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Ranking and Generating Alternatives for the National Air Intelligence Center's (NAIC) Resource Allocation Strategy

Steven M. Cox

RANKING AND GENERATING ALTERNATIVES FOR THE NATIONAL AIR INTELLIGENCE CENTER'S (NAIC) RESOURCE ALLOCATION STRATEGY

THESIS

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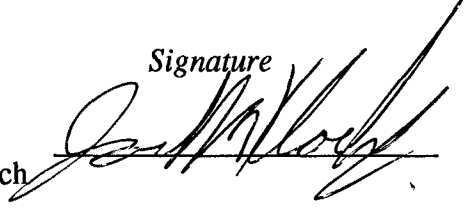
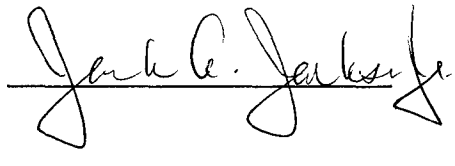
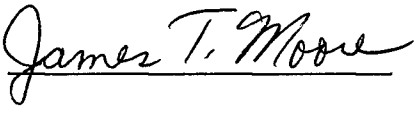
Advisor:	Jack M. Kloeber, Jr., LTC, USA Assistant Professor of Operations Research Department of Operational Sciences Graduate School of Engineering	
Reader:	Jack A. Jackson, Jr., Lt Col, USAF Assistant Professor of Operations Research Department of Operational Sciences Graduate School of Engineering	
Reader:	James T. Moore, Lt Col, USAF Associate Professor of Operations Research Department of Operational Sciences Graduate School of Engineering	

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THESIS

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Steve Cox

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Abstract

Allocating resources is never an easy task, especially when requirements call for more resources than those available. It gets more difficult when the availability of resources shrinks from year to year. This is the case at the National Air Intelligence Center (NAIC) located primarily at Wright-Patterson Air Force Base in Ohio. In each of the past five years, NAIC has been forced to make their resource allocation decision with fewer dollars and less manpower. This decision has been time consuming, manpower intensive, and sometimes very heated. In an effort to lessen these three consequences, a resource allocation model, based upon the NAIC Commander's values and preferences, was developed. The methodology for the model is founded upon decision analysis with value-focused thinking. A scoring sheet based on measures which were taken from the commander's values was also developed. Using multi-attribute utility theory, the measures were scored using scoring functions and then multiplied by the commander's preferences to determine an overall utility score. For the FY99 budget cycle at NAIC, 62 unique funding proposals were scored and ranked using 28 measures for each proposal. The developed value hierarchy allows NAIC to choose their own alternatives based on this ranked list. Significant differences in perceived impact exist between recommended proposal cuts and the list of proposals approved for cuts by NAIC. Some sensitivity analysis was performed on the commander's preferences.

I. Introduction

1.1 Background

Since 1989, the Air Force's budget and manpower levels have decreased while operations tempo has increased, requiring units to do more with less [1; 13; 34]. As such, more demands are placed on the individual units each year [36]. These demands require units to continually look for new and innovative means to manage and allocate their declining resources. The National Air Intelligence Center (NAIC) is one such unit. Their Decision Unit (DU) process for allocating resources is creative, but it is time consuming and makes picking the best alternative difficult [39]. The programs or projects designated to be trimmed were typically selected with a great deal of subjectivity.

1.2 Problem Statement

To perform resource allocation, NAIC created the DU process. This DU process cuts across the typical functional unit or line unit areas of NAIC [23; 28]. This process provides a means to track and allocate all of NAIC's resources, including manpower and budget, which are split into the areas of research, development, test and evaluation (RDT&E); procurement; external assistance; and operations and maintenance (O&M). Within NAIC's DU process for resource allocation, many difficult decisions are made. Currently, the NAIC Commander is presented a set of alternatives where each alternative

is a percentage of NAIC's resources. The commander must select a certain number of alternatives or provide his own in order to determine the resource allocation strategy for that year. He uses his experience, his value system, and the Senior Management Team's (SMT) opinion to make this decision. However, he has no tools to help quantify the value of the different choices he faces.

1.3 Research Objective

The intent of this research is to develop a methodology that would allow the NAIC Commander to choose alternatives for NAIC's allocation of resources consistent with and based upon his values and preferences that show his objectives for NAIC. A secondary goal is to develop a method that would significantly shorten the length of time it takes to generate equal or better alternatives than those currently being presented to the Commander. This thesis explores techniques to rank alternatives and processes to generate alternatives in order to help the NAIC Commander make a more timely and value based decision on his unit's resource allocation strategy.

1.4 Scope

The research's intention is not to alter or redesign NAIC's DU process. Instead, it seeks to assist the commander by providing good alternatives and quicker and more consistent evaluation of alternatives within the DU process. Resource allocation

alternative generation is a major bottleneck in the DU process requiring many iterations and much time. This research examines methods that help evaluate and rank alternatives and methods that provide for alternative generation. The expected outcome is a decrease in the time it takes to provide resource allocation alternatives based on the decision maker's values and preferences, less subjectivity and less political maneuvering.

1.5 Overview of Thesis

Chapter II provides a brief literature review. Specifically, it provides an overview of the DU process, explores other resource allocation techniques, examines decision analysis and value-focused thinking, and provides a brief overview of the software packages DPL and Logical Decisions. The Decision-Analysis Process Flowchart is also presented in this Chapter along with a short examination of the knapsack problem.

Chapter III is based upon the Decision-Analysis Process Flowchart and addresses the first three blocks in that flowchart to include identifying the decision situation and understand objectives, identify alternatives, and decompose and model the problem.

Chapter IV documents the changes that occurred for FY99's resource allocation strategy. While the software model built in Chapter III does not apply, the methodology that was used, decision analysis with value-focused thinking, still applies and was used to score and rank the proposals. This chapter addresses the next two blocks in the flowchart: choose the best alternative and perform sensitivity analysis. In other words, it presents and discusses the results of the methodology used for NAIC. Also, this chapter

compares the recommendations arrived at through this methodology with NAIC's current resource allocation strategy.

Chapter V deals with the final two blocks in the flowchart by addressing whether or not further analysis is needed. The chosen alternative was not intended to be implemented, only the methodology examined for inclusion into NAIC's resource allocation process in years to come. Conclusions are made and other insights gathered during the analysis are presented.

II. Literature Review and Methodology

2.1 Overview

While this research seeks to generate and rank alternatives and to assist in the selection decision for NAIC's resource allocation strategy, a thorough understanding of NAIC's DU process is required. Since it does not follow the traditional, functional means of allocating resources, this process is difficult to understand, but it is currently the method that NAIC uses to provide its resource allocation alternatives to the commander [28]. Knowing the DU process also provides a better understanding and background for the problem statement. After the DU process is discussed, other resource allocation techniques are explored. Decision analysis and value-focused thinking are examined. The software that was used to model this problem is reviewed and explained. Lastly, a brief explanation of knapsack problems is provided.

2.2 DU Process

Typically, the NAIC Commander annually issues policy, guidance and baseline resources to begin the DU process [25; 26]. From this policy, guidance, and baseline, each of the 19 DU Managers prepares a DU plan based on expected customer requirements. Currently, each DU Manager includes four levels in their plans, based on incremental cuts of 5%. In other words, the first plan outlines how the DU would cut

resources by 5%. The other three levels deal with resource reductions of 10%, 15%, and 20%, respectively. The 19 DUs are broken down into Production (10 DUs), Data Exploitation (five DUs), and Infrastructure (four DUs). A different scoring sheet was used to score the impacts for each of the three areas. The DU Managers use these scoring sheets to score their levels. These plans and scoring sheets are submitted to the DU Council.

Within the DU Council, there is a DU Focus Group whose purpose is to resolve any conflicts and perform any necessary research or quality checks on the DU plans. For example, a conflict in resource allocation might arise if two or more of the plans submitted by different DUs call for more than 100% of the available resources. After the DU Focus Group fixes any discrepancies it discovers, the results and recommendations are then presented to the entire DU Council. At this time, a ranked list is developed based on the scoring sheets and recommendations from the DU Focus Group. This ranked list is then forwarded to the Senior Management Team (SMT) which is composed primarily of the senior officers and civilians within NAIC. The SMT reviews the ranked list and develops a resource allocation alternative from that list and presents it to the commander. Considering the advice of the SMT, the commander decides NAIC's resource allocation strategy or determines that another alternative must be designated or developed [27; 28].

2.3 Resource Allocation Strategies

There are many resource allocation methods and strategies available, and this section highlights just a few. Hardly a day goes by without some company being required

to take some type of resource allocation cut. Just a few examples are General Motors Corporation, Amtrak, NASA, Ford Motor Company, Polaroid Corporation, TJX which owns Marshalls, Proctor and Gamble, Budget Rent A Car, and even the IRS [16; 19; 20; 31; 32; 33; 35; 38; 41]. While not much information is presented in these articles on the strategy used to accomplish these cutbacks, it appears that much thought went into choosing between competing alternatives. These alternatives came about through various techniques, many of which are documented in Chapter 6 of Clemen's textbook *Making Hard Decisions* [8: 187-209]. Probably one of the easiest, least time consuming methods is referred to as a peanut butter spread by Air Force Materiel Command (AFMC)/XPM [4: 28; 37: 15]. This strategy cuts an equal percentage from all organizations. An attempt was made to develop a value-based model for AFMC's manpower reductions, but the values and measures used in this model were difficult to obtain [37: 17-22]. Another thesis effort was conducted on AFMC's manpower reductions. This effort used linear programming techniques in an effort to generate manpower reduction alternatives [4: 5]. Linear programming is a very powerful technique, but for AFMC, it did not prove fruitful. Performing a cost-benefit analysis is another method that can be used to evaluate resource allocation alternatives. Major Donald Barton used this technique to help Unit Training Managers make better decisions on their resource allocation alternatives [2].

Charles Mendoza wrote about resource allocation in the construction industry [21]. He mentions that heuristics and optimization techniques, mathematical programming

and enumeration, can be used to solve constrained resource allocation problems.

> "Heuristic approaches employ rules that have been found to work reasonably well in similar situations. They seek better solutions. Optimization approaches seek the best solutions but are far more limited in their ability to handle complex situations and large problems" [21: 44].

A thesis effort produced by Robert Buffum as a student at the Naval Postgraduate School also documents different resource allocation strategies [5]. He highlights the Naval Air Test Center's (NATC) resource allocation strategy and then discusses two alternate strategies. To begin, he suggests that NATC uses an "incremental process" which focuses only on the current strategy and increments that strategy to varying degrees. The incremental process also considers only a small number of the possible alternatives for their resource allocation. Buffum points out many of the shortcomings of that approach [5: 17,18]. He then writes about a satisficing resource allocation model and an optimal resource allocation model. The satisficing model may not provide all of the necessary ingredients to obtain an optimal solution to the problem but can be used to show management that a better solution is possible. The Defense Logistics Agency (DLA) used a forecasting model to help allocate their resources. They said "a forecasting model is required to help managers identify the magnitude of the changes in advance so that they can take proactive steps to match resources with customer requirements" [9: v].

Another method used to help decide a resource allocation strategy is simulation. "The United States Coast Guard's law enforcement mission is conducted in an atmosphere of uncertainty" [6: 1]. Simulation offers easier measurement of performance, modeling of uncertainty, and statistical inference. There are many other methods and strategies in addition to the few already mentioned that select a resource allocation alternative. For

NAIC's resource allocation strategy, decision analysis using value-focused thinking was chosen as the method to select the best alternative from those generated.

2.4 Decision Analysis

Clemen says that there are four areas of difficulty faced in most decisions where decision analysis can be helpful. These four areas are complexity, uncertainty, multiple objectives, and differing perspectives leading to different results [8: 2-3]. NAIC's problem encompasses complexity, multiple objectives and differing perspectives leading to different results. After all, there are roughly 19 trillion possible resource allocation alternatives to consider for 19 DUs at five levels each, where the five levels are 0%, 5%, 10%, 15%, and 20%. Also, with all of the DU Manager's scoring their percentage cuts, there is inevitably going to be a certain amount of subjective judgment. The American Heritage Dictionary defines subjective as "particular to a given individual; personal." According to Clemen, "The decision-analysis approach allows the inclusion of subjective judgments. In fact, decision analysis *requires* personal judgments; they are important ingredients for making good decisions" [8: 5]. Under these guidelines, NAIC's resource allocation problem can be subjected to a decision analysis approach. Figure 1 shows a flowchart for decision analysis taken from Clemen's book which forms the basis for Chapters III, IV, and V [8: 6].

