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Benefit Cost Analysis of Parametric Pricing Model for Procurement of F-16 Aircraft

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BENEFIT COST ANALYSIS OF PARAMETRIC
PRICING MODEL FOR
PROCUREMENT OF F-16 AIRCRAFT

An internship report submitted in partial fulfillment
of the requirements for the degree of
Master of Science

By

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ABSTRACT


This project was conducted in response to an Air Force decision to allow Department of Defense contractors to change the way that they propose efforts which will be produced under Department of Defense contracts at Wright-Patterson Air Force Base F-16 System Procurement Office (SPO).

The project consists of a benefit-cost analysis designed to specifically examine the benefits and the costs of the new system proposed. The future value of the costs and benefits were evaluated to determine the plausibility of the program.

The results were obvious. For a total cost of $30,905, the government could benefit almost $20 million. This is for the evaluated program alone. The entire process, once validated, could be applied across the F-16 SPO. The F-16 SPO receives approximately two new orders per year for the purchase of F-16s. An average program value is $300M. If the process were applied to all new programs, the savings would be applied to two new programs every year for average savings of $24M per program, or $48M per year. The total savings over ten years would be over $352 million.

The Air Force should look at this process very seriously. The reality of the matter is that the Air Force is uncomfortable changing the acquisition process, but for the savings involved, as outlined here, the process needs to be considered.
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I. INTRODUCTION

This project was conducted in response to an Air Force decision to allow Department of Defense contractors to change the way that they propose efforts which will be produced under Department of Defense contracts at Wright-Patterson Air Force Base F-16 SPO. The project consists of a benefit-cost analysis designed to specifically examine the benefits and the costs of the new system proposed.

Throughout history, the United States government has developed laws and regulations pertaining to procurement of supplies and services. These laws and regulations have been codified in the Federal Acquisition Regulation (FAR). This government regulation provides guidance and direction for every stage of the acquisition process from development of specifications to the closing of the contract once all work has been completed. When the United States Air Force procures supplies from a company, the FAR governs how those purchases are to be proposed by the contractors, and subsequently analyzed by the Air Force.

Typically, in major procurements, there will be more than one company vying for the government contract. In this case, market forces (competition) are able to keep the price at a level that can be determined to be “fair and reasonable” by the government’s representative, the contracting officer (CO). The competition between the companies will keep them from inflating their prices. According to the FAR, this is the most favored way of determining a fair and reasonable price by the CO. (FAR 15.402)
However, there are a few more ways to determine fair and reasonable price when competition is not possible. One way is for the company to prove that the price that they are offering is their established price for which the item is offered to the general public. This is known as a catalog price (FAR 13.106-3(a)(2)(iii)). In doing this, they are able to show the price that the market will bear. Thus it must be fair and reasonable. The CO can also use “historical prices” as a basis for the determination. When using historical prices, the CO reviews previous acquisitions of similar items, and makes a determination based on the historical price (FAR 15.403-1(c)(1)(iii)). The CO must be able to rationalize any price increase or decrease due to inflation, economies of scale, etc. The previous price paid, however, must have been determined fair and reasonable using a technique other than “historical price.”

When no competition is available for an item, the item has no catalogue price, and no previous purchase history, the CO must still be able to determine the price paid is a fair and reasonable. In this scenario, the contractor must submit certified cost or pricing data. Submission of cost or pricing data is the least efficient way to contract; “Contracting officers shall not require unnecessarily the submission of cost or pricing data, because it leads to increased proposal preparation costs, generally extends acquisition lead time, and consumes additional contractor and government resources (FAR 15.402(a)(3)).” This, however, is the predicament that CO’s find themselves in when procuring major weapon systems. In the case of the Lockheed Martin F-16 Fighting Falcon, there is only one company that produces this aircraft; Lockheed Martin Tactical Aircraft Systems (LMTAS) in Fort Worth, Texas. These acquisitions are called “sole source” acquisitions. There is no catalogue price for an F-16, and each procurement
is usually a unique configuration, thus there are no historical prices. In a sole source acquisition, the government must receive all data that prudent buyers and sellers would reasonably expect to affect price negotiations significantly (FAR 15.401). This includes all costs of their subcontracts, labor hour calculations and rates used, as well as all additional costs factored from the labor hours. This data must be certified to be current, accurate and complete in writing as of the date of the final negotiation. The government reserves the right to sue for damages if it is ever revealed that any defective data was submitted, either knowingly, or unknowingly.

All of the factors, which are incorporated into the procured item, are given to the government in a proposal. The proposal is a breakdown of every element of the production process, including amount of time that each department will spend manufacturing each component of the item. The proposal is typically hundreds of pages long, with thousands more pages of technical data. Government Engineers, Manufacturing experts, and a Price Analyst analyze the proposal. The experts will annotate questions or concerns while the contracting officer is reviewing the Terms and Conditions of the contract. The entire effort is then negotiated, and the final price is documented. The final document is signed by both parties.

