4

How often does a PS-BCA recommend a change in the expected course of action (status quo/baseline) and how often is that change actually implemented?	
Response	# of Expert Responses
For Legacy programs, very rarely, if ever	3
Doesn't matter, the process is so inefficient/changes probably won't happen	4
Too Early to tell	2

Our group of experts were clearly less than optimistic about implementing changes with the PS-BCA. For legacy programs, due to the nature of the weapon system being in sustainment for many years in some cases, some made mention that changing anything could present unnecessary risk to something the warfighter depends on now for the mission at hand. Therefore, many legacy platforms are not recommended for a change in direction for maintaining them in the PS-BCA. Therefore, putting the time, money, and effort into them potentially produces no realized return on investment for the Air Force. Regarding the process and the PS-BCAs for new programs, our experts also showed some pessimism in the process. There were four responses out of the six SMEs coded that “it didn’t matter” or “referenced the inefficient process.” Once again, this points to a perception/mentality that no matter what, the recommended changes probably are not happening regardless of the benefit to the Air Force. Lastly, two replies were coded at “Too early to tell” due to the nature of the current standardized processes being very new.

Our next question explored the feasibility of conducting Product Support Business Case Analyses organically. Prior to 2016, there were several PS-BCAs that were conducted organically and they tended to be far less expensive.

Table 12: Response Subjects Question 1.5

What are the implications of conducting a PS-BCA organically or through a contractor?	
Response: Organic	# of Expert Responses
With proper manning/training, organic is preferred	5
Potential bias if left to Program Office	2
Concern with adequate/consistent workflow	2
Response: Contractor	
Contractors do not remove workload burden off government workers	5
Contractors process is getting better	3
High cost of using contractors	4

All of our subject matter experts were very open to the idea of finding a way to conduct PS-BCAs organically as it would save the government substantial dollars. However, many of these responses came with caveats related to the PS-BCA needing to be done correctly; otherwise it would likely make the process worse. Proper manning and training would be keys to the success of implementing the PS-BCA process organically. There was some concern that an organic PS-BCA team may not consistently have enough to do each day, lending credence to the idea that the process should be rolled up to a level above the program office level. Furthermore, this would remove any concerns of bias that were expressed as well.

Table 13 below shows another broad question asked of our subject matter experts where we were trying to find some commonality among them to narrow our focus in later interviews. We asked our panel of experts what are some of the important considerations that would enhance or inhibit the effectiveness of a product support business case analysis.

Table 13: Response Subjects Question 1.6

What are some important considerations that would either enhance or inhibit the effectiveness of PS-BCA's?	
Response:	# of Expert Responses
Better Communication/Leadership Backing	6
Conducting/thinking on a larger scale will enhance return on investment	5
Done too early in the process	3
Process is inefficient/takes too much time	5

There was a lot of consensus around needing better communication around the process from leadership and the importance of leadership buy-in when it comes to implementing the recommended changes. If no changes will be implemented, even if the PS-BCA recommends it, then leadership should effectively communicate why no change is happening whenever possible. There were also several comments regarding doing these on a larger scale to enhance the return on investment. As an example, if there are several jets using the same landing gear, why is each program office doing a separate PS-BCA? There should be a way to roll it up to a higher level and conduct one PS-BCA to consolidate resources and get a better ROI. The last point which had the greatest amount of consensus is related to the process. The PS-BCA takes too much time and is too inefficient.

In our final question to our panel of experts, we asked if there were any other items not discussed as a “catch all” with our initial round of questioning.

Table 14: Response Subjects Question 1.7

What would you like us to know about PS-BCA's and the ROI that we have not already discussed?	
Response:	# of Expert Responses
Not optimizing our resources/ROI with PS-BCA process status quo	6
Tracking/follow-up is an issue	3
Communication is an issue	3

Per the table 14 above, there was near consensus that despite the improvements, we are not optimizing our resources or return on investment for our product support business case analysis process. According to our SMEs, there is clearly still plenty of room for improvement in the process.