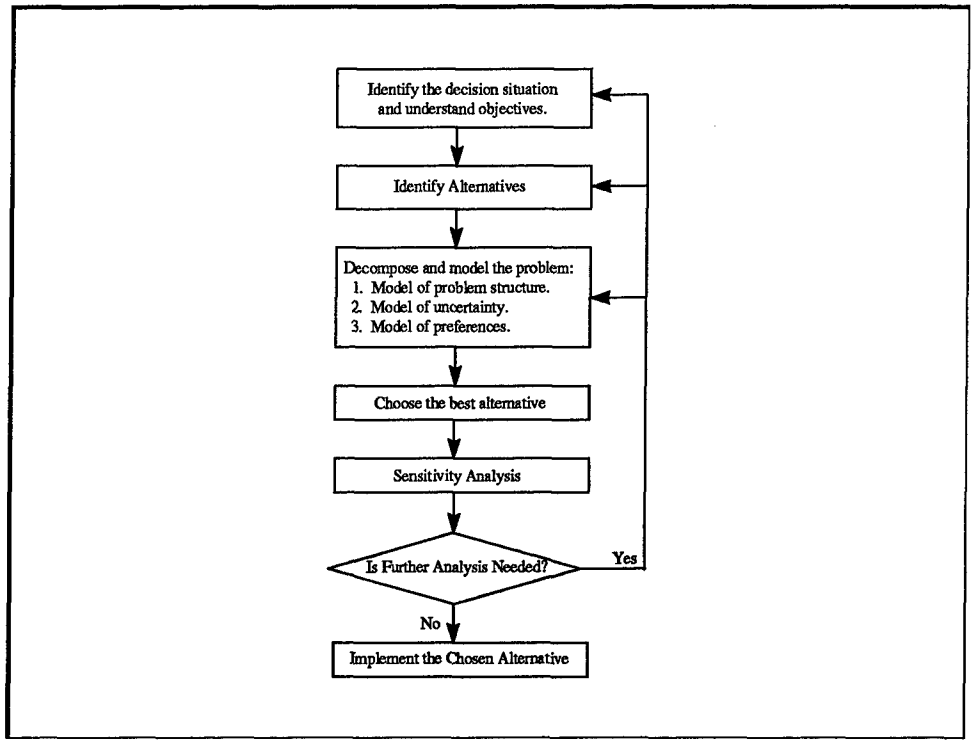


Figure 1. Decision-Analysis Process Flowchart

2.5 Value-Focused Thinking

The Decision-Analysis Process Flowchart is followed in Chapter III. However, the means for accomplishing many of the key elements in that process is value-focused thinking. Ralph Keeney developed the idea of value-focused thinking by suggesting that "values should play a more central role in formalizing decision-making processes" and that "value-focused thinking should lead to better alternatives than those generated by 'conventional' procedures" [3: 465]. "Value focused thinking essentially consists of two activities: first deciding what you want and then figuring out how to get it" [15: 4].

Keeney distinguishes between alternative-focused thinking and value-focused thinking. Alternative-focused thinking is more or less choosing from the obvious

alternatives at hand [15: 6]. These alternatives come from some prespecified list, and often people are left wondering how that list was formed [15: 8]. The decision maker just has to choose the best alternative from the list. On the other hand, value-focused thinking begins with values; "Values are principles used to evaluate the actual or potential consequences of action and inaction, of proposed alternatives, and of decisions" [15: 6,7]. Values are used to form alternatives. Why consider value-focused thinking over another method? Keeney emphatically answers this by saying that "value-focused thinking should lead both to more appealing decision problems and to choices among better alternatives than those generated by happenstance or conventional approaches" [15: 8]. Figure 2 gives a great overview of what value-focused thinking entails where the arrows represent influences [3: 467].

For NAIC's problem, most of the areas contained within Figure 2, which shows what value-focused thinking entails, are accomplished and presented in Chapters III and IV. Figure 2 is applied to NAIC's resource allocation strategy. Specifically, NAIC's objectives are defined. A value hierarchy is formed where a value hierarchy contains the values and measures that define the objectives for NAIC in greater detail. Scoring functions, similar to utility functions, are developed to score the measures. Value-focused thinking helped create alternative, allowed for a large amount of communication with both the NAIC Commander and the DU Managers, and provided some very useful information. Data is collected from scoring sheets where the DU Managers rate their percentage cuts and data is collected on how important each measure and objective is to the commander. Finally, alternatives are evaluated using decision analysis software. Two types of decision

analysis software are DPL and Logical Decisions which are examined in the following two sections.

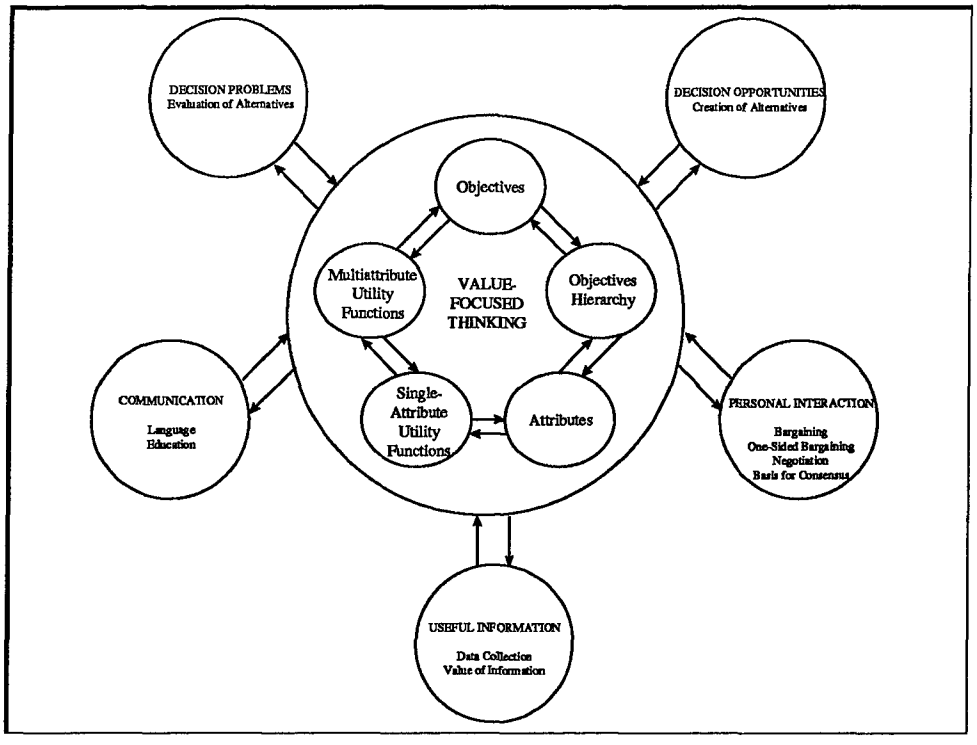


Figure 2. Overview of Value-Focused Thinking

2.6 DPL

DPL allows decision analysis problems to be represented in three possible views [10: 41]. All three are very useful in conveying information to the decision maker whether it is by using the decision tree, influence diagram, or a combination of both. The decision tree term is appropriate because it is similar to a tree. There is one beginning structure, either a decision node or chance node, similar to the trunk of a tree. A decision node is a

rectangle and represents the possible alternatives for a certain decision and a chance node is an oval and incorporates uncertainty. A value node in the shape of a rectangle with rounded corners contains a single value in DPL. From the starting point, there can be many branches off the trunk. In DPL, these branches can be value, decision, or chance nodes springing from the beginning node. There are also branches springing from branches. When climbing a tree, an objective may be to reach the very top, to go as far out on a particular limb, or just to reach that bird nest. In DPL, different objectives can also be designated and solved. DPL automatically designates the objective function as attribute 1 if there is only one measure. If there is more than one measure that defines the objective function, DPL has the capability to define and track up to 64 different attributes or variables that form the objective function. Attributes are also used in DPL to define constraints in the decision tree view. Constraints can be used to prune the tree in order to lessen the number of alternatives considered and evaluated. Figure 3 provides an example of a decision tree in DPL where the path that provides optimality is highlighted in black. The numbers under each branch are the attribute values.

DPL also provides the capability to create influence diagrams. With many decisions and/or chance nodes and many alternatives within these nodes, the decision tree can become enormous. If Figure 3 were fully expanded, it would show 125 different branches or alternatives. Key dependencies, decisions, and uncertainty also become difficult to show in a large decision tree. When decision trees become too large, influence diagrams help the decision maker and provide "an unambiguous representation of probabilistic and value dependencies" [10: 44]. DPL shows these dependencies

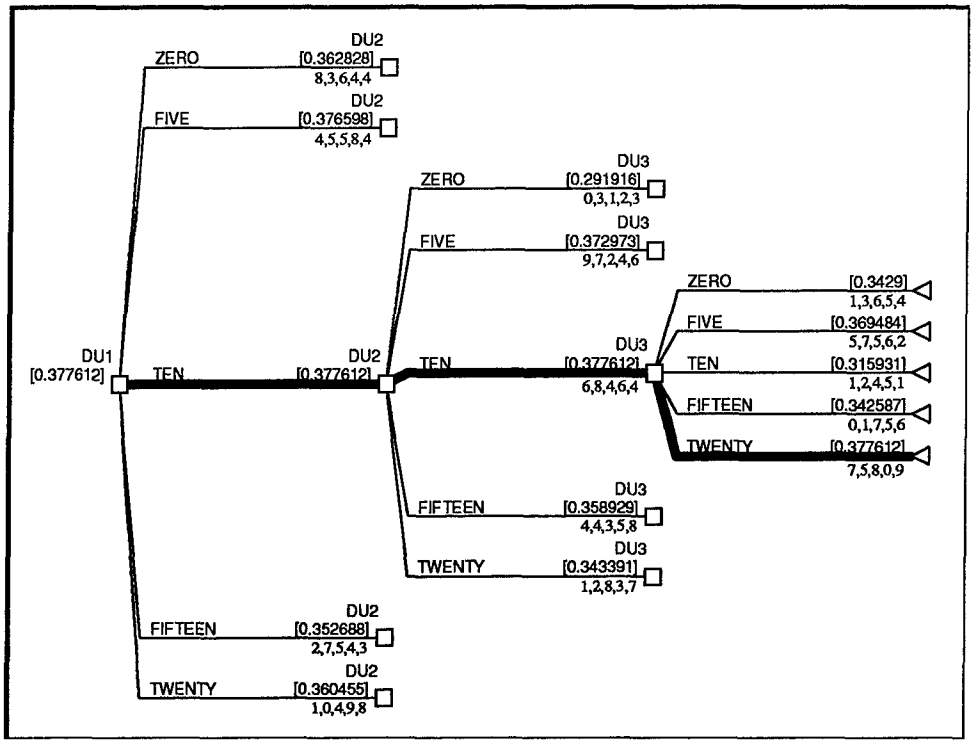


Figure 3. Example Decision Tree in DPL

through different colored arcs in the influence diagram. However, influence diagrams do not show the alternatives within a decision node nor the possible outcomes within a chance node.

Given the strengths and weaknesses of both influence diagrams and decision trees, it is sometimes necessary to do both. Modeling of NAIC's problem makes use of both the influence diagram and decision tree.

2.7 Logical Decisions

Logical Decisions for Windows (LDW) is a software package that ranks alternatives, develops a value hierarchy with goals and measures, applies weights to goals

and measures, and develops utility functions for the measures [17: 14]. LDW is used in considerable detail to provide a value hierarchy for NAIC, scoring functions for the measures, and sensitivity analysis on the commander's weights. While DPL has the capability to perform sensitivity analysis, LDW provided a better capability. Specifically, sensitivity analysis was used for one weight at a time while keeping the other weights proportional and summing to one. This was best accomplished in LDW.

2.8 Knapsack Problems

Any integer program that has only one constraint and all of the variables are confined to being zero or one is a knapsack problem [40: 468]. The idea behind this is that a knapsack can only hold so much. Not only that, but it can only hold an integer number of items. Therefore, the most beneficial item goes into the knapsack first and then the next most beneficial. This continues until the knapsack is full. With a knapsack problem though, this may not be an optimal choice. For example, items one, two, and three fill the knapsack. However, items four and five together take up just as much room as item three, but provide more benefit. The optimal strategy in this case would be to have items one, two, four, and five in the knapsack. Therefore, a typical knapsack problem has the benefits in the objective function and the constraint contains the cost or how much a particular item fills up the knapsack. The constraint's right hand side is the amount of space available in the knapsack. Typically, the objective function is maximized and the constraint is less than and equal to some value.