The process is very time consuming and expensive for both parties to support. The government not only must pay its own people to perform the duties on the contract negotiations/analysis (a team which can typically exceed 15 people), but also must pay the contractor for their efforts in supporting the same (an element of the proposal that is called bid and proposal costs). The time from identification of the requirements to actual contract award can easily take two years under this process.
Since contractors, such as Lockheed Martin, have been building certain defense systems (F-16s) for years, they have raw data on thousands of aircraft. Knowing this, a company called Price H (which has been purchased by Lockheed Martin) has developed a computer-pricing program to estimate the cost of a weapon system using the database from all previous similar aircraft production runs. This system of estimating costs has been deemed "parametric estimating." The Lockheed Martin model looks for relationships between past manufacturing complexities, quantities, requirements, etc., and the weight of the aircraft. The model uses statistical methods to estimate the cost to the contractor of a new production run of "X" aircraft based on the weight and complexity factors of the desired aircraft.

For this model to be used for the F-16, the government needed to validate the database upon which the system was based. The government wanted to actually be present while the database was verified within the model. The government had already approved the calculations and equations that the model uses. At that point, the inputs would have all been agreed upon and all calculations approved, so the output from the program would be the agreed upon cost of the new aircraft. Profit would be negotiated separately.

The United States government has been funding parametric laboratories with large contractors for years. The purpose of these labs has been for the contractors to develop and propose parametric estimating systems. The F-16 SPO is the first Program Office to use parametrics for an entire aircraft purchase. However, an analysis was not done to determine if the change in processes would be economically advantageous. Rather, this point was merely assumed. The analysis reported herein compares the quantifiable
aspects of the benefits and costs. It also discusses the aspects of the benefits and costs that were not quantifiable.
II. HISTORICAL DISCUSSIONS

A. Introduction

Prior to actual process initiation, there was a focus group comprised of the individuals who would be involved in the new process. This focus group reviewed the proposed process and made a determination as to the viability of proposing an airframe acquisition using parametric estimating techniques. There were a few major issues discussed pertinent to the accuracy of the process, and the confidence of the contractor in the model. The issues were very important and are discussed in the following subsections.

B. Content of the Database

Lockheed Martin presented the database they wanted to use when the parametric estimating tool was originally described to the US Air Force. The presentation centered on the fact that Lockheed Martin had raw data regarding the production of F-16 aircraft dating back 20 years. These aircraft were spread over 40 different procurements for eighteen different countries. Accordingly, Lockheed Martin proposed that they had an excellent historical perspective on what it should cost to build an aircraft today. All of this data was to be input into the parametric estimating system and be the basis for our proposal.

After the presentation, the government team met separately to discuss the viability of using the new system. The general agreement among the government team was that parametric pricing was finally mature enough to use on a major acquisition. The Foreign
Military Sales (FMS) program that was selected to be the trial program was a sale of ten F-16 aircraft to the country of Bahrain, a program code named Peace Crown II.

C. Issues from Day One

At the beginning of the Peace Crown II program, an F-16 Program Office Team traveled to Lockheed Martin to validate the Price H parametric estimating system database. Basically, the team was going to verify that the system was accurate using ex-post forecasting of existing programs that were 100% complete. The team was going to meet with Lockheed as well as government personnel at the site. The primary reason for meeting with the government personnel at the site was to verify that the entire history of the F-16 program had been correctly input into the Price H system. This verification was very time consuming and was completed predominantly by the Defense Contracting Auditing Agency (DCAA) and Defense Contracts Management Command (DCMC) personnel at Lockheed Martin.

Upon arrival, the F-16 government team learned that the database being used did not include the entire database of 40 procurements. Instead, the database merely contained data from one F-16 program. The only data that was included was data from a program that had been negotiated just six months prior, code named Peace Vector V. This program was for the production of 21 F-16 aircraft of the exact configuration that we were going to procure under the Peace Crown II program.

The government team immediately became concerned about the accuracy of this technique. The government team brought up the concern that calculating an estimate from one observation would be considerably less accurate than basing it on 40 observations. When queried as to the possibility of including all of the programs into the
database, Lockheed Martin insisted that that was not the best way to go. The contractor was adamant that the pricing system was not mature enough to handle a database of the entire 20 years of F-16 procurements. If this was the case, the government team then suggested that we include another four programs (instead of 40) of aircraft that are similar to the aircraft being procured on our acquisition. The Lockheed Martin team, again, came up with many reasons why that was not a reasonable idea. We quickly reached an impasse, and decided to elevate the issue to management. Those results will be discussed later.

Another major problem with using one observation centered on the accuracy of the data from the one program in the database. The government team thought that the database would contain actual costs incurred on past programs. However the Peace Vector V program was only 5% into the production process. We were not dealing with actual costs incurred, but rather a negotiated (estimated) price. This caused two major problems.