Round Two Interviews

We used the responses from our subject matter experts to generate the questions for our second round of interviews. The goal was to focus more specifically on actionable recommendations. We were able to gather insights from two additional subject matter experts for round two as well. Their replies are included in the results in the tables below.

The first question of our round two interviews was related to the feedback received in round one regarding the informational/decision making data. Nearly all the subject matter experts agreed that there is value in doing the Product Support Business Case Analysis (PS-BCA) because of the information gained. In our question, we wanted to know if these courses of action in the PS-BCA were not implemented, was the

informational/decision making data enough to justify the time/effort/money invested into them. Table 15 below shows the replies from our SMEs. The first portion of the table shows the simple Yes/No reply to the question. However, the second part of the table shows the clustering of their replies from our coding and how they line up with their answer to the first part of the question.

Table 15: Response Subjects Question 2.1

In your view, is the informational/decision making data the Air Force receives from the Product Support Business Case Analysis (PS-BCA) sufficient to justify the time/money/effort invested into them? Why or why not?	
Response:	# of Expert Responses
Yes	2
No	6
Response:	
Not worth it if leadership does not implement cost saving COAs	11
Current process is too inefficient to optimize ROI	7
Data alone make it worth the cost of doing a PS-BCA	2

Six of our eight subject matter experts said that if the Air Force does not implement the changes or course of actions that a PS-BCA recommends, it is not worth the time/money/effort of doing them. These responses were coded saying that the changes must be implemented by leadership for the Air Force to receive sufficient return on investment. There were seven responses making mention that it did not matter because the process is too inefficient currently for the Air Force to optimize ROI. There were two responses coded in saying that the value of the data alone is enough to justify

and that the PS-BCA continue and whether or not the recommendations are implemented should not factor in to the cost of doing them.

In round 1, there were several comments regarding the process needing to be rolled up/done at a higher level and should be conducted organically to realize the best rate of return for PS-BCAs. Question 2 is broken down into two parts with part a asking our experts to rate on a scale how beneficial it would be having a dedicated/trained office to conduct the PS-BCA and part b asked our experts at what level these need to be conducted to optimize ROI. Table 16 and Table 17 below show the clustering of their coded replies for this question.

Table 16: Response Subjects Question 2.2a

On a scale of 1-5, how beneficial would it be to the Air Force’s Return on Investment (ROI) to have a dedicated/trained office specifically tasked with conducting PS-BCA’s organically? Please elaborate. Note: 5 being overwhelmingly beneficial and 1 being no benefit at all.	
Response:	# of Expert Responses
1	0
2	1
3	1
4	3
5	3
Response:	
Must be done right to realize return on investment	7
Sees pros/cons to either choice	3
Status quo of process is best way forward	2

Six of our eight interviews rated the benefit a 4 or 5 when expressing how beneficial it would be to the Air Force in conducting these organically and with a dedicated/trained staff. There was a caveat in almost all of those responses; however, as

they said that it must be implemented correctly for optimizing return. If it was not implemented with sufficient manpower or training, it would not be in the Air Force’s best interest to do this. Only two replies said that the current process using contractors is the best way forward.

Table 17: Response Subjects Question 2.2b

At what level do you feel PS-BCAs should be conducted to provide the highest ROI to the Air Force? Please elaborate on your selection.	
Response:	# of Expert Responses
AFLCMC Functional (LG Home Office/AQ (Prog Mgt)/EN/FM	1
Center of Expertise Equivalent	4
DoD/OSD	1
Major Product Centers (LCMC/SMC/NWC)	2
Response:	
Need to look across platforms to optimize ROI	4
Removes Bias	3
Status quo of process is best way forward	2

When asking part b to question two, there were various viewpoints on at what level these PS-BCAs should be conducted. However, 50% of our subject matter experts agreed that there should be an Air Force Center of Expertise equivalent for the acquisitions field to optimize the return on investment for this analysis. There was an overwhelming response around the fact that the Air Force needs to look across platforms to optimize ROI and by doing so and conducting at a higher level, this would remove any potential bias from those invested in the outcome of what a PS-BCA recommends.