2.9 Summary

This chapter provided a basic understanding of how NAIC performs its resource allocation. A brief review was then conducted to discuss how other military and civilian organizations perform their resource allocation. An overview of decision analysis and value-focused thinking as a methodology used for NAIC's problem was then explained with some background into decision analysis software. Chapter III applies decision analysis and value-focused thinking to NAIC's problem and shows how the decision analysis software is used to model the production and ranking of alternatives for NAIC's resource allocation strategy.

III. Decision Analysis Process Using Value-Focused Thinking for NAIC

3.1 Overview

The first three blocks of Figure 1 on page 10 define the basic structure for this chapter. To begin, the decision situation needs to be identified and the objectives need to be understood. The decision situation involves the NAIC Commander choosing a resource allocation strategy from a set or list of alternatives provided by the SMT. The overall objective is to minimize the impact that NAIC will incur from any budget cut that this organization is required to take. To best meet this overall objective, value-focused thinking was used to develop subobjectives that were used to measure the impact of alternatives presented to the commander. These subobjectives are developed and formed into a value hierarchy. The commander also determines the relative importance of those subobjectives or values by designating weights for the values.

The next block states that alternatives need to be identified. This section comprises a very small portion of this chapter. The third block requires considerable attention. Most of Clemen's book is focused on decomposing the problem [8: 7]. For this block, measures are introduced and defined. DU Managers score the measures using scoring sheets. Scoring functions are then used to translate the measures from the scoring sheets into a utility score. These utility scores from the first scoring function are then aggregated and translated into another utility score. After this, the aggregated scores are multiplied by the commander's weights producing scored alternatives. This third block also incorporates decision analysis software. Using DPL and Logical Decisions, the

problem structure and preferences are modeled. There is no uncertainty modeled. The remaining blocks in Figure 1 are addressed in Chapters IV and V.

3.2 Understand Objectives

Developing the subobjectives requires an understanding of the overall objective. The overall objective is to minimize the impact that NAIC will incur from any budget cut that it is required to take. The keyword in the overall objective is impact and that forms the basis for all of the subobjectives. In other words, what impacts NAIC? Before this question can be answered, another, more important question, must be answered. Who decides what impacts NAIC? Is it one person or a group of people that decide this issue? For NAIC, even though the SMT as a group make recommendations to the commander for NAIC's resource allocation strategy, the commander is the decision maker and either rejects or accepts their recommendations.

Section 3.2.1 discusses the subobjectives chosen by the NAIC Commander and places those subobjectives in a value hierarchy. From this point forward in the discussion of subobjectives, the subobjectives are given the term values. In some cases, one value is just as important as another, but this is not true in all cases. Section 3.2.2 gauges the weight of one value over another in order to determine the importance of the values. Knowing the values and importance of those values completes block one in Figure 1, Understand the Objectives.

The NAIC Commander's values were placed in a value hierarchy and then each value was weighted. Both the value hierarchy and the weights are very critical inputs to

the resource allocation model and are shown in Appendix A. Defining the commander's value hierarchy and weighting his values took approximately three hours of the commander's valuable time and was accomplished in two separate interviews [11; 12]. Mrs. Wilkinson and LTC Kloeber both provided important information during these meetings and also took notes to ensure the accuracy of the commander's value hierarchy and associated preferences.

3.2.1 Values

The first interview with the NAIC Commander took place on 1 November 1996. The purpose of the interview was to obtain his values for NAIC's resource allocation strategy. To speed up the process, a draft value hierarchy was developed and explained to the NAIC Commander. This draft drew fundamental values from NAIC's Mission and Organizational Pamphlet, and NAIC's Master Plan [23; 24]. The key objectives and goals within these documents provided many of the values used in the draft hierarchy. Considerable preliminary coordination occurred to determine the commander's most probable values. During the interview, it was very important to ensure the commander understood that he was building his value hierarchy and not the analyst's. He could change it in any way he thought necessary.

In particular, the commander moved the Future Requirements value to a much higher level and took away the Internal Customer value in order to focus all of the DUs on the External Customer value. These were just a few of the changes he made and the entire process took approximately one hour. The commander also thought that further research

was needed to develop the Unit Performance portion of the value hierarchy. Using the Unit Self Assessment and the Mission Effectiveness Inspection, a draft value hierarchy was developed [11; 29; 30]. This value hierarchy was then sent to the NAIC Commander for approval and was returned without any further corrections.

Figure 4 displays the top three levels of the commander's value hierarchy. The

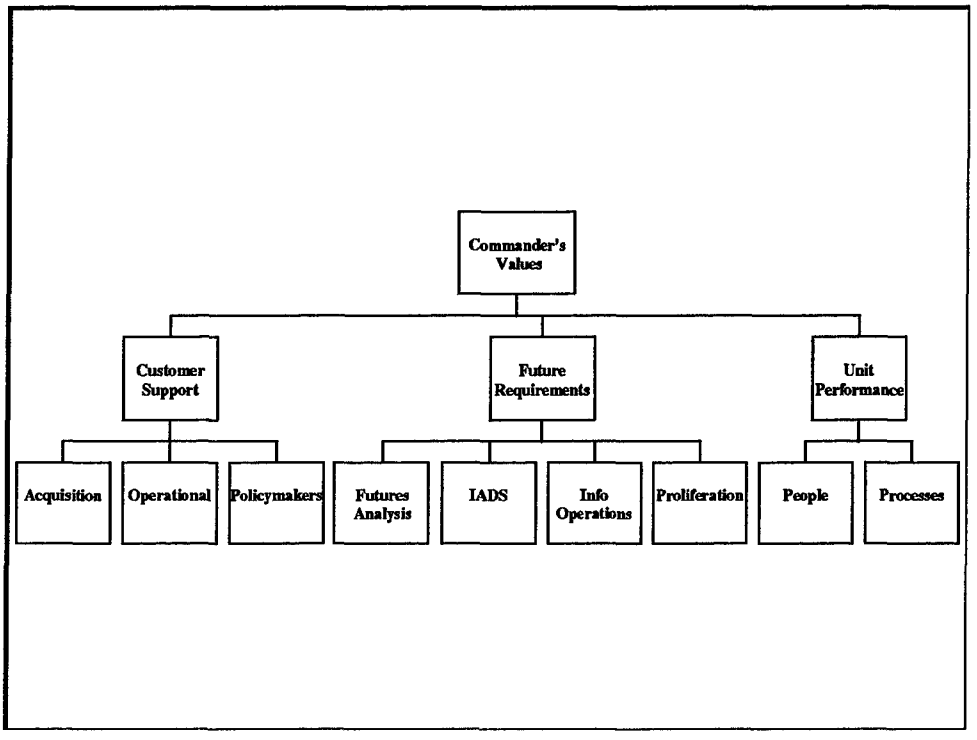


Figure 4. Top Three Levels of Value Hierarchy

higher the value is in the tree, the more important the value is to the commander. As shown, the commander's top three values were Customer Support, Future Requirements, and Unit Performance. The three values under the Commander's Values block also contain values, or subobjectives, under them. Remember that the Commander's Values

block is the overall objective which is to minimize the impact of a budget cut on NAIC. Figure 4 shows only three levels in the value hierarchy. Overall, there are five levels in the value hierarchy which is presented in its entirety in Appendix A.

3.2.2 Weights or Preferences

The second interview with the commander was conducted on 20 December 1996 [12]. This interview proved to be much more time consuming and demanding, taking approximately two hours. The commander weighted all of the values. From this interview, some values were deemed unnecessary for this resource allocation cycle and some were combined to form only one value. For example, under the Future Requirements value, the Futures Analysis value was comprised of Economics, Leader Personality, Military Doctrine, State Relationships, and Technology values. These five values were rolled up or combined into the Futures Analysis value for various reasons. To begin, it would be very difficult to score these five values and the commander felt that the DU Managers could subjectively consider these values collectively and produce an overall score for all five values. This overall score was placed in Futures Analysis.

The commander used a direct assessment method to weight his values. The direct assessment was based on the following thought:

> You have 100 marbles. These marbles can be distributed in any manner you want. At each level in the hierarchy you have an additional 100 marbles. Once all the marbles are gone, there are no more for that level. Consider Customer Support, Future Requirements, and Unit Performance. How would you distribute those 100 marbles?

There is a distinction between branch and level. The top value is the overall value, or objective, labeled Commander's Value. Under this, there are three branches, Customer Support, Future Requirements, and Unit Performance which together form a level. The reason they form a level is that all three have the same value above them. The reason they are all branches is that each have levels below them. Each level on each branch was weighted with 100 marbles. The commander made these choices based on what he thinks to be most important. For instance, look at Customer Support in Figure 5. Under Customer Support is Acquisition, Operational, and Policymakers where another 100 marbles were distributed. This process was continued for each branch and level.

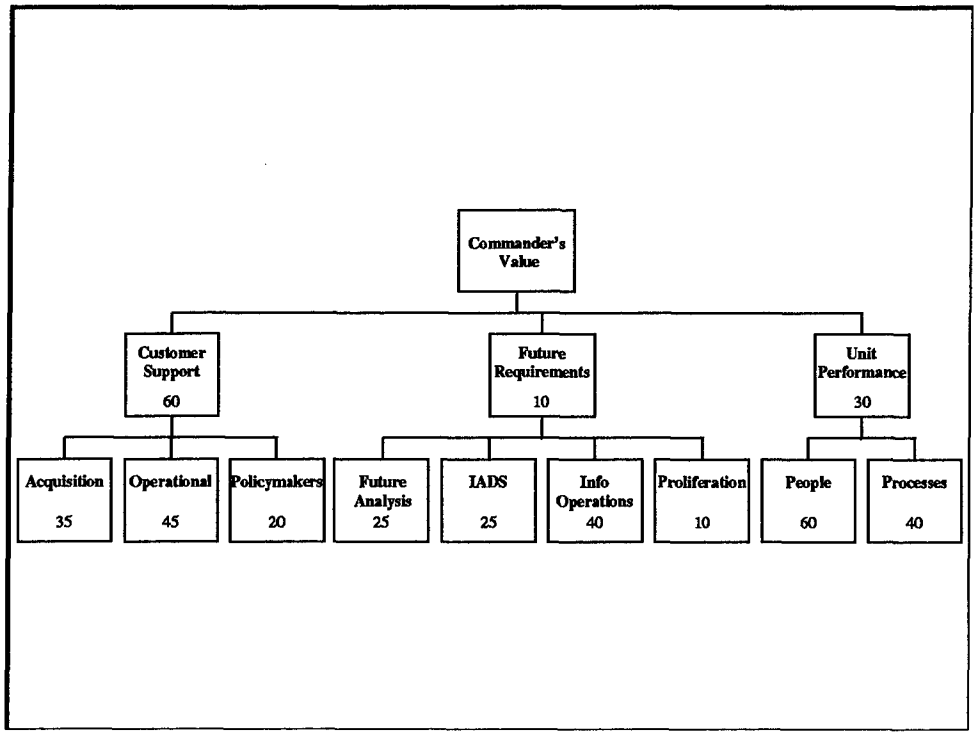


Figure 5. Top Three Levels of Value Hierarchy with Weights

The marbles give a weighting to the values with the higher the number having more importance. Looking at Figure 5, one can see that the Customer Support/Operational holds the most weight, 60*45, then Customer Support/Acquisition with 60*35, then Unit Performance/People with 30*60, and so on. Note that Figure 5 only contains three of the five levels. An observation made during this interview was that the commander had a more difficult time scoring four or more values on one level. All of the commander's weights are given in the value hierarchy in Appendix A.

3.3 Identify Alternatives

The decision situation is for the commander to choose a resource allocation strategy and the objective in the decision situation is to minimize the impact on NAIC for NAIC's budget cut. Now, according to Figure 1 on page 10, alternatives must be identified. What constitutes an alternative? The commander chooses a resource allocation strategy based on a certain number of alternatives. Since the objective of NAIC's resource allocation strategies is to minimize the impact on NAIC of any budget cut, then each alternative for this methodology is based on how it impacts NAIC. The impact was developed into a value hierarchy composing the commander's values. The commander also weighted those values. So, ultimately, an alternative is based on the commander's values and weights and this is developed in greater detail later in this chapter. Now, remember the DU Process. There are 19 DUs. Each DU produces plans based on a 5%, 10%, 15%, and 20% cut level. Thus, each DU might be cut 0%, 5%, 10%, 15%, or 20%.