The first problem that this caused was due to the type of contract that the Peace Vector V was negotiated under. Peace Vector V was negotiated as a Firm Fixed Price (FFP) contract. This means that the only aspect of the contract that is actually negotiated is the final price of the effort. Of course that final price is supported by reams of data as to how that price is fair and reasonable. This is the price no matter what actually happens during the production process. Since the only agreed to item is the final price, this allows the two parties to write the specifics of the negotiated price to their management differently. Lockheed will tend to take labor hours, and therefore dollars, from one area
of the production, and add it to the profit margin to show that they negotiated a higher profit. They are able to do this for a few reasons.

As mentioned previously, the price that was negotiated was a bottom-line price that was determined to be fair and reasonable by the government. With FFP contracts, contractors are able to take that bottom-line price and reduce the costs, internally, as they assume efficiency over the life of the program. If the contractor is able to realize the efficiencies, they are rewarded as the dollars that are saved in production are moved to profit. In allowing this, the government is able to encourage technological development and process improvements at no additional cost to the government. The government will realize increased savings on future programs as those efficiencies are used. To make this more understandable, let's use a car example instead of airplanes.

If I were to negotiate a car deal for $20,000, I would have data to support that this car is worth $20,000. This would most likely be done using a cost comparison with like items. I would not negotiate four tires plus a windshield plus an engine, etc. When the car is delivered, all I care about is that it is what I ordered, and that it costs me $20,000. Let's say that immediately after I ordered the car, the manufacturer developed a new way to cast the engine of the car. This new technology saved them $1000 per car. The manufacturer would then be able to take the $1000 that was saved and put it toward the profit margin on the car. Instead of making perhaps $2000 on the deal, the dealer now makes $3000 as the cost savings in production is put right into profit, and not passed on to me.
All of this movement of the numbers is done while maintaining the same bottom-line price that was signed. It is then up to Lockheed Martin to manage the contract so that the lesser hours reported to their management are the actual hours used.

The government, however will tend to do the opposite. The CO will take money from the profit line to show that we did not give the contractor too much profit. This is accomplished in the following manner.

Before the government can reach a final negotiation position, an engineer examines the “major cost drivers.” A major cost driver is defined as any specific element of cost that significantly contributes to the total final cost of an item (i.e. labor). The engineer, after reviewing the proposal submitted by the contractor, recommends a range of hours in any specific area that would be “reasonable” (i.e. 80 – 100 hours). The government’s beginning negotiation position will start at the lower end of each range (i.e. 80 hours). The negotiator is usually able to negotiate some of the elements toward the lower end of the allowable range.

Once the final price is agreed upon, the government negotiator can then go back and take some of the money out of the profit margin, and put it into the other area (i.e. from 80 to 95 hours). In doing this, the CO will show that the effort is still within the “reasonable” range. Thus, the government is able to reduce the profit that is shown on their write-up and still maintain that a reasonable price is paid.

The fact that the two sides write the final price elements differently is at the root of the problem of using Peace Vector V as the only data point.

In the creation of the Peace Crown II database, the contractor used their write-up of the Peace Vector V program. Lockheed agreed that this might or may not be the write-
up as seen by the government. Therefore, the numbers being used are not agreed to
numbers (even though the final price may be), rather the numbers as Lockheed saw them.
That is why it is imperative, according to the government, to use actual costs incurred.
Actual costs are indisputable.

The second problem with using a negotiated number rather than actual costs is the
fact that the Peace Vector V program could over-run or under-run from the negotiated
price. At the 5% complete point, the Peace Vector V program was under-running by
about 12%. This would indicate that perhaps the contractor did an excellent job
negotiating the Peace Vector V program and will reap a possible additional 12% profit
from that program because of it. When asked about the under-run, Lockheed merely
stated that the Peace Vector V program is still in its infancy and that the under-run could
quickly change to “even,” or an over-run.

Because of the facts outlined above, the government felt that it was imperative
that the team use actual costs incurred for an entire program, rather than a negotiated
amount.

The government team, in an effort to compromise, offered that it would be more
advantageous to use the most recent completed program of aircraft most similar to the
planes being purchased instead of Peace Vector V. The government team even proposed
that we might be able to use this program as the only observation point for this
“experimental” program. The government team found a program that had been
completed for about four years. The program was for purchase of an aircraft that were
very similar to the ones being purchased for Peace Crown II. The program was called
Peace Vector IV. It only took Lockheed personnel about three or four hours to load the
data. Some ex-post forecasts were run to determine the accuracy using the data from these planes. The results were fairly accurate (within 1% of the actual costs). The government believed that when a more detailed model was used, it would be very accurate. Lockheed Martin, however restated that they desired to use the original data that they had proposed (from the Peace Vector V negotiated settlement). Both sides agreed that the decision had to be made at a higher level, so the issue was elevated. The week long meeting was considered a success since the government gained confidence in the Price H model, and developed a strategy for success with the Peace Crown II program.