Question 3 was broken into three parts in an effort to get candid feedback on where the Product Support Business Case Analysis (PS-BCA) process can be improved,

where the guidance was most beneficial/useful, and where it was lacking/had contradictions. These results are in Tables 18-20 below.

Table 18: Response Subjects Question 2.3a

Now that you have gone through the process, do you have any recommendations to improve the PS-BCA guidance?	
Response:	# of Expert Responses
Don't do blanket 5 year requirement/Each system has unique needs	4
Guidance is pretty good now overall and continues to improve	5
More leadership support and communication	2

Most of our subject matter experts agreed that the guidance is good overall now as opposed to the way it was before it was standardized. They also said that the guidance also continues to improve. The most widely categorized recommendation was for there not to be a blanket five-year requirement in doing the PS-BCA. Additionally, there were responses addressing leadership involvement. The thought process behind these responses is that if leadership were more involved in expressing how PS-BCAs help them make decisions or communicate reasons behind not implementing a recommendation, it could help those working on the PS-BCA see a purpose that is not just a “check the box” project to meet some requirement. It instead makes a difference and their efforts are valued.

Table 19: Response Subjects Question 2.3b

What was the best/most useful aspect of the provided guidance?	
Response:	# of Expert Responses
Spells out process/way forward/responsibilities	9
Brings transparency/fidelity/standardization to process	8

When asked about the best/most useful aspects of the guidance, the respondents pointed overwhelmingly to two key issues: 1) how to conduct the PS-BCA, and 2) who is responsible for each part of the process. This was something that our program offices did not have early on and points to a clear improvement over time. Respondents also referred to the transparency and fidelity that is now part of the process. Again, there appears to be consensus that the process much more clear and transparent now.

Table 20: Response Subjects Question 2.3c

Where was the guidance lacking? Did you find any specific contradictions?	
Response:	# of Expert Responses
Not much lacking/Good overall/process improving	6
More details needed on the concept of incremental cost rates	2
Other misc. process concerns	2

When asking our subject matter experts to point out, for the most part, there was consensus on “not much is lacking now” and that “the process is good overall.” Only a few responses were coded for minor clarifications or changes but nothing major

regarding the overall guidance which is certainly a testament to the improving of the process since its inception.

Question 4 was geared to asking the simple question of what surprised our interviewees now that they have gone through the process of conducting a Product Support Business Case Analysis (PS-BCA) start-to-finish.

Table 21: Response Subjects Question 2.4

In going through the process, what surprised you?	
Response:	# of Expert Responses
Time/Effort to complete	8
Varying degree of expertise for those involved	3

The clear consensus to this question revolved around the time/effort it takes to complete a PS-BCA. The longer it takes, the more risk there is involved in the process for the costs to escalate and the Air Force not to receive optimal return on its investment. There are instances in which people/leadership involved on a PS-BCA leave for various reasons and then the team has to replace that person and get them up to speed. Also, the different checkpoints, meetings, and briefings add to the time significantly in completing these.

The final question of this round was asked with the intent to be a “catch all” on anything not discussed already or anything we may have missed. We asked our experts if they had any parting thoughts on the process of PS-BCAs and how the Air Force can

receive optimal return on investment. Table 22 is a summary of the clustering of their responses from our coding process.

Table 22: Response Subjects Question 2.5

Are there any other specifics you would like to share on improving the process/guidance that have not already been discussed?	
Response:	# of Expert Responses
To maximize ROI, we must implement at a higher level	7
Need to shorten process/build efficiencies	4
Track results/see where we are for next round	3

The overwhelming theme to this question was that while there was not really anything to add, it was to reiterate previous thoughts of importance to maximize ROI. Seven responses were categorized in that PS-BCAs must be done at a higher level. The other large portion of responses related to shortening the process/building efficiencies. Lastly, there were three categorized responses mentioning a “wait-and-see” mentality for the next round of PS-BCAs. This is because that PS-BCAs must be conducted every five years at a minimum. It is important to see where these weapon systems are in the next round of PS-BCAs and how it compares to where it was intended to be from the last PS-BCA.