Using this information, the resource allocation alternatives for NAIC consist of each DU taking a certain percentage cut based upon how those cuts impact NAIC.

3.4 Decompose and Model the Problem

This section focuses on the third block in the Decision-Analysis Process Flowchart shown in Figure 1. According to Clemen, "decomposition is the key to decision analysis" [8: 7]. NAIC's problem is decomposed and broken down to a level that allows the decision maker and all others involved with this problem to "understand their structures and measure uncertainty and value" [8: 7]. While there is no uncertainty involved in this problem, understanding NAIC's values is very important. A considerable amount of work has already been accomplished with values in Section 3.2 where a value hierarchy was formed and the commander determined the relative importance of those values by assigning weights to them. The remaining portions of this section 'decomposes' the problem at hand. While an alternative consists of each DU taking one of five levels of cuts, this section goes into great detail on how those cuts are scored. Measures are defined from the value hierarchy and a scoring sheet is produced for those measures. Two types of scoring functions, similar to utility functions, are used to translate unlike units into like units. Finally, using the commander's weights that were assigned to his values, a score for an alternative is developed.

3.4.1 Identify Measures

Measures are not much different than values. To be precise, measures are measurable values. In developing the value hierarchy, the values, or subobjectives, continued to be broken down into more values. When a value was reached that could no longer be broken down or decomposed into more values, that value has been fathomed. For example, look at the Unit Performance value in Figure 6.

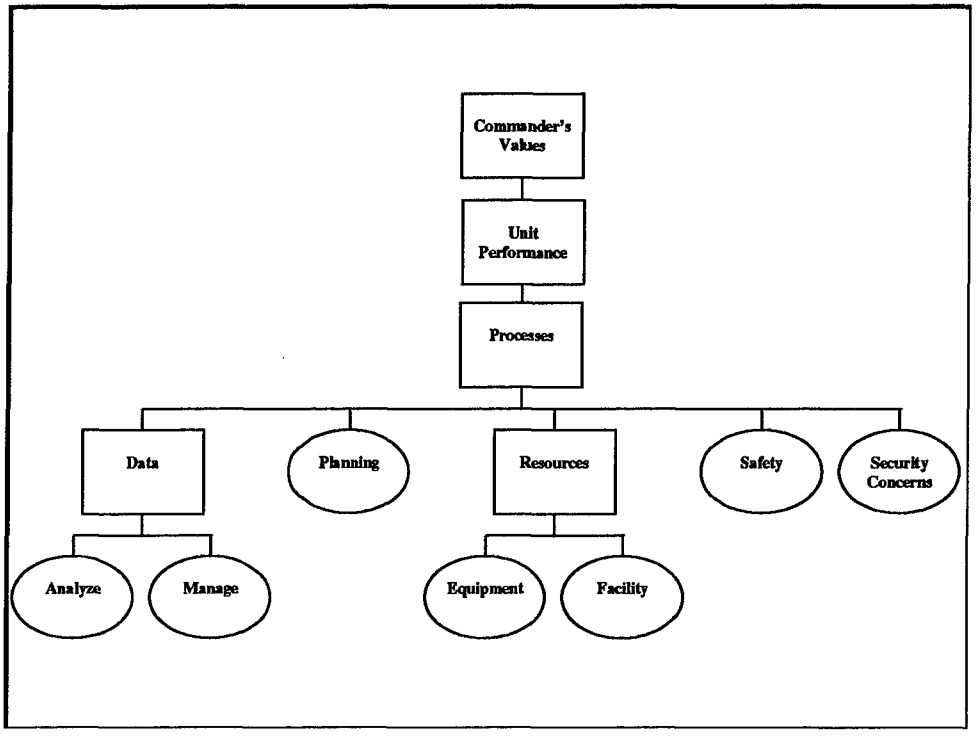


Figure 6. Developing Measures

The Processes value under the Unit Performance value was broken down into Data, Planning, Resources, Safety, and Security Concerns values. Data and Resources were considered capable of being further decomposed whereas Planning, Safety, and Security

Concerns values could not be broken down any further. Values that can no longer be decomposed become *candidates* for measures. It is not automatic. Some candidates for measures are very difficult to gauge on some scale. Such was the case for the seven measures under Future Requirements/IADS/Threat Description and the three measures under Future Requirements/Info Operations/Offense/(C4, Electronic Systems, and Space Systems). These measures were *rolled up* into the value above them. The value that they were rolled up into then became the measure. For example, Threat Description, C4, Electronic Systems, and Space Systems became the measure. The measures that were rolled up are shown in Appendix A. The NAIC Commander also changed some of the other measures. For instance, at one point, Relevance and Tailored were measures under Customer Support/(Acquisition, Operational, and Policymakers)/Quality. The commander thought there was little distinction between these two measures and combined them into one measure, Relevance. All of these changes occurred during the second interview [12].

3.4.2. Scoring Measures

In Appendix A, the measures are easily recognized. They are represented by ovals and play a very important role in the overall model because they are the actual items that the DUs score. First and foremost, the DUs used a scoring sheet to rate their percentage cuts. Once these scoring sheets were marked, these sheets were used to find the utility score for each plan using scoring functions for each measure. There are 41 measures that need to be scored by every DU Manager for each level of cut.

3.4.2.1 Scoring Sheets for Measures

The scoring sheets were developed using line scales as opposed to number scales for the following reasons. Using a line scale, the impact that a certain percentage cut would have on measures is stressed, not the numerical score that the impact would receive. This allows the DU Managers to focus on the impact and not on a number. If a numbering scale was used, values may have been inflated. Lastly, line scales required less time to score. Whether a measure should receive a 7.5 or 7.6 based on its impact, is not considered by the DU Managers. That step was not required with line scales and saved time. With all of the benefits of using a line scale, there was a drawback. While the time needed to score the percentage cuts was less for the DU Managers, the analyst is required to use his/her time to translate the impact into a utility score. This is accomplished using scoring functions for the measures at a DU level. The scoring sheets are contained in Appendix B.

3.4.2.2 Scoring Functions for Individual Measures

For NAIC, there are two applications of scoring functions. The first application was applied to each DU on all 41 measures. The scoring functions for all of the measures scored using the first application were linear and a template is provided in Appendix C. The range of these scoring functions goes from zero to ten and was based on the NAIC Commander's recommendations [12]. The scoring functions could have had any range as

long as the range was consistent [8: 474]. Again, the method for obtaining a particular measure's utility score was to use the scoring sheets filled out by the DU Managers. Each line scale used in the scoring sheets effectively was the X-axis for the scoring functions. At the point where the DU Managers placed an X on a measure's line scale, or X-axis, an orthogonal line was drawn up to the point of intersection on the scoring function. At this point, the utility score on the Y-axis was obtained. For example, consider Figure 7. This scoring function would have a utility score of 3. This type of scoring was accomplished for each measure, for each percentage cut, for each DU. Now, the aggregate scoring functions, or the second application of scoring functions, are similar, but serve a different purpose as discussed in the following section.

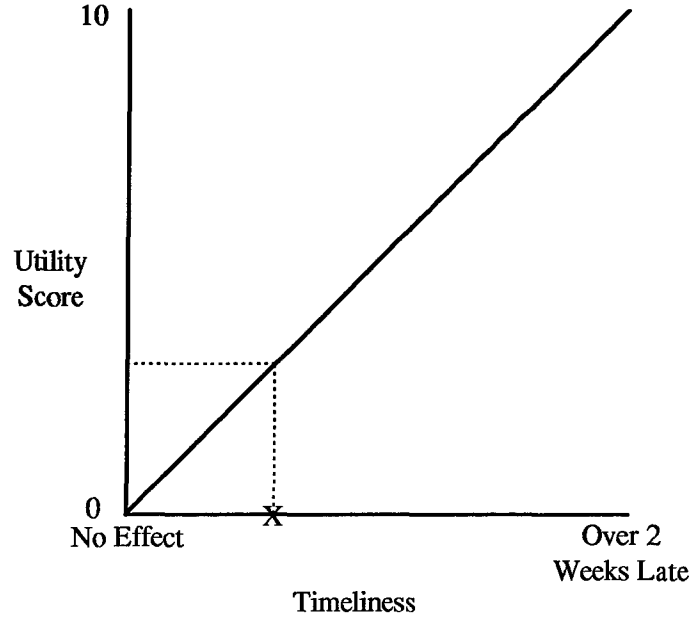


Figure 7. Example Scoring Function for DU Measures

3.4.2.3 Scoring Functions for Aggregate Measures

With the first application of the scoring functions performed, each DU has scores for their measures ranging from zero to ten on all 41 measures for each cut level. The second application of the scoring function was also applied to all 41 measures, but in a slightly different manner. These scoring functions were used to obtain an overall score for an alternative where the first application of scoring functions was used to obtain scores for DU plans. Recall that an alternative consists of each DU taking one of five possible cuts, 0%, 5%, 10%, 15%, or 20%. Like measures were then added together across the DUs for each alternative. To help understand this, consider one measure, Timeliness. The first application of scoring functions has been accomplished. Also consider *one* alternative, where the cut level is specified for each of the 19 DUs: DU1 5%, DU2 10%, DU3 5%, DU4 20%, DU5 0%, DU6 10%, DU7 0%, DU8 20%, DU9 15%, DU10 15%, DU11 0%, DU12 20%, DU13 0%, DU14 5%, DU15 15%, DU16 10%, DU17 0%, DU18 20% and DU19 20%. Since the first application of scoring functions has been accomplished, each of the DUs at the given level of cut for this alternative has a score for the measure Timeliness. These 19 distinct scores were added together producing a second score that ranges from zero to 190. This second score, which is marked by the X on the Timeliness axis in Figure 8, was then used for the second application of scoring functions and an impact score was obtained. This process was performed on all 41 measures for this single alternative. The Y-axis has a range from 0 to 10. As mentioned earlier, the Y-axis can have any range as long as there is consistency. A template for the aggregate scoring function is contained in Appendix D.

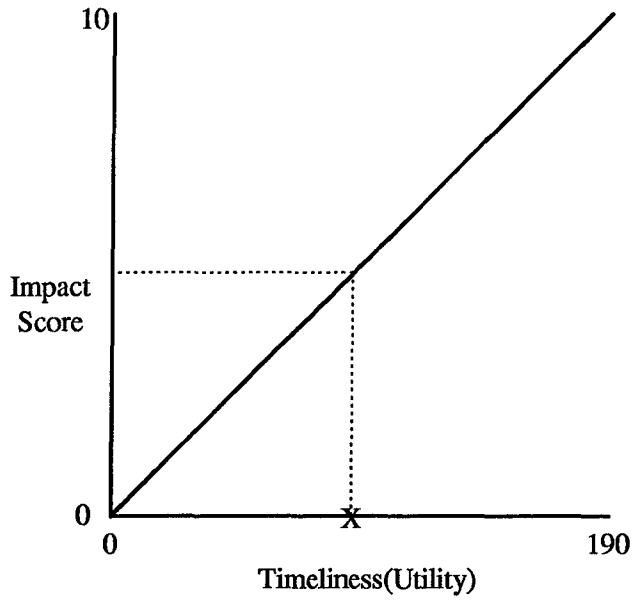


Figure 8. Example Aggregate Scoring Function for Model

3.5 Model Summary

Now that all of the 'pieces' to this model have been identified, there remains the task of putting the puzzle together. One of the pieces was put together already. That piece was using the scoring function scores for the measures from the DUs and adding them together to assess the aggregate scoring function to obtain an impact score. The remaining two pieces, the commander's value hierarchy and the commander's weights, now come into play. Using what Clemen's defines as an additive utility function and modified for the extra number of levels, an alternative for NAIC was scored using

$$\sum_{w=1}^{W} k_w \left\{ \sum_{x=1}^{X_w} k_{wx} \left[\sum_{y=1}^{Y_{wx}} k_{wxy} \left(\sum_{z=1}^{Z_{wxy}} k_{wxyz} U_{wxyz} \right) \right] \right\} \quad (1)$$

For Equation (1), k_w represents the Commander's weight for the wth value, k_{wx} represents the Commander's weight for the xth value under the wth value, k_{wxy} represents the Commander's weight for the yth value under the xth value under the wth value, and so on for k_{wxyz}. W, X_w, Y_{wx}, *and* Z_{wxy} are the number of branches for each level where W is three based on the Customer Support, Future Requirements, and Unit Performance values. X_w is based on each of the values above it, Customer Support, Future Requirements, and Unit Performance where the branch under Customer Support has Acquisition, Operational and Policymakers. Therefore X_1 is three, X_2 is five because of Futures Analysis, IADS, Info Operations, New Mission Area, and Proliferation, and X_3 is two because of Processes and People. Y_{wx} and Z_{wxy} are determined in a similar manner. *Uwxyz* is the scoring function's impact score for the measures under the values. The upper range on the summation signs ensure the summation occurs over the proper value [8: 557]. In words, this states that the scoring function's impact score for the aggregate model were multiplied by the measure's weight as shown in the value hierarchy. Those values were then multiplied by the weights one level above them in the value hierarchy. Scores are then added together for that branch *and* level and then multiplied by the weight on the next level up from them. This continues until the top of the value hierarchy is reached, which in this case was Commander's Values. In this manner, different alternatives earned different scores. Once this is accomplished, the best alternative with respect to NAIC's value hierarchy can be

chosen to complete the fourth block in the Decision-Analysis Process Flowchart shown in Figure 1 on page 10. There is one item that must be discussed before moving on to the software used to model this problem. The additive utility function must meet a condition called mutual preferential independence in order to be applicable to NAIC's value hierarchy.