D. Management Response

Shortly after the meeting at Lockheed, the government team met with the Director of the F-16 Program Office. At this time, the Director was briefed as to what problems the government team encountered while on its trip to the contractor facility. The Director was briefed on the fact that the program that was sold to him, and the rest of the F-16 SPO, was not the program that was being implemented. The team briefed the director of the aforementioned positions (both government and contractor.) To the surprise of the government team, the Director told the team to proceed with the contract using the data that was proposed by the contractor. We later found out that one of the Vice President of Lockheed was able to make a pre-emptive phone call to the F-16 Director and lobby for his position. He was very successful.

E. Terms and Conditions

The terms and conditions of a contract can be more important than the price of a contract. At times, if certain terms are in the contract, the contractor has the right to come
back to the government at a later date and ask for more money. There are two terms that were particularly important in this program because the contractor asked for them, and in the government's opinion they could have been handled within the Price H system.

The first term that Lockheed was trying to incorporate into this contract was a clause for Diminishing Manufacturing Sources (DMS). DMS is a problem that companies face as the government tries to maintain weapon systems that are very old and technologically behind. Contractors who are building older systems, such as the F-16, are in constant search to find suppliers that are able to build components that use 1970's and 1980's technology. It can be quite expensive to have a company retool their existing operation for a one-time production of an electronic component that hasn't been produced for years. The DMS clause that was proposed by the contractor would allow them to return to the government after the contract was signed, with all incurred DMS costs and be reimbursed for them. It is a way to significantly reduce risk for the contractor.

Regarding DMS, it was the government team's position that these costs could be projected by the Price H system. Every F-16 procurement has DMS costs. This means that there should be data available for most of the last F-16 production programs, for input into the Price H system. This data could be used by Price H to forecast the DMS cost that the Bahrain program would encounter. The Lockheed Martin Price H expert confirmed this fact and said it would only take a few days to load the data, and set up our model to accomplish the task. They begrudgingly agreed to do it.

The longer that Lockheed Martin could hold off the estimation of the DMS problem, the less risk there would be to the company. Every day that went by meant more data from the subcontractors regarding DMS, and the more accurate their estimate
would be, meaning less risk. Eventually, the DMS problem was estimated using the Price H system.

Another condition of the contract that was troublesome was the area of the “offset agreement” between Lockheed Martin and the government of Bahrain. An offset agreement entails a direct agreement between the contractor and the FMS customer without the involvement of the US government. Most FMS programs have an offset agreement. Offset agreements will typically be for the contractor to put a percentage of the total contract value back into the country’s economy through local purchase of goods or services. They range from the contractor agreeing to erect a school, to the contractor agreeing to purchase a certain amount of domestic goods from the home country. Offset costs and the administration of the offset program can be very expensive. The contractor must manage the offset program like any other program. According to Federal Regulations, the cost of the administration of the offset program can be charged to the acquisition that they are supporting. “All costs incurred for offset agreements with a foreign government or international organization are allowable if financed wholly with customer cash or repayable foreign military finance credits (Department of Defense FAR Supplement 225.7303-2(a)(3)(I)).” The Bahrain program has a unique challenge in that this will be the first time that the administration of the offset program will be allowed as a billable item on the contract. Lockheed Martin wanted to make the offset charges a clause of the contract. If the government allowed this, they could come back to the government once the actual costs were incurred for full reimbursement.

Although the ability of offset programs to be billed to a contract is new, the actual offset programs themselves are not. The contractor has always had to maintain these
programs without any insight by the government. This being the case, the government team wanted Lockheed Martin to put all of the past offset administrative cost data into the Price H system. The Price H system could then predict our offset cost as part of our firm fixed price. The Price H operator verified that he could have the data available and input into the computer in a matter of days. Once again, the contractor agreed to go forward.

The next term that was problematic was a clause called the Economic Price Adjustment (EPA) clause. This clause allows the contractor to seek a price adjustment in the future based on the price of certain volatile commodities. The clause is designed to deal with costly volatile commodities such as gold, platinum, or hydrazine. However, in the 1970’s, Lockheed was able to apply this clause to labor since inflation was rampant and labor costs were considered volatile. This practice was generally accepted in the F-16 SPO even as recently as 1998. Lockheed was seeking the same clause on this program. The government team denied the contractor the clause, and the contractor said that they would address it at a later date since this issue was not particular to Price H.