Summary

The results discussed above are a combination of both quantitative data using descriptive statistics and qualitative data using the Delphi Method. The quantitative data was provided via an Air Force Life Cycle Management Cost database where we were

able to see possible trends for the current processes, however, with such a small sample size, it is impossible to draw any concrete conclusions from that data. The qualitative data had six interviews for round 1 and eight for the round 2 questioning. The results were coded to show trends and then clustered together around the specific questions to identify possible emerging themes from our panel of subject matter experts. Our team took the results from both of these methods to create a list of possible options for the Air Force to take to optimize its return on investment. Those conclusions and recommendations will be discussed in the next chapter.

V. Conclusions and Recommendations

Overview

This chapter discusses the conclusions and recommendations our research produced during these studies. The goal of Chapter V is to explain the results of the quantitative data and the final round of Delphi Study interviews for each of our research questions. The first section will contain a question by question comparison of data. The comparisons are conducted in the manner previously described in Chapter III. Each question will include a discussion on the quantitative and qualitative data, what the takeaways are, and possible trends.

The final section will conclude the analysis with the recommendation for possible courses of action to optimize return on investment as well as any insights gained from this research. Finally, we will conclude with recommendations for future research.

Question One

What are the costs (Time/money/effort) of a PS-BCA and do the recommended benefits to the Air Force (Monetary/Non-monetary) outweigh these costs?

If we assume that the product support business case analysis recommendations are followed, it is possible that it is worth the time/money/effort to conduct them. However, the quantitative data is inconclusive. While a single program with large savings far outweighed the losses for the other programs, removing that extreme data point changes the results dramatically. One possible trend that emerged was that weapon systems that

had rolled-up/combined requirements included in the same PS-BCA appeared to get a significant benefit from combining analyses.

The qualitative data from our subject matter experts suggest a strong consensus that we are not seeing the benefits outweigh the cost with our current process. Based on our analysis, it appears that:

1. By not implementing the recommendations of a PS-BCA, the Air Force is missing out on key opportunities to save tax payer dollars, improve processes, or both.
2. Requirements could be rolled-up to a higher level to mitigate inefficiencies. If done at a cross-platform level, similar requirements could be combined in a single PS-BCA and the Air Force could receive a higher ROI.

It is important to note that not all benefits to the Air Force should be calculated in dollar terms. For instance, sometimes the stated goal for a PS-BCA is to maximize aircraft availability rather than to minimize life cycle cost. Hypothetically, if the recommendation of that PS-BCA is to build a new maintenance facility for \$50 million, an accounting of the benefit of the increased aircraft availability would be important to include. Therefore, when doing this analysis, it is important to look at all possible aspects of the benefits to the Air Force when conducting Product Support Business Case Analysis.

Question Two

What is the average ROI the Air Force receives when doing a PS-BCA?

Due to the recent history of the standardized procedures in conducting a PS-BCA, both the data and the interviews point to a trend that it is too early for us to draw any

concrete conclusions on what the average return on investment is to the Air Force. However, if we look at the current quantitative data and assume similar trends for future PS-BCAs, one very successful product support business case analysis can pay for many other PS-BCAs that appear to “lose money.” Removing the largest “savings” and “loss” from the data, we are left with five programs to analyze. Of these remaining five programs, three of them would have cost more money in comparison to the status quo to implement, however, due to the two programs with rolled-up requirements providing significant savings; there is still an average savings of over \$49M in taxpayer dollars. It is important to look at the stated mission for the PS-BCA. Was the goal to minimize life cycle cost or did was another stated mission like aircraft availability the objective? Regardless, while the data suggest there is room for improvement if the Air Force wishes to optimize the ROI of a PS-BCA, there have been significant improvements to the process over time and there is no reason to believe that further improvements will not continue to be made.

Question Three

What changes to the current PS-BCA processes/guidance are necessary for the Air Force to receive optimal ROI?

Both the quantitative and qualitative data provide evidence to suggest that while the PS-BCA process/guidance has improved, in its current form, the Air Force is not receiving optimal return on investment. The quantitative data suggests there is a possibility that after all costs are considered, the PS-BCA process could still cost the taxpayer more than what the end result will be. Furthermore, we infer from our qualitative research that the current process is not optimized. There is a prevailing belief

that the process takes too long, is potentially too narrow in scope, and there is a resistance to change by leadership which could lead to nothing being implemented in the end.