3.5.1 Mutual Preferential Independence

This concept is best understood using an example taken from Clemen's book [8: 579].

> "An attribute Y is said to [be] preferentially independent of X if preferences for specific outcomes of Y do not depend on the level of attribute X. As an example, let Y be the time to completion of a project and X its cost. If we prefer a project time of 5 days to one of 10 days, assuming that the cost is 100 in each case, and if we also prefer a project time of 5 days to one of 10 days if the cost is 200 in both cases, then Y is preferentially independent of X; it does not matter what the cost is--we still prefer the shorter completion time."

In order to have mutual preferential independence in the above example, cost must also be preferentially independent of project time. Clemen gives an example of where mutual preferential independence may not hold by describing how ones "preference for amount of homework effort might depend on course topic" or even the instructor teaching the material [8: 579]. The question now turns to whether or not NAIC's additive utility function has mutual preferential independence as applied to their problem. Clemen discusses how one can determine whether or not independence exists for NAIC's problem and says the simplest approach is to use paired comparisons [8: 580]. Since this is only a

first look at NAIC's problem, mutual preferential independence was not checked; it was assumed to hold. Clemen says that "if a decision maker has done a good job of building a decomposable hierarchy, mutual preferential independence probably is a reasonable assumption" [8: 579]. A decomposable hierarchy has been built for NAIC. Assuming mutual preferential independence is appropriate at this point for NAIC's problem.

3.6 Software Used to Model the Problem

Using software to model the problem falls under block three in the Decision-Analysis Process Flowchart in Figure 1. While some background in DPL and LDW has already been given in Chapter II, this section shows how the software was used and applied to this problem. Various pieces of software were used to model the problem. The value hierarchy was the basic building block for the model. Without the values, the model has no other basis. The weights for the measures were incorporated into the decision analysis model. After the line scales from the scoring sheets were converted to a utility score, these scores for the measures were placed into an Excel Spreadsheet and read into DPL. Excel was used because it provided quicker access to the scores. DPL automatically adds the measures designated as attributes for an alternative from one DU to the next producing the aggregated values. Once all of the DUs' measures, with each DU at a certain percentage cut level, were added, the second scoring function was applied. Using Equation (1), the weights were applied to the scoring functions and an alternative was scored. Budget constraints were used to decrease the run time. The following sections go into much greater detail about the model that was built. Chapter IV contains

the results where the best alternative was chosen and sensitivity analysis was performed. Chapter V addresses the final two blocks of Figure 1 by discussing whether or not further analysis is needed. In addition, the implications of implementing the chosen alternative and recommendations for future work are provided in Chapter V.

3.6.1 DPL® 3.20.01

DPL was the core model building software [10]. There were two areas in DPL that were important to the NAIC model, the influence diagram and the decision tree. The first area is the influence diagram. The model used two groups of figures in the influence diagram. The first group contained the decision to be made by each DU and the second contained the commander's weights which were displayed in a value hierarchy format. The first diagram is shown in Appendix E. The decision tree was automatically generated from the influence diagram. However, the decision tree was modified significantly in order to best model NAIC's problem. Both the influence diagram and decision tree provided various key requirements that allowed the model to be effective.

3.6.1.1 Influence Diagram

There were 19 decision nodes in the influence diagram. Each decision node contained five alternatives or choices. The numerical value placed on those branches corresponded to the percentage cut taken for that DU. The numerical values on those branches are pointers to an array in Excel which is described later. The data from the

spreadsheet was converted into DPL code. Now, DPL was told to use that particular data by selecting the Include option and then selecting Before Data Definitions option. If this was not accomplished, the program would not run correctly. With these steps accomplished, several steps were then taken in the decision tree view.

3.6.1.2 Decision Tree

The decision tree view contained several items that needed to be accomplished. In this view, 44 attributes were defined. These attributes can be viewed as the variables for the objective function and constraints. Attributes were used to track all 41 measures which were used to develop the objective function. The remaining three attributes were used as variables for two budget constraints. The constraints are necessary because the run time is dramatically decreased when the constraints are used to prune some of the branches of the tree. For example, a 13 DU model's run time was decreased from approximately 200 hours to five hours using the constraints. The attributes are shown in Appendix F and the constraints and objective function are shown in Appendix G.

3.6.1.2.1 Attributes

There were 41 attributes used for the objective function, representing the 41 measures, and three attributes used for two constraints for a total of 44 attributes. The attributes were designated in the get/pay expressions for a decision node in DPL. An undocumented function of DPL allows attributes to automatically add together as

progress was made from one decision node to the next. Also, this model extensively made use of arrays within DPL. There was currently no documented instruction for how this would be accomplished, but ADA technical support staff assisted with this effort [7]. The last item that needed clarification was the second to last attribute which contained a minus sign. This attribute was used to help keep track of the amount of money cut from an individual DU at a particular level and played a key role in one of the constraints. The specific reason the minus sign was needed was to discount the automatic addition that was referred to earlier. There was not a method to 'turn off' the automatic addition so this aspect was hard coded in order to turn it off. Since the first decision node had nothing added to it, it was not necessary to subtract anything. The attributes for each section of the decision tree are contained in Appendix F.

3.6.1.2.2 Constraints

Two constraints served a very important purpose. As already stated, the program time was cut dramatically using the two constraints. A concept that must be included here was that constraints in DPL were evaluated at each decision node. The constraints were built on the actual amount of budgetary cuts that NAIC was required to perform. Given a certain dollar amount that NAIC had to cut, the first constraint was based on going over this cut amount and the second on going under this cut amount. The thought process for these constraints was simple. To begin, the 19 DUs were rank ordered by the amount of money they had available for cutting, highest to lowest. Then, using DPL's ability to add attributes as it goes along in the decision tree and that constraints were checked at each

decision node, the first variable of the constraint contained the actual dollar amount cut so far for that alternative up to that point. Added to this variable was the total summed amount of dollar cuts for the remaining DUs set at the highest level of cuts. This provided a value that could be compared to the required dollar amount that NAIC needed to cut. If this constraint was violated, then the branch was pruned from that point forward.

The lower constraint was similar. Instead of not cutting enough however, it is also possible to cut too much. Setting this constraint reasonably over the dollar amount that NAIC was required to cut provided a reasonable bound. If an alternative, at any point in the decision tree, went over this amount, that branch was also halted and no longer evaluated. So, upper and lower bounds were put on the dollar amount cut. If a branch evaluated at a certain point in the decision tree did not fall within these bounds, it was pruned. The constraint functions are given in Appendix G.

3.6.1.2.3 Objective Function

The objective function also contained the same two constraints. The reasoning was that the objective function was evaluated at the very end of the decision tree. The constraint functions were evaluated only at the current node and did not include evaluation at the end node. So, in order for the constraints to still apply, they were included in the objective function. The objective function was formed using Equation (1) from Section 3.3. Incorporating the weights that were set in the influence diagram and the scoring functions for the individual measures into Equation (1), the objective function was

produced. The objective was to maximize Commander's Values and the objective equation used to do it is shown in Appendix G.

3.6.2 Excel® 7.0

Excel was used as a storage and input device [22]. It stored the DU level utility scores for each DU for each measure for each percentage cut in a 5x44 array. The five rows were associated with the different percentage cuts and the 44 columns were associated with the 41 measures and 3 budget constraint variables. These arrays were then converted into DPL code from the Main DPL Program window and used in the DPL model. The spreadsheet values are contained in Appendix H.

3.6.3 Logical Decisions® 4.01

Logical Decisions was used preliminarily to build the value hierarchy [17]. The hierarchy built in Logical Decisions is contained in Appendix I. Logical Decision was considered a good software package to perform some sensitivity analysis on the top twenty alternatives and as a means to score and generate the DU level utility functions.

3.7 Summary

This chapter went into great detail on the first three blocks of the Decision-Analysis Process Flowchart. An NAIC value hierarchy was developed, the commander weighted those values, measures were defined, scoring sheets were made, and scoring

functions were defined. Also, software was used to implement and make use of all of these pieces of information. Chapter IV discusses some changes that occurred over the course of this study which prompted some elements from Chapter III to be modified. While the value hierarchy, weights, measures, scoring sheets, and scoring functions remained mostly unchanged, the model built using the software was no longer applicable. This points to the usefulness of value-focused thinking. While the whole situation or model may change, the ingredients of the model are very robust and will not change unless a new decision maker comes along or the previous decision maker deems it necessary.

IV. Analysis and Results for NAIC (FY99 Cycle)

4.1 Overview

The FY99 Budget Cycle at NAIC forced some changes in the methodology presented in Chapter III. While NAIC was forced to take a 13% cut, the commander decided to take that cut entirely from external assistance, research and development, and procurement. For validation purposes, only Tier III program items (external assistance proposals) are evaluated in this thesis. As such, there were 62 proposals to evaluate by ten DU Managers where the proposals would be cut completely or entirely saved. NAIC wanted these 62 proposals ranked using the methodology presented in Chapter III.

4.2 NAIC Requirements

The methodology was general enough to account for the change in budgeting procedures. The value hierarchy still applies as do the commander's weights. This is one of the strengths of value-focused thinking. It can be applied in many different cases and used for various studies or analyses. The scoring sheets required a few changes. Wording of the measures changed from 'a certain percentage cut' to 'if this contract is cut.' There was only one line scale for each measure instead of a line scale for 5%, 10%, 15%, and 20% because the proposals would either be cut or not cut. Also, 13 of the measures were not included in the scoring sheets. NAIC analysts thought these 13 measures did not apply and would not produce any change in the scores to warrant their use. The 13

measures left out were the three DoDIPP measures, Promotion Frontier, Communication, Work Environment, Planning, Safety, Security Concerns, Analyze, Manage, Equipment, and Facility. While this saved some time for the ten DU Managers that scored the measures, time savings may have hindered obtaining a complete overall utility score. Added thought should have been given to scoring or leaving out these 13 measures. Equation (1) also still applied to the evaluation of the 62 proposals and was used to rank the proposals.

Instead of providing NAIC a certain set of alternatives for their resource allocation strategy, NAIC wanted the 62 proposals scored and ranked using the value hierarchy, commander's weights, scoring sheets, and the first set of scoring functions. At this point, NAIC, based on the cut required, would designate the proposals to be cut based on the rank order. This presents some problems because it is highly unlikely that the required amount of resources will permit cutting an integer number of proposals. So, to help in this endeavor, some cost-benefit analysis is performed and a model can be built in the same fashion as in Chapter III. Chapter III's model contained 19 DUs with five levels each. The model for this current structure would contain 62 proposals with two levels each and produce resource allocation alternatives for NAIC, not ranking of the proposals.