The government caused the last problem, which was one of the most difficult to overcome. The FAR requires that any contractor who provides cost or pricing data for determination of fair and reasonable price who subcontracts to any subcontractor for more than $500,000, must also obtain cost or pricing data from the subcontractor. “Cost or pricing data are required before... the award of a subcontract at any tier, if the contractor and each higher-tier subcontractor have been required to furnish cost or pricing data (FAR 15.403-4(a)(1)(ii)).” This statement at first may sound confusing, but impacts the schedule quite dramatically. Lockheed is able, through the use of parametric pricing, to speed up the generation of data and submission to the government. However, their
subcontractors do not use the Price H parametric model. They must, therefore, submit their cost and pricing data to Lockheed using the old method, which takes time, and reams of paper. The Peace Crown II program did not have time in the schedule to allow for the submittal of these data by the subcontractors.

The government team attempted to get a waiver for this Federal Acquisition Regulation requirement. The government team briefed management what they needed to do, and the Director of the F-16 contracting office stated that he would test the water with his superiors to see what the chances of actually getting a waiver would be. After a few weeks, the answer came back that if a waiver were to be requested, one would most likely not be granted.

F. Team Players

The most difficult problem to overcome became evident from the first day. The contracting officer (CO) that the government appointed to the team was not of the same mindset as the rest of the team. The entire government team thought that anything could be done, unless a regulation existed that stated it could not. The rest of the team was ready and willing to take chances, not only with procedures and policies, but also with schedule. From day one, the entire government team was trying to convince the CO to come on-line with the rest of the team. It never happened. This issue and all others mentioned in this section will be discussed in more detail in the conclusion section of this study.
III. METHODOLOGY

A. Overview

When trying to determine the costs and benefits of this new program, there will be three main areas of concern. The first area will be the accuracy of the two systems. How accurate is the new system of estimating, compared to the old system. The second area of concern will be how much manpower is used in the old system versus the new system. If there is an increase in the manpower needed for the new system, the benefit of using it must be suspect. The third area that will be compared is the timelines of the two processes. There is a lot of cost (in the form of risk) to the government as time moves on. The more time that passes, the more risk is passed from the contractor to the government (see below.)

When determining the potential costs and benefits of this new program, perhaps the greatest factor will be the accuracy of the model. To illustrate this, consider an acquisition to purchase 16 F-16 aircraft. The airframe alone for these 16 (not including engines or radars) will cost about $300 million. Assume that the old system of estimating was accurate to within 10% of the actual costs incurred. For a $300 million program, this would equate to $30 million over the three years of the program, or $10 million per year. This is a significant savings. The possibility does exist for the cost to be 10% higher. However research has indicated that F-16 contracts will typically under-run (meaning that the actual costs come in under the original estimated contract cost.) When there is an over-run (meaning that the actual costs come in over the original estimated amount), it is usually only for one program. After that, the next several programs will experience an
under-run as the contractor pads the proposal to preclude another over-run. Actually, a representative from Lockheed stated, off the record, that they would typically determine a worst case scenario for building the aircraft, and then add another 8-9% to the bid for contingency. Thus, if a program does well concerning cost, it could potentially reap an additional profit of 8-9%.

The manpower savings potential for this effort are obvious. Typically, about 30 people work full-time on a large program. This total represents both the government and the contractor. Since the government directly pays for both they were just grouped together into one large group. This group of 30 people work together through the entire acquisition process. The average acquisition time for the last 2 F-16 programs prior to the Peace Crown II program was 652 calendar days from initial requirement identification to contract award. For years, the F-16 SPO has been trying to decrease both the number of personnel on both sides, and the number of days that it takes to complete an acquisition. Perhaps this effort will be able to accomplish both.

The contracts being awarded by the F-16 SPO are FFP contracts. FFP contracts are considered to be the most advantageous to the government (FAR 16.202-1). They place on the contractor, “maximum risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively and imposes a minimum administrative burden upon the contracting parties.” This is because there is an agreed to price for the delivery of item. The dollar amount will never change, unless the government changes the requirement. If the contractor is able to manage a program so that the end cost is $2 million below the agreed to price, this goes 100% to the contractor. However, if the opposite happens and the
contractor has to spend more on the program than they negotiated, the contractor must take it out of their profit. This type of contract is beneficial to the government for two reasons.

The first reason is that in using FFP contracts, the government is able to stabilize their budget. The government knows, each year, how much money will be spent for an item. There are no unanticipated requests for money (called an “unfunded”) to cover a cost over-run. In cost type contracts, these over-runs are “must pays,” and the government must take it out of other areas of the budget for the current fiscal year. The second benefit of a FFP contract is that they encourage prudent program management by the contractor.