Recommendations

While our research had some limitations, there were trends that emerged from both the quantitative and the qualitative analysis that allow us to make a few recommendations. First, leadership must model and expect buy-in from those conducting the PS-BCA and stress the importance of implementing the findings. In our interviews, there appeared to be a culture of “checking the box.” There was an expectation that regardless of the PS-BCA recommendation, nothing would change. Furthermore, leadership should be open and willing to make the changes necessary to demonstrate that these PS-BCAs do matter and are not just being done to “meet a requirement.” Second, the quantitative analysis illustrated that nearly 60% of PS-BCAs cost more money to complete than the savings associated with best possible recommended action. Additionally, the possibility of a policy changes should be explored. For instance, perhaps PS-BCAs should only be conducted when necessary for the benefit of the decision maker and not simply to meet a policy requirement. Perhaps the required frequency of conducting PS-BCAs should be revisited. Lastly, it would be beneficial to explore a “center of expertise” model, wherein a dedicated and trained office staff conducts product support business case analyses at a higher level than the program office. The majority of SMEs believed that a Center of Expertise equivalent for the acquisitions field would provide optimal return on investment. This could remove potential bias from

the program office levels, allow the centralized organization to look across different weapon system platforms to combine requirements into one PS-BCA. Finally it would save the taxpayer dollars by reducing reliance on expensive contractor conducted analyses.

Significance of Research

This research is significant in several ways. First, future researchers could use the research areas discussed above as a template and springboard for future studies using actual life cycle management cost data from weapon systems. Second, leadership could see the potential trends in our research and take that information into consideration as they are making decisions and communicating the importance of the product support business case analysis to those in charge of conducting them. Finally, the research results provide possible areas for policy changes that could enhance and optimize the rate of return for PS-BCAs for the Air Force.

Future Research

There are possibilities for future research into this topic which can provide a clearer picture on the Air Force's return on investment in conducting Product Support Business Case Analysis. Prior to exploring this topic again, is our recommendation that enough time has passed from the current standard processes with recommendations implemented and cost data for the weapon systems so that the researchers have the benefit of hindsight and historical costs. This will allow them to compare the "what

should have happened” to “what actually happened” with the weapon systems and their PS-BCA. Most of the recommendations in the PS-BCA database have not been approved to be implemented so there is no actual cost data but only estimates. It is our belief that follow-on research, if done at the appropriate time in the future, can glean valuable insight into the PS-BCA process and be able to speak to the actual return on investment to the Air Force and taxpayer dollars.

APPENDIX A – IRB Exemption Letter



DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OHIO

13 Aug 2018

MEMORANDUM FOR Dr. David Fass (AFIT/ENV)

FROM: Brett J. Borghetti, Ph.D.
AFIT IRB Exempt Determination Official
2950 Hobson Way
Wright-Patterson AFB, OH 45433-7765

SUBJECT: Determination on exemption request from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for "Assessing the USAF's return on investment for business case analyses", dated 06 Aug 2018.

1. Your request was for exemption based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2) Research activities that involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) Any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.
2. Your study **qualifies for this exemption** because you are not collecting identifying information or answers to questions which, if the responses were disclosed, could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation. If you make any changes to the list of questions which could result in collecting information leading to the possible identification of participants, please consult with me for a review of the revised questions before continuing your interaction with human subjects.
3. This determination pertains only to the Federal, Department of Defense, and Air Force regulations that govern the use of human subjects in research. This determination is only for the research outlined in the exemption request letter.