4.3 Analysis

This section focuses on the results obtained from the methodology used for NAIC's resource allocation strategy. First, the results for the 62 proposals are examined and ranked solely on the score they received using the value hierarchy, commander's

weights, scoring sheets, and scoring functions combined to produce an overall score. Next, the individual cost of each proposal is incorporated and a cost-benefit analysis is provided, based on the computed overall score. In section 4.3, sensitivity analysis is performed on the weights assigned to the top three values under the overall value, Commander's Values. The three weights examined are for the values, Customer Support, Future Requirements, and Unit Performance. Finally, the actual policy that NAIC implemented for this cycle is examined and compared to the results attained in this chapter.

4.3.1 Results Based on Methodology

The results in Table 1 rank the 62 proposals for external assistance based on the methodology set forth in Chapter III. The methodology combined the NAIC Commander's value hierarchy, the NAIC Commander's weights, the measures and their scoring sheets, and the utility scores from the scoring sheets. These ingredients were used to determine an overall impact score for each proposal based on the overall objective to minimize the impact of a budget cut to NAIC. A low score indicates a low impact. With this in mind, the overall strategy is to select for cutting the proposals having the lowest impact until the necessary amount of budgetary cut is achieved. Table 1 ranks the proposals based on their impact. It also shows the funding level for each proposal as well as the cumulative impact and cumulative amount cut for any point in the table. NAIC took a $8.544 million cut for this cycle. Using Table 1 and drawing the line, which is

shown at $8.789 million, results in cutting 22 proposals with a cumulative impact of 36.6628.

Table 1. Rank Order based on Impact

RANK ORDER	PROPOSAL NUMBER	IMPACT SCORE	CUMULATIVE IMPACT	FUNDING (1000)	CUMULATIVE AMOUNT CUT
1	DU9-13	0.435	0.435	233	233
2	DU9-1	0.478	0.913	173	406
3	DU9-9	0.837	1.750	326	732
4	DU9-4	0.884	2.633	281	1013
5	DU9-2	1.066	3.699	384	1397
6	DU6-4	1.123	4.822	218	1615
7	DU3-6	1.199	6.021	298	1913
8	DU9-18	1.232	7.253	187	2100
9	DU9-19	1.402	8.655	93	2193
10	DU6-1	1.509	10.164	130	2323
11	DU9-15	1.591	11.756	359	2682
12	DU9-10	1.839	13.594	698	3380
13	DU9-14	1.971	15.565	716	4096
14	DU9-16	2.041	17.606	932	5028
15	DU9-21	2.050	19.656	154	5182
16	DU9-20	2.125	21.781	218	5400
17	DU9-7	2.255	24.036	417	5817
18	DU9-17	2.279	26.315	1396	7213
19	DU6-5	2.401	28.716	70	7283
20	DU1-2	2.610	31.326	445	7728
21	DU1-5	2.614	33.940	130	7858
22	DU9-8	2.723	36.663	931	8789
23	DU9-6	2.736	39.399	182	8971
24	DU6-3	2.741	42.140	247	9218
25	DU9-5	2.959	45.099	696	9914
26	DU9-3	2.986	48.086	714	10628
27	DU3-4	3.200	51.286	135	10763
28	DU1-6	3.214	54.500	211	10974
29	DU3-3	3.228	57.728	671	11645
30	DU1-3	3.247	60.975	495	12140
31	DU5-1	3.285	64.260	524	12664
32	DU1-1	3.288	67.548	390	13054

33	DU9-11	3.317	70.865	465	13519
34	DU6-7	3.348	74.213	257	13776
35	DU6-6	3.382	77.595	24	13800
36	DU5-2	3.529	81.124	233	14033
37	DU5-3	3.633	84.757	322	14355
38	DU4-5	3.812	88.569	110	14465
39	DU6-2	3.834	92.403	512	14977
40	DU3-1	3.908	96.311	699	15676
41	DU9-12	3.970	100.281	698	16374
42	DU8-1	4.078	104.359	933	17307
43	DU8-3	4.326	108.684	87	17394
44	DU10-2	4.438	113.122	775	18169
45	DU8-5	4.469	117.592	1834	20003
46	DU8-4	4.558	122.150	372	20375
47	DU4-2	4.561	126.711	342	20717
48	DU4-3	4.576	131.287	378	21095
49	DU3-2	4.628	135.916	567	21662
50	DU3-5	4.757	140.673	758	22420
51	DU7-1	4.938	145.611	347	22767
52	DU4-6	4.968	150.579	735	23502
53	DU4-4	5.003	155.582	192	23694
54	DU10-1	5.024	160.606	463	24157
55	DU2-3	5.232	165.838	311	24468
56	DU2-2	5.234	171.073	218	24686
57	DU8-2	5.250	176.323	87	24773
58	DU4-1	5.372	181.695	110	24883
59	DU2-1	5.377	187.071	208	25091
60	DU2-4	5.395	192.466	903	25994
61	DU4-7	5.507	197.973	261	26255
62	DU3-7	5.534	203.507	791	27046

4.3.2 Results Based on Cost-Benefit Analysis

Another way to rank the 62 proposals is by impact-cost ratio which is impact divided by the cost. As a side note, cost could have been divided by the benefit, but since

the objective has been to minimize, that concept is continued. Table 2 shows these rankings. For the $8.544 million that NAIC cut, drawing the line at $8.916 million results in cutting 13 proposals with a cumulative impact of 23.206.

Table 2. Rank Order based on Impact/Cost

RANK ORDER	PROPOSAL NUMBER	IMPACT COST	IMPACT SCORE	CUMULATIVE IMPACT	FUNDING (1000)	CUMULATIVE AMOUNT CUT
1	DU9-17	0.00163	2.279	2.279	1396	1396
2	DU9-13	0.00187	0.435	2.714	233	1629
3	DU9-16	0.00219	2.041	4.755	932	2561
4	DU8-5	0.00244	4.469	9.224	1834	4395
5	DU9-9	0.00257	0.837	10.061	326	4721
6	DU9-10	0.00263	1.839	11.900	698	5419
7	DU9-14	0.00275	1.971	13.871	716	6135
8	DU9-1	0.00276	0.478	14.349	173	6308
9	DU9-2	0.00278	1.066	15.414	384	6692
10	DU9-8	0.00292	2.723	18.137	931	7623
11	DU9-4	0.00314	0.884	19.021	281	7904
12	DU3-6	0.00402	1.199	20.220	298	8202
13	DU9-3	0.00418	2.986	23.206	714	8916
14	DU9-5	0.00425	2.959	26.165	696	9612
15	DU8-1	0.00437	4.078	30.243	933	10545
16	DU9-15	0.00443	1.591	31.834	359	10904
17	DU3-3	0.00481	3.228	35.063	671	11575
18	DU6-4	0.00515	1.123	36.186	218	11793
19	DU9-7	0.00541	2.255	38.441	417	12210
20	DU3-1	0.00559	3.908	42.349	699	12909
21	DU9-12	0.00569	3.970	46.319	698	13607
22	DU10-2	0.00573	4.438	50.757	775	14382
23	DU1-2	0.00586	2.610	53.366	445	14827
24	DU2-4	0.00597	5.395	58.761	903	15730
25	DU5-1	0.00627	3.285	62.047	524	16254
26	DU3-5	0.00628	4.757	66.804	758	17012
27	DU1-3	0.00656	3.247	70.051	495	17507
28	DU9-18	0.00659	1.232	71.282	187	17694

29	DU4-6	0.00676	4.968	76.251	735	18429
30	DU3-7	0.00700	5.534	81.785	791	19220
31	DU9-11	0.00713	3.317	85.101	465	19685
32	DU6-2	0.00749	3.834	88.935	512	20197
33	DU3-2	0.00816	4.628	93.564	567	20764
34	DU1-1	0.00843	3.288	96.852	390	21154
35	DU9-20	0.00975	2.125	98.976	218	21372
36	DU10-1	0.01085	5.024	104.000	463	21835
37	DU6-3	0.01110	2.741	106.741	247	22082
38	DU5-3	0.01128	3.633	110.375	322	22404
39	DU6-1	0.01161	1.509	111.884	130	22534
40	DU4-3	0.01211	4.576	116.460	378	22912
41	DU8-4	0.01225	4.558	121.018	372	23284
42	DU6-7	0.01303	3.348	124.366	257	23541
43	DU9-21	0.01331	2.050	126.416	154	23695
44	DU4-2	0.01334	4.561	130.977	342	24037
45	DU7-1	0.01423	4.938	135.915	347	24384
46	DU9-6	0.01504	2.736	138.652	182	24566
47	DU9-19	0.01507	1.402	140.054	93	24659
48	DU5-2	0.01515	3.529	143.582	233	24892
49	DU1-6	0.01523	3.214	146.796	211	25103
50	DU2-3	0.01682	5.232	152.029	311	25414
51	DU1-5	0.02011	2.614	154.643	130	25544
52	DU4-7	0.02110	5.507	160.150	261	25805
53	DU3-4	0.02371	3.200	163.350	135	25940
54	DU2-2	0.02401	5.234	168.585	218	26158
55	DU2-1	0.02585	5.377	173.961	208	26366
56	DU4-4	0.02606	5.003	178.964	192	26558
57	DU6-5	0.03431	2.401	181.365	70	26628
58	DU4-5	0.03465	3.812	185.177	110	26738
59	DU4-1	0.04884	5.372	190.549	110	26848
60	DU8-3	0.04972	4.326	194.875	87	26935
61	DU8-2	0.06035	5.250	200.125	87	27022
62	DU6-6	0.14092	3.382	203.507	24	27046

4.3.3 Optimal Strategy

While the alternative selected based on the Impact/Cost had a much lower cumulative impact than the alternative selected based on the ranked impacts alone, this may still not be the optimal alternative. To set the stage for this optimization, NAIC must cut at least $8.544 million. Also, each proposal is either cut completely or not at all. There is a benefit, or impact, associated with each proposal. These items fill the necessary requirements to be treated as a knapsack problem. The objective function in this case would be to minimize impact where each proposals impact is multiplied by one or zero based on whether or not that proposal is chosen to be cut. The sole constraint contains the cost for each proposal and it is also multiplied by zero or one for the same reason. The constraint is greater than or equal to $8.544 million because this amount must be cut. The formulation becomes:

$$\text{minimize } b_i x_i$$
$$\text{subject to: } c_i x_i \geq 8544$$
$$x_i = 0 \text{ or } 1, \; i = 1,\ldots,62$$

where b_i, c_i, and x_i is the ith proposal's impact score, funding level (1000), and whether the proposal is cut (x_i=1) or not (x_i=0) respectively.

Coding this problem into LINDO yielded an optimal solution where the proposals DU9-17, DU9-13, DU9-16, DU8-5, DU9-9, DU9-10, DU9-14, DU9-1, DU9-2, DU9-8, DU9-4, and DU93 were selected to be cut [19]. The only difference between this alternative and the alternative selected using the Impact/Cost is that the proposal DU3-6 was not selected. Also, the LINDO optimal solution cuts $8.618 million instead of $8.916

million and only 12 proposals instead of 13. The cumulative impact drops to 22.007. The LINDO code and variables used to obtain those codes are contained in Appendix J.

4.3.4 Selecting Alternatives

Selecting alternatives satisfies the fourth block in the Decision-Analysis Process Flowchart by allowing NAIC to choose the best alternative from Table 1, Table 2 or the Knapsack problem. The means for choosing an alternative is fairly straightforward using Table 1 or Table 2 and the alternative is already provided using LINDO. Given a required dollar amount to cut, NAIC looks at the far right column in either Table 1 or Table 2 and finds the dollar amount that exceeds the amount to cut. At this point, all proposals above this line are the proposals to cut. A few items need to be considered at this point. First, the objective is to minimize total impact to NAIC. With this in mind, Table 2 would be chosen over Table 1 because for any dollar amount cut up to the very last proposal, Table 2 has less impact for NAIC. The LINDO solution would be chosen over Table 2 because less impact is cut. However, the LINDO solution may be more difficult to explain and the impact savings may not outweigh this.

The second item that needs to be considered in selecting an alternative, is how far over the cut line NAIC is willing to go. For *example*, consider Table 1. Also consider that NAIC is required to take a $5.818 million cut. This is a hard constraint and $5.818 million must be cut. However, in Table 1, up to and including Proposal 17 cuts $5.817 million and Proposal 18 cuts $1.396 million by itself. Using the method set forth in the

previous paragraph, $1.395 million over the required amount is cut. However, if Proposal 19 is cut instead of Proposal 18, only $.069 million over the required amount is cut.