One drawback to FFP contracts is that they require a higher profit for the contractor due to increased risk. This is where timeliness comes in. If it takes two years (the standard) to negotiate a contract, this decreases the risk to the contractor. At any time, before the contract is signed, the contractor is able to update their proposal to reflect the most current situation. Typically it will take three years to build an F-16. If the contract is not signed for two years, the contractor has the opportunity to update their proposal 66% through the process time wise. However, at that point in time the contractor will have incurred about 95% of the cost for the program. Thus, at the two year point there is a substantial decrease in risk as the contractor realizes 95% of actual costs. Due to contract type the government still pays the higher profit rate. If the government could award a more timely contract, they would gain the benefit of not allowing the contractor to update their proposal (usually upward) every time something happens within the first two years of the program. Examples of this would be if a
subcontractor wants to charge more for a part, the contractor can just update their proposal and pass the cost directly on to the government. Or if a subcontractor will be late on a delivery, the contractor can just negotiate a few more months into the schedule with the government rather than negotiate a better schedule with the subcontractor, or making the subcontractor pay penalties for not meeting schedule.
B. Model

I. Theoretical

This sub-section will discuss the theoretical model that will be used for the benefit-cost analysis. The model is based upon the discussion that took place in the overview section above. The elements of benefits and costs found here will be used in the empirical model if they are measurable with any degree of accuracy. Therefore, only some of the elements found herein will be used in the empirical model. Here are the theoretical benefits and costs.

Benefits

One of the benefits that would be gained by the government if the parametric estimating system were implemented would be the accuracy of the new system. As outlined previously, the new system has the potential to be very accurate. Lockheed Martin admitted that their current estimating system was only accurate within approximately 10% of the actual costs. We proved in our model that the Price H system was accurate at worst case, within 1% of actual costs. Gaining this accuracy would be a great advantage for the government.

Another large benefit would be a decrease in the manpower required to build and negotiate a proposal and contract. This is, of course, a benefit because it will result in decrease in cost for the government and the contractors. Since the government is paying the salaries for both entities, this is actually a double benefit. The benefit would be realized as fewer people work fewer hours.

A great benefit of using the new system would also be found in terms of the timeliness of the new estimating system. As outlined above, if the government could
award a more timely contract, they would gain the benefit of not allowing the contractor to update their proposal (usually upward) every time something happens to their costs. It would ensure that contractors are truly absorbing the risk that the government is paying them to absorb.

Costs

The costs of the new system are also very straightforward. The cost of the up front training could be very expensive. The Peace Crown II government team spent five business days in training for the Price H estimating system. The entire government team was trained by the contractor’s Price H experts. Thus, there were opportunity costs for paying the salaries of the government people to not be accomplishing another task. There was also the cost that the government had to pay the contractor to provide the training.

Another great cost will be in the confidence of the accuracy of the Price H system. This is a very interesting cost because the government actually pays for confidence. By nature, humans resist change. Any time you change a process, it takes time to develop confidence in the new system. It is very difficult for the government to change the way it is doing things. This resistance is magnified when money is concerned. So there will be the cost that is incurred when management has less confidence in the new system. During the first few programs there will some distrust in the accuracy of the new procedure. However, after a few years, actual data will be available. If the actual costs incurred are as accurate as anticipated, this will inspire confidence in the new system.
Empirical

In this sub-section of the analysis, I will determine which of the costs and benefits in the theoretical model are measurable. This analysis will use a future value approach where the costs are subtracted from the benefits using the following equation:

\[ F_{\text{total}} = F_{\text{benefits}} - F_{\text{cost}} \]

**benefits**

The first benefit mentioned above is measurable. There is an obvious benefit in the area of accuracy if the parametric estimating system were implemented. As outlined previously, the new system has the potential to be very accurate. Lockheed Martin admitted (off the record) that they would typically add a contingency of 8-9% to their worst case cost scenario. If the parametric system were implemented, this would put an end to this practice. Once the database was agreed to, both parties would agree to the costs as generated by the computer. Since the data base was developed independently by the contractor, there were no additional costs to the government in developing the data base. An additional 8-9% would never be added.

The next benefit mentioned above is also measurable. The savings in manpower required to build and negotiate a proposal and contract is measurable for this effort. It can be measured in two areas.

The number of people working under the new system will be decreased. Thus, the annual salaries for all people who will not be needed for the new process will be saved. There will also be savings as the number of months that it takes for the new process decreases.
The last benefit mentioned is not measurable. Timeliness of the new estimating system is not measurable. Realistically, the government would merely be getting what they are paying for; the contractor absorbing the risk that they are getting paid to absorb for their increased profit rate.

All of the measurable benefits mentioned above can be found laid out on Table 1 of this analysis. Now, the analysis must turn to the cost side of the equation.

Costs

The first element of cost mentioned in the theoretical model is measurable. The up front training will cost the government money. The costs will increase as the government pays its own people to attend the training as well as the salaries of the contractors who provide it. These costs, under the present process, would never be incurred.