8/13/2018

X 

Signed by: BORGHETTI.BRETTJ.1009082820
BRETT J. BORGHETTI, Ph.D.
AFIT Exempt Determination Official

APPENDIX B – Round 1 Questions

Interview Questions

Requirements for Interviewees

At least 4 years of defense acquisition experience
No more than 2 years since last acquisition assignment

Demographic Information

Rank:
Duty Location:
Unit:
Years of Acquisition Experience:
Current Job Title:

Interview Questions

- Q01. Based on your experience in conducting Product Support Business Case Analyses (PS-BCA), what are the most significant opportunities and challenges of current policy requirements?
- Q02. In your view, what is the most effective way to measure the Return on Investment (ROI) on PS-BCAs?
- Q03. Do you find/feel that the Air Force is receiving sufficient ROI from PS-BCA's? Why or why not?
- Q04. How often does a PS-BCA recommend a change in the expected course of action (status quo/baseline) and how often is that change actually implemented?
- Q05. What are the implications of conducting a PS-BCA organically or through a contractor?
- Q06. What are some important considerations that would either enhance or inhibit the effectiveness of PS-BCA's?
- Q07. Thank you for your time today. What would you like us to know about PS-BCA's and the ROI that we have not already discussed?

APPENDIX C – Round 2 Questions

1. In your view, is the informational/decision making data the Air Force receives from the Product Support Business Case Analysis (PS-BCA) sufficient to justify the time/money/effort invested into them? Why or why not?
- 2a. On a scale of 1-5, how beneficial would it be to the Air Force's Return on Investment (ROI) to have a dedicated/trained office specifically tasked with conducting PS-BCA's organically? Please elaborate.
Note: 5 being overwhelmingly beneficial and 1 being no benefit at all.
- 2b. At what level do you feel PS-BCAs should be conducted to provide the highest ROI to the Air Force? Please elaborate on your selection.
 - Program Office
 - PEO
 - AFLCMC
 - MAJCOM
 - SAF/AQ
 - DoD/OSD
 - AFCOE Equivalent
 - Other _____
- 3a. Now that you have gone through the process, do you have any recommendations to improve the PS-BCA guidance?
- 3b. What was the best/most useful aspect of the provided guidance?
- 3c. Where was the guidance lacking? Did you find any specific contradictions?
4. In going through the process, what surprised you?
5. Are there any other specifics you would like to share on improving the process/guidance that have not already been discussed?
6. Are you willing to be available by phone/email if we had any other questions or needed further clarification on anything?

References

- Air Force Life Cycle Management Center (AFLCMC). (2017, June 15). Standard Process For Product Support Business Case Analysis (PS-BCA) Process. Retrieved from afacpo.com/AQDocs/Product_Support_Business_Case_Analysis.docx
- Camm, F., Matsumura, J., Mayer, L. A., & Siler-Evans, K. (2017). *A New Methodology for Conducting Product Support Business Case Analysis (BCA)*. RAND Corporation. Retrieved from https://www.rand.org/pubs/research_reports/RR1664.html
- Chang, K.-F., & Yang, H.-W. (2011, June 10). An Effective Approach to Construct Value-Based Decision Model for Positioning Strategy. *Information Technology Journal*, 10(7), 1402-1408. doi:10.3923/itj.2011.1402.1408
- Defense Acquisition University. (2018, February 28). Acquisition Category (ACAT). Belvoir, VA, USA. Retrieved from <https://www.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=a896cb8a-92ad-41f1-b85a-dd1cb4abdc82>
- DoD Product Support Business Case Analysis Guidebook*. (2011). US Department of Defense. Retrieved from <http://www.dtic.mil/dtic/tr/fulltext/u2/a606465.pdf>
- DoD Product Support Business Case Analysis Guidebook*. (2011). US Department of Defense.
- DoD Product Support Business Case Analysis Guidebook*. (2014). US Department of Defense. Retrieved from <https://www.dau.mil/guidebooks/Shared%20Documents/BCA%20Guidebook%202014.pdf>
- DoD Product Support Business Case Analysis Guidebook*. (2014). US Department of Defense. Retrieved from <https://www.dau.mil/guidebooks/Shared%20Documents/BCA%20Guidebook%202014.pdf>
- Dufresne, K. (2017, November 15). The Delphi Technique. Retrieved from <https://www.students4bestevidence.net/the-delphi-technique/>
- Dyer, J. S., Fishburn, P. C., Steuer, R. E., Wallenius, J., & Zionts, S. (1992, May). Multiple Criteria Decision Making, Multiattribute Utility Theory: The Next Ten