Lastly, consider the proposals belonging to DU9. In Table 1, 19 of their 21 proposals were in the top 30 with low impact scores. In Table 2, 16 of their 21 proposals were in the top 30 with low impact-cost scores. This may represent a problem. If the commander does not want to cut a high proportion of the number of proposals from DU9, then the tables can be altered. When the number of proposals, based on cost, impact or some other criteria, is reached, the remaining proposals for DU9 are taken out of the table and all other proposals are moved up. This can be done for any DU.

To conclude this section, it is not the analyst's job to select an alternative. It is his job to make recommendations and give insights based on the data received. Using the insights and recommendations in this section, the NAIC Commander is better able to choose the resource allocation alternative that is best suited to the organization based on the methodology presented in Chapter III. The choice is left to the decision maker.

4.4 Sensitivity Analysis

Logical Decisions analysis software was used to perform sensitivity analysis on the NAIC Commander's weights [17]. Given the time limitations for this research, sensitivity analysis was performed only on the weights associated with the Customer Support (0.6), Future Requirements (0.1), and Unit Performance (0.3) values. These three values hold the most weight overall. To show this, return to Figure 5 on page 22. The overall goal is Commander's Value. Under this is the Customer Support, Future Requirements and Unit

Performance weights which account for 100% of the Commander's Value. Under the Customer Support value which contains 60% of the weight for the overall goal, there are the Acquisition, Operational, and Policymakers values with weights assigned. At most, the Acquisition, Operational, and Policymakers weights have 60% of the overall goal because of the weight assigned to the Customer Support value. Therefore, if the proposal rankings do not change when the weights assigned to the Customer Support, Future Requirements, and Unit Performance values are changed one at a time, then the rankings will not change for any of the other weights. As mentioned in Chapter II, the weights remain proportional and still sum to one when sensitivity analysis is performed. To explain this, consider the initial weights given to the top three values. If the Customer Support weight was changed to 0.5, then the remaining two weights sum to 0.5 and retain their original proportions. Future Requirements increases to 0.125 and Unit Performance increases to 0.375 which is still a proportional weight of 0.1 and 0.3 respectively, i.e.,0.25*0.5 = 0.125 and 0.75*0.5 = 0.375. Sensitivity analysis was performed on one weight at a time in order to hold that one weight change responsible for any change in rankings. While sensitivity analysis could be conducted over the entire range, zero to one, of these weights, the sensitivity analysis used here varied each of the three weights by 0.1 in both directions. In other words, Customer Support was placed at 0.5 and 0.7, Future Requirements at 0.0 and 0.2, and Unit Performance at 0.2 and 0.4. The sensitivity analysis rankings are given in Appendix K.

Sensitivity analysis is used to determine how/if things change in response to one variable being changed while all others are left constant. Appendix K has six graphs that

show how the rankings changed from one weight change to the next. Figure 9 shows the format for those graphs. While the next ten pages could be used to show each and every change that occurred for the sensitivity analysis graphs, only general insights are provided.

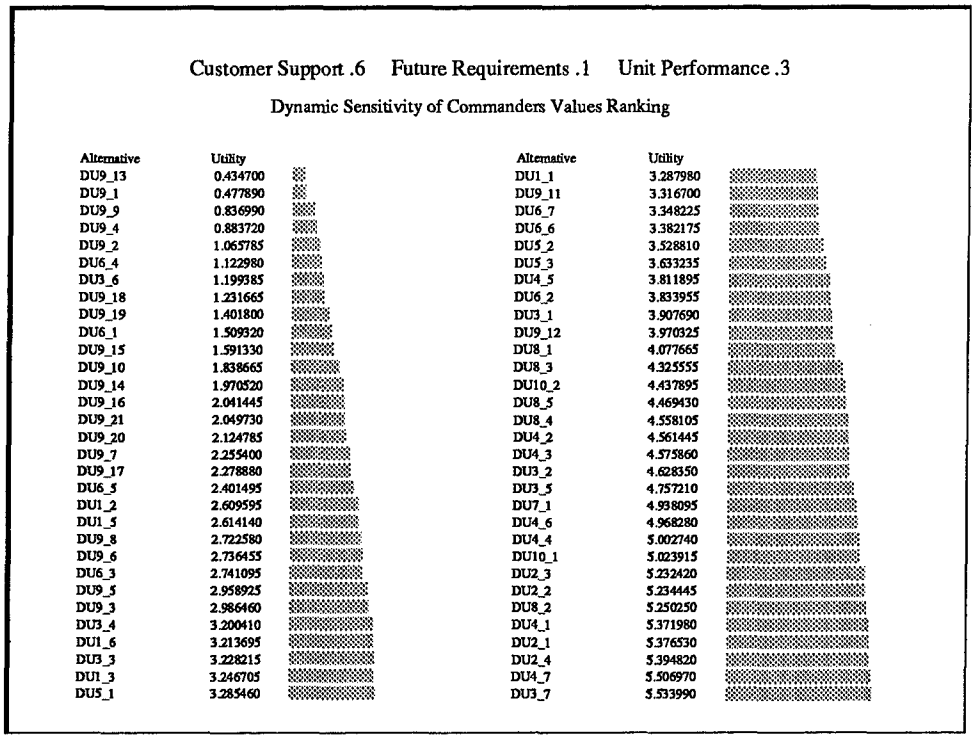


Figure 9. Sensitivity Analysis Graph

Impact scores for the most part were less when the Customer Support weight decreased to 0.5 and Unit Performance weight increased to 0.4. Impact scores were higher when Customer Support weight increased to 0.7 and Unit Performance weight decreased to 0.2. There were mixed results on the sensitivity analysis for the Future Requirements' weight. Decreasing the Future Requirements weight to zero, DU2, DU5, DU8, and DU9 received lower impact scores, and DU1, DU4, and DU6 received higher

impact scores. Increasing Future Requirements weight to 0.2 yielded lower impact scores for DU1, DU4, and DU6 and higher impact scores for DU2, DU3, DU5, and DU8.

4.5 NAIC Implementation Compared to Model Results

Table 3 provides a quick comparison between the model results and the NAIC selected alternative. Table 3 contains each proposal's ranking based on its impact score from Table 1 and each proposal's ranking based on the Impact/Cost ratio from Table 2. In addition to these two rankings, Table 3 shows NAIC's selected resource allocation alternative by annotating whether each proposal was cut completely (Y), cut partially (P), or not cut at all (N). NAIC's cut for this cycle totaled $8.544 million in external assistance.

There seems to be little correlation between what NAIC actually chose to cut and the rank ordering from the two methodologies. Examining the ranking of the proposals to be cut provides an idea of the amount of correlation. From Table 1, the first 22 proposals would be cut. Adding the proposals rankings together ,i.e., 22+21+...+1, gives a total of 253. Not considering the proposals that NAIC cut partially, the sum of the rankings for the proposals they cut is 628. This amounts to approximately a 2:5 ratio. Using Table 2, the first 13 proposals are cut resulting in a value of 91. Based on Table 2 rankings, the sum for NAIC's strategy is 777 for about a 1:9 ratio.

Table 3. Validation and Rank Order

Proposal	Table 1 Rank	Table 2 Rank	Cut?	Proposal	Table 1 Rank	Table 2 Rank	Cut?
DU1-1	32	34	N	DU6-6	35	62	Y
DU1-2	20	23	N	DU6-7	34	42	Y
DU1-3	30	27	P	DU7-1	51	45	N
DU1-5	21	51	Y	DU8-1	42	15	N
DU1-6	28	49	Y	DU8-2	57	61	Y
DU2-1	59	55	N	DU8-3	43	60	N
DU2-2	56	54	N	DU8-4	46	41	Y
DU2-3	55	50	Y	DU8-5	45	4	Y
DU2-4	60	24	N	DU9-1	2	8	Y
DU3-1	40	20	N	DU9-2	5	9	Y
DU3-2	49	33	P	DU9-3	26	13	N
DU3-3	29	17	N	DU9-4	4	11	N
DU3-4	27	53	N	DU9-5	25	14	N
DU3-5	50	26	N	DU9-6	23	46	N
DU3-6	7	12	N	DU9-7	17	19	N
DU3-7	62	30	P	DU9-8	22	10	N
DU4-1	58	59	N	DU9-9	3	5	Y
DU4-2	47	42	N	DU9-10	12	6	N
DU4-3	48	40	Y	DU9-11	33	31	N
DU4-4	53	56	Y	DU9-12	41	21	N
DU4-5	38	58	N	DU9-13	1	2	Y
DU4-6	52	29	N	DU9-14	13	7	N
DU4-7	61	52	Y	DU9-15	11	16	N
DU5-1	31	25	N	DU9-16	14	3	N
DU5-2	36	48	Y	DU9-17	18	1	P
DU5-3	37	38	N	DU9-18	8	28	N
DU6-1	10	39	Y	DU9-19	9	47	Y
DU6-2	39	32	N	DU9-20	16	35	N
DU6-3	24	37	N	DU9-21	15	43	N
DU6-4	6	18	Y	DU10-1	54	36	Y
DU6-5	19	57	Y	DU10-2	44	22	P

Correlation can also be shown through the amount of dollars cut, the number of proposals cut and the cumulative impact from those cut proposals. Based on impact

alone, there was $2.626 million of the $8.544 million or 30.7% of the actual dollar amount chosen to be cut which represents the overlap between these two alternatives. However, only 22 proposals would be cut if the impacts were used compared to the 27 that NAIC cut partially or completely. Remember the cumulative impact for the 22 proposals from Table 1 was 36.66. Using impact/cost, there was $3.819 million of the $8.544 million or 44.7% of the actual dollar amount chosen to be cut which represents the overlap between these two alternatives. If Table 2 were used to determine NAIC's resource allocation strategy, only 13 proposals, compared to the 27 that NAIC selected, would be cut with a cumulative impact of 23.21.

The cumulative impact scores from Table 1 and Table 2 are important. The total impact score for NAIC's strategy results in approximately 70.5 which does not account for any of the proposals that were partially cut. This 70.5 value close to doubles the impact score from Table 1 and is over three times as large as the impact score from Table 2. In other words, NAIC's impact score is equivalent to cutting approximately $13.519 million in Table 1 and $17.507 million in Table 2.

This paragraph highlights some of the possible reasons why the proposals recommended for cut in Table 1 and Table 2 did not match the actual proposals cut by NAIC. To begin, the SMT decided what proposals to cut with some input from their DU Managers. The DU Manager's scored the proposals. The percentages may have been higher if the SMT had scored the proposals. As an example, DU8 and DU9 have different DU Managers but the same representative at the SMT. DU8's proposals had an average impact score of 4.53 and DU9's proposals had an average impact score of 1.96.

However, more money was cut from DU8 than DU9. Another possibility is that the commander's weights were not accurate for this cycle. Sensitivity analysis can be used to zero in on the weights that would more adequately reflect how this cycle's proposals were selected. A key place to start is with Future Requirements because this seemed to be the only weight that discriminated between DUs. Also, the scoring sheets may not have accurately reflected the intended measures, or there may be additional measures and values within the value hierarchy that were not exposed. These reasons and many more would cause the methodology to not accurately reflect the NAIC Commander's resource allocation strategy.

V. Conclusions and Recommendations

5.1 Conclusions

The objective of this research was to provide NAIC with a tool or method for resource allocation that would save time, generate better alternatives, and select an alternative based upon the NAIC Commander's values and preferences. The study concludes that decision analysis using value-focused thinking provided a method for accomplishing this objective. The method took less time to develop alternatives and can be used to select an alternative based upon the NAIC Commander's values and preferences. Whether the alternatives are better has not been determined.

Of key importance throughout this whole research effort is the attainment of the NAIC Commander's values and preferences which will be used to help focus and direct NAIC. Whether these values and preferences are used to select a resource allocation strategy, new program implementation, customer support, or how NAIC does business, all are candidates for application of the NAIC Commander's values and preferences. NAIC will be better focused and have a better understanding of what their commander values and how he prefers those values through this research.

Also of use to NAIC was the scoring mechanism used for this methodology. Using a line scale allows them to obtain more accurate and timely information from both internal and external customers for the metrics that organizations are now being required to keep.

5.2 Lessons Learned

Resource allocation is a very dynamic process and may be changed up to the last moment. Having a method that can accommodate this active process no matter the change is critical, as was learned in the final weeks of this research.