The second cost mentioned was the lack of confidence in the accuracy of the Price H model. This element is not measurable. The only element of cost that will be measured and accounted for is the additional cost of training for the people involved in the new process.
IV. RESULTS

The results of this study were evaluated for a period of ten years from the base year. I chose ten years in an effort to realize the actual savings for a relatively short period of time. I did not want to unrealistically inflate the numbers by using a longer period of time.

The Future Value (FV) for this analysis given the measurable benefits and measurable costs outlined above can be found in the lower right hand corner of Table 2.

In Tables 1-4, each cost and savings element was discounted at a rate of 5.77% each year. This was done because the funds that are saved are kept in Federal bank accounts. The money will remain in these accounts until it is used for another project. Even when that money is used, it is being used in lieu of other money that will remain in a Federal Bank Account. 5.77% was the selected interest rate for Federal Funds on March 8, 2000.

Benefits

The benefits that were gained from implementing the program can be found at Table 1. The two areas that were deemed to be of a measurable benefit were Accuracy and Manpower.

The money saved from the accuracy of the new system was realized in the base year only (this is when the money is saved). That dollar amount was escalated by the interest rate for federal funds in the out years because the money would be held in a federal bank account (See table 1.)

As stated previously, Lockheed Martin typically adds 8-9% to their proposals in an effort to cover any unforeseen contingency. Using paramtrics, that would not happen.
For the Peace Crown II program (approximately $125M based on Lockheed Martin historical data), this would equate to a savings of approximately $10M in the base year (.08 * $125,000,000.) $10,000,000 is the baseline savings at the top of Table 1.

The money that was saved from the decreased manpower was realized in the base year and the next year (using the average of 1.78 years.) Again, that dollar amount was escalated in the out years by the interest rate for federal funds (See table 1.)

A government acquisition team can average about 15 people at any given time. There will usually be more people working the acquisition in the middle of the process (price analyst, contracting officer, program manager, logistical specialist, finance specialist, engineers, etc.) but 15 is a good average. These people are usually at the GS-11 or 12 pay scale for federal service. For purposes of this analysis their salaries will be set at $50,000 (A GS-11 starts at $41,000 and a GS-12 makes a maximum of $61,000.) The military people working these efforts are typically Captains, with higher-ranking people advising. Therefore the average salary for the military member will be set at $50,000 for the military people too (a Captains salary ranges from about $46,000 to $55,000.)

In a worst case scenario the actual number of people working an acquisition on the government’s side will most likely not change with the new parametric pricing system. This is because the government still maintains the fiduciary responsibility with respect to tax dollars. The government must still be able to determine that the price is fair and reasonable as described earlier. As envisioned, the entire team of government experts will review the data that comes out of the Price H system to ensure that the numbers are
realistic. There will, however be significant reduction in the amount of time that each of the individuals is needed.

Lockheed Martin will also be able to decrease manning. They stated that they could support an acquisition under the new system with only 4 people. This would be an 11-person decrease. At $50,000/year, and an average acquisition taking 1.78 years, this is a savings of $11 * 50,000 * 1.78 = $979,000. $500,000 of this will be realized in the base year and $479,000 will be saved in the second year.

With the new Price H parametric estimating system, it is anticipated that an acquisition can be completed in six months, from identification of the requirement to the signing of a contract. This is significantly less than the current F-16 SPO average of 652 days (1.78 years). Thus the cost of the savings to the government will be $50,000 * 19 people * (1.78 − 0.6), or $1,121,000. The 19 people account for 15 government and 4 contractor. Six months worth of the savings ($570,000) is saved in the base year with the remainder being saved in the second year ($551,000.) Total Future Value savings will be $19,953,839.

Costs

The entire Peace Crown II government team spent five business days in training for the Price H estimating system. This consisted of training about ten people for five business days. Thus, assuming 52 weeks in one year at an annual salary of $50,000, the weekly pay of each person was $50,000/52 = $961 per week. For ten people, the total cost for the government personnel would be $9,610.

However, the training that was provided was also at a cost to the government. The contractors sent four people and their equipment to Wright Patterson AFB for the
five-day period. The cost of airline travel, hotels, and per diem for the contractors was approximately $1300 per person for the five-day period. Also, their weekly average salary was approximately equal to that of the government personnel, or $961. Thus the total cost to the government to pay the contractors for the training was $1300 + $961 = $2261 per person X 4 people = $9904. The entire cost that the government paid for the training was $9904 + $9610 = $18,654. When escalated over ten years, the total cost is $30,905 (See Table 2.)
CONCLUSIONS

A total cost of $30,905, the government could benefit almost $20 million. This is for the Peace Crown II program alone. As mentioned previously, the entire process, once validated, could be applied across the F-16 SPO. The F-16 SPO receives approximately two new orders per year for the purchase of F-16s. These orders are typically for between 8 and 40 aircraft at a cost of between $100M and $1.0B. A good average is $300M per program. If the parametric process were applied to all new programs, the savings would be applied to two new programs every year. Assuming that the new process saves 8% on each program, this would equate to $24M per program. The total savings over ten years would be over $352 million (See Table 3.) In the base year, two new programs were figured into the equation. In each subsequent year, two new programs were figured, plus the additional savings from the previous year due to manpower decreases.