- Years. *Management Science*, 38(5), 645-654. Retrieved from http://web.mit.edu/~yves/www/decision%20theory/multiple_criteria_decisio---the_next_ten_years.pdf
- Hubbard, D. W. (2014). *How To Measure Anything*. Hoboken, New Jersey: John Wiley & Sons, Inc.
- Keeney, R. L. (1992). *Value-Focused Thinking*. Cambridge, Massachusetts: Harvard University Press.
- Linstone, H. A., & Turoff, M. (1975). *The Delphi Method: Techniques and Applications*. Addison-Wesley.
- Murphy, J. (2012). Attributes of an Effective Product Support Business Case Analysis. *Defense AT&L: Product Support Issue*, 53-54. Retrieved from <http://www.dtic.mil/dtic/tr/fulltext/u2/1016166.pdf>
- Product Support Manager Guidebook*. (2016). US Department of Defense. Retrieved from <https://www.dau.mil/guidebooks/Shared%20Documents/PSM%20Guidebook.pdf>
- Saaty, T. (1980). *The Analytic Heirarchy Process*. New York: McGraw-Hill.
- Schmidt, M. (2018, July 17). *Business Encyclopedia*. Solution Matrix Ltd 2014-2018. Retrieved from <https://www.business-case-analysis.com/business-case.html>
- Slottje, P., Sluijs, J. v., & Knol, A. (2008). *Expert Elicitation: Methodological suggestions for its use in environmental health impact assessments*. Retrieved from http://www.nusap.net/downloads/reports/Expert_Elicitation.pdf
- Trochim, W. M. (2006). *Descriptive Statistics*. Retrieved from Web Center For Social Research Methods: <https://www.socialresearchmethods.net/kb/statdesc.htm>
- Zikmund, W. G. (1997). *Business Research methods*. Fort Worth: Dryden Press.

REPORT DOCUMENTATION PAGE				<i>Form Approved OMB No. 074-0188</i>	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>					
1. REPORT DATE (DD-MM-YYYY) 22-03-2019		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To) August 2017 - March 2018	
TITLE AND SUBTITLE An Assessment of the Air Force's Return on Investment for Product Support Business Case Analysis Processes				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Tyson, Robert E., Captain, USAF				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S) Air Force Institute of Technology Graduate School of Engineering and Management (AFIT/ENV) 2950 Hobson Way, Building 640 WPAFB OH 45433-8865				8. PERFORMING ORGANIZATION REPORT NUMBER AFIT-ENV-MS-19-M-201	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Life Cycle Management Center Deputy Director, Financial Management Tina H. Nguyen, Col, USAF 1865 4th St, Bldg 14, Room 116 Wright-Patterson AFB, OH 45433-7765 tina.nguyen@us.af.mil				10. SPONSOR/MONITOR'S ACRONYM(S) AFLCMC	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.					
13. SUPPLEMENTARY NOTES This material is declared a work of the U.S. Government and is not subject to copyright protection in the United States.					
14. ABSTRACT The purpose of this research is to focus on one of the more important cost savings initiatives within the Department of Defense -- Product Support Business Case Analyses (PS-BCA). Our research questions explore the current cost and impact of this DoD cost saving policy using a mixed methods approach using both quantitative and qualitative data. The quantitative data showed significant improvements in the process in conducting PS-BCA's as they became more standardized after 2016 however, despite this, 60% of programs showed a negative return on investment should their recommendations get implemented. Furthermore the qualitative data collected showed significant concerns regarding the PS-BCA process and that there is a belief that the Air Force is receiving suboptimal ROI in this process. These results were then used to answer our research questions to address these concerns and to also make policy recommendations to improve the PS-BCA process. Our results may assist senior leaders within the cost analysis career field in their decision making and also may be a useful starting point for future research.					
15. SUBJECT TERMS Acquisition Processes, Return on Investment, Decision Support					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 74	19a. NAME OF RESPONSIBLE PERSON R. David Fass AFIT/ENV
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code) (937) 255-3636, ext 4388 (robert.fass@afit.edu)

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39-18