The cost for the entire SPO can be figured in a similar way. All training costs can be spread over ten years (See Table 4.) Assuming 2 new programs per year, the costs of training would be $18,654 * 2 = $37,308. Over ten years, the total costs would be a little over $486,000.

Obviously, this new parametric pricing program should be used by the F-16 SPO. Most of the savings come from the accuracy of the system, and the Contractor’s confidence in it. In a time where the Air Force is cutting personnel across all career fields, they need to take efficiencies where they can. Many times, contractors, as better ways to do business, will present these efficiencies. The Air Force must be ready to accept these efficiencies after they have been tested and verified.
This economic analysis was very fair. Real numbers were used “from the source.” None of the actual numbers used were made up. I used worst case scenarios to make the savings smaller rather than larger, and costs larger rather than smaller. Still, the results were obvious. In reality, the entire project went another way.

Reality

Due to mistrust between the contracting officer, and Lockheed Martin, the entire parametric pricing project fell apart.

Although the pricing software was verified, Lockheed Martin never used the data that the government was comfortable with. Since this issue came up at the very beginning of the project, the government never trusted the Contractor. For years there had been an adversarial relationship between the government and the contractor. The government felt that the contractor was trying to get rich and the contractor felt that the government was trying to make them do work and not pay a fair price. This distrust was at the root of the problem.

Whenever Lockheed Martin raised a concern, the CO felt like they were trying to gain an unfair advantage. The Diminishing Manufacturing Sources (DMS) problem was a real concern for Lockheed Martin. After they agreed to have the computer estimate the DMS costs, the CO stated that he would never sign the contract if that were the case.

The “offset agreement” between Lockheed Martin and the government of Bahrain was a similar situation. The Price H system predicted our offset cost as part of our firm fixed price. Again, the CO stated that he would never sign the contract if that were the case because he had never done it that way before.
The Economic Price Adjustment (EPA) clause was never an issue. Lockheed Martin removed their request after further consideration.

The anticipated most difficult problem of subcontractor’s cost and pricing data never appeared. The other problems took so long to settle that the subcontractors were able to submit all required data to the CO. At that point, however, there was a new CO.

The CO that was on the project was replaced after approximately 10 months. By the ten-month point, this whole contract should have been signed, but it was not. This was in large part due to the CO’s contrary attitude. Thus, a new CO was appointed. This CO had no background as far the parametric pricing was concerned. This CO wanted cost and pricing data along with the Price H data. In an effort to award the contract, the data was produced. The contract was eventually signed. It was considered a success because it was awarded faster than any F-16 contract in the history of the SPO. The parametric pricing initiative was dropped after this contract was signed. The issue should be revisited.
TABLE 1: Peace Crown II Future Value of Benefits

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<th>Accuracy</th>
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TOTAL SAV FROM ACC $16,567,712

<table>
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</tr>
<tr>
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<tr>
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TOTAL SAV FROM MAN $3,386,127

TOTAL SAVINGS = $19,953,839
TABLE 2: Peace Crown II Future Value of Costs

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TOTAL COST FROM TRNG $30,905

\[
\text{FVtotal} = \text{FVbenefits} - \text{FVcosts}
\]

\[
\text{FVtotal} = 19,953,839 - 30,905
\]

\[
\text{FVtotal} = 19,922,934
\]

TOTAL COST $30,905
### TABLE 3: F-16 SPO Future Value of Benefits

#### Accuracy

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</thead>
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</tr>
<tr>
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**TOTAL SAV FROM ACC** $312,942,908

#### Manpower

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<th>$</th>
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</thead>
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**TOTAL SAV FROM MAN** $39,628,068

**TOTAL SAVINGS =** $352,570,977
### TABLE 4: F-16 SPO Future Value of Costs

**Training**

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<th>Cost</th>
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<td>$424,659</td>
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<td>$486,470</td>
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**TOTAL COST** $486,470

\[
\text{FV}_{\text{total}} = \text{FV}_{\text{benefits}} - \text{FV}_{\text{costs}}
\]

\[
\text{FV}_{\text{total}} = 352,570,977 - \quad 486,470
\]

\[
\text{FV}_{\text{total}} = 352,084,507
\]
REFERENCES

1. Information regarding the format and general content of a Benefit-Cost Analysis were taken from classroom notes and handouts from EC740, Benefit-Cost Analysis, Summer Quarter 1995-96, Wright State University, Dayton, OH

2. All FAR references were taken from the Federal Acquisition Regulation, CCH Incorporated, Chicago, 2000, http://farsite.hill.af.mil/VFFARA.HTM