Saving time or taking short cuts in a process may not always be good. For this cycle at NAIC, only 28 of the 41 measures were used to score and rank the proposals. Even if the remaining 13 measures seemed to have no impact, they should have been included anyway. Surprises can always occur and may tip the scales between one alternative and another.

Of big concern to NAIC was the question of subjectivity and how to deal with it. Are the DU Managers intentionally inflating the impact that a dollar amount cut would have on them or are they being honest? If they are honest, are they more likely to get their resources cut because they do not score as high as their peers who inflated their scores? These issues abound everywhere it seems. NAIC dealt with these issues, as most organizations do, by not completely trusting the impact given by the DU Managers. It may have been more appropriate to have had the SMT score the proposals or at least review them.

5.3 Future Research

There are many techniques and methods that perform resource allocation. Additional research should be conducted to determine if a better method than the one used is available. In addition to the NAIC Commander's values and weights, it would be appropriate and useful to obtain the values and weights held by each member of the SMT. While this is a vast undertaking, the values and weights held by the SMT could prove very valuable to NAIC.

5.4 Recommendations

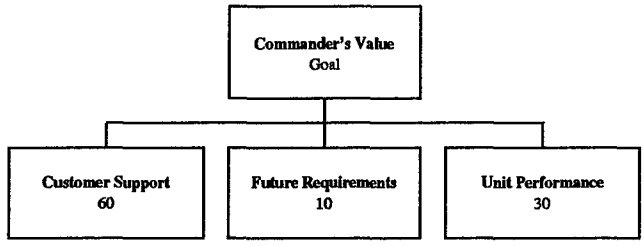
While this methodology scored proposals that were used to develop the alternatives for NAIC's resource allocation strategy, the validation of this methodology showed a disconnect. That difference could have occurred in many areas. Using sensitivity analysis, it may be possible to account for this difference in the commander's weights. As already mentioned, the place to start is with Future Requirements. LDW performs sensitivity analysis very well, but provides no ability to perform cost-benefit analysis which produced better results than those based on the impact alone. A different software package may do a better job and should be explored.

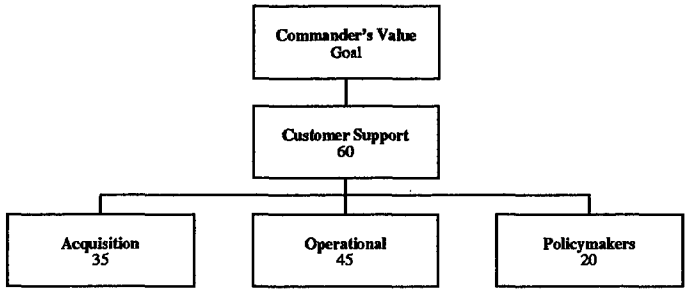
The anomaly may also have been in the SMT's recommendations. An alternative may be to have the SMT review the scoring sheets before the analyst scores them or to shift the burden of resource allocation off of the DU Managers and onto the 2-Letter Directorate Chiefs who compose the SMT. This would make the 2-Letters responsible for filling out the scoring sheets and ensuring the scoring sheets adequately convey the

measure being scored. Also, regardless of whether or not a measure might not apply to a situation, score that measure anyway. Surprises may provide a much better ranking of the alternatives or proposals than those arrived at by leaving measures out of the scoring process.

Lastly, the value hierarchy should be examined and revisited to ensure no values or measures were missed. The value hierarchy, along with the weights, should be reviewed annually or as needed to maintain their applicability and usefulness.

Appendix A. NAIC Commander's Value Hierarchy





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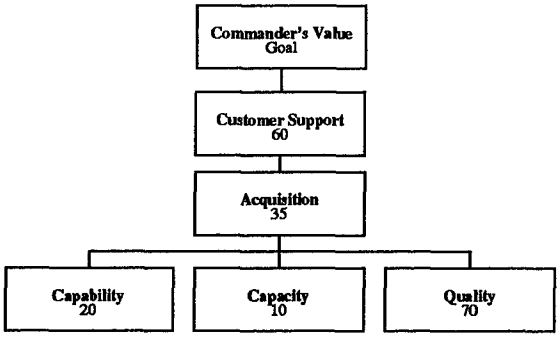

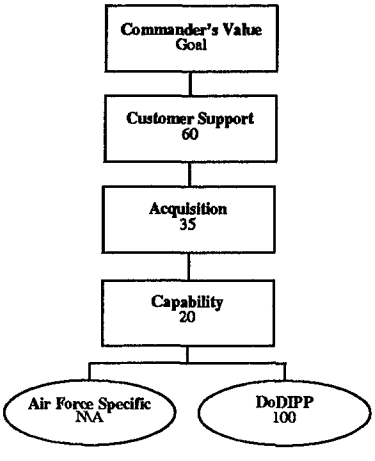

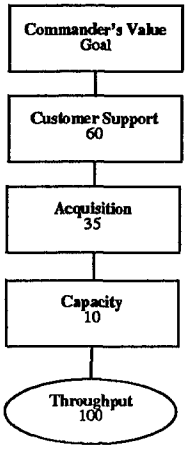

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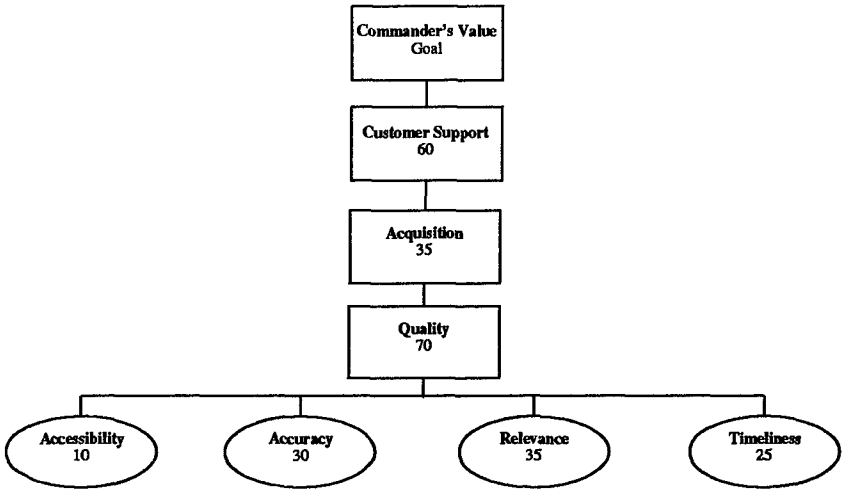

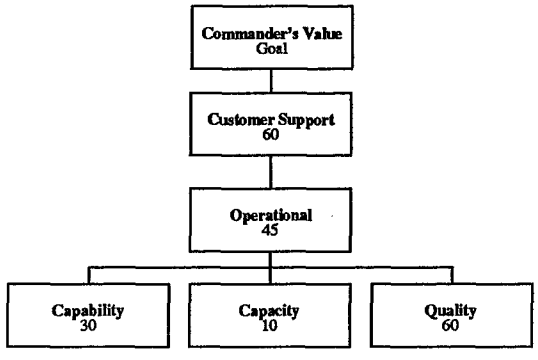

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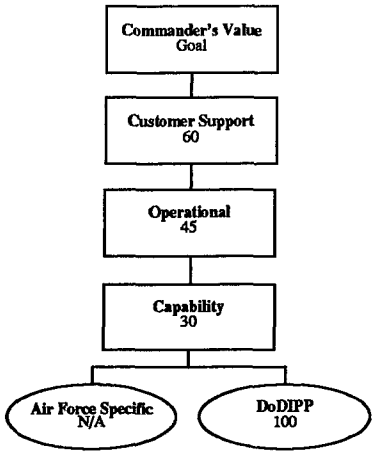

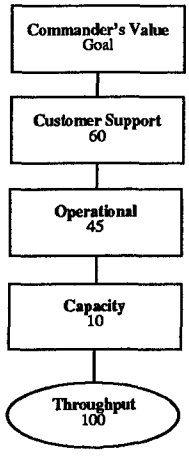

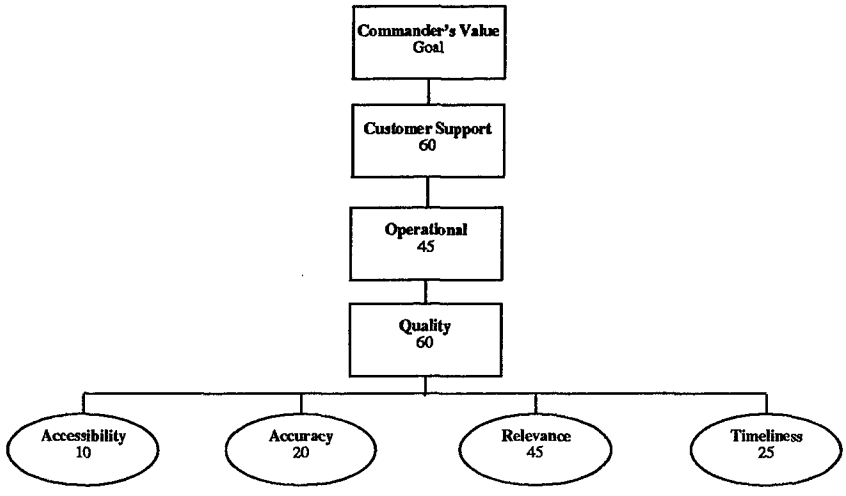

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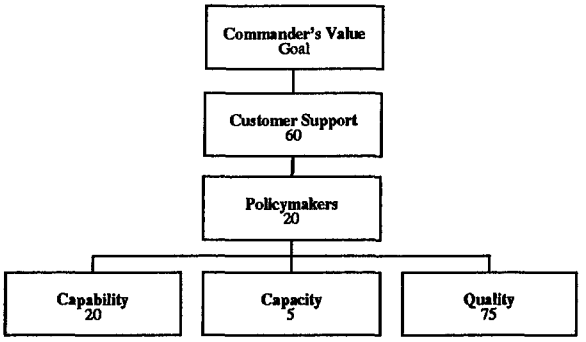

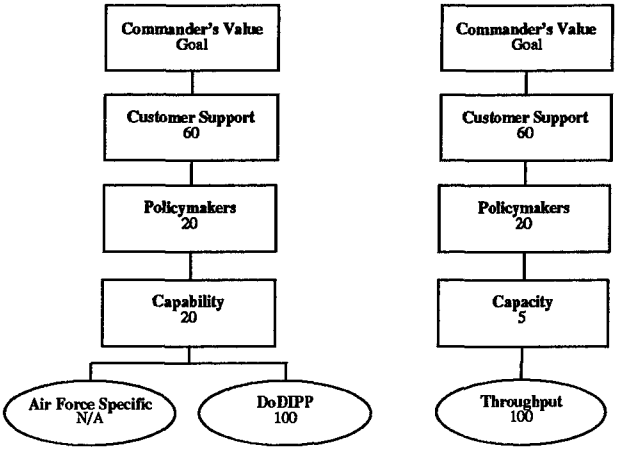

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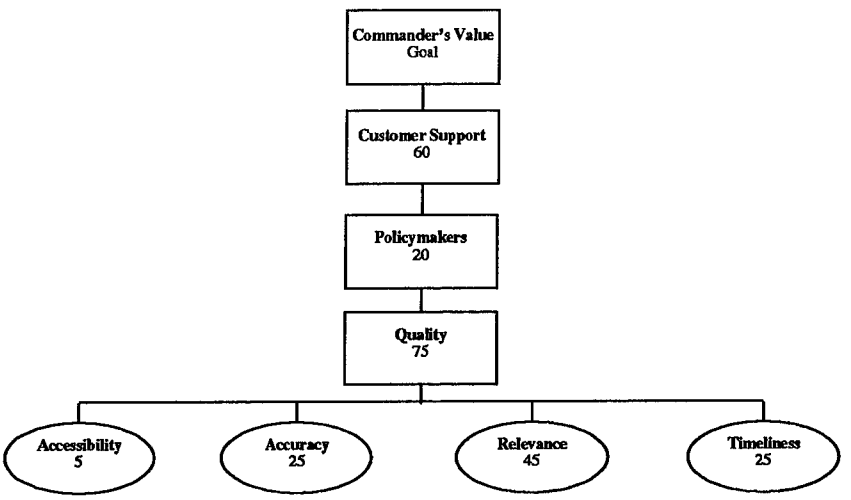

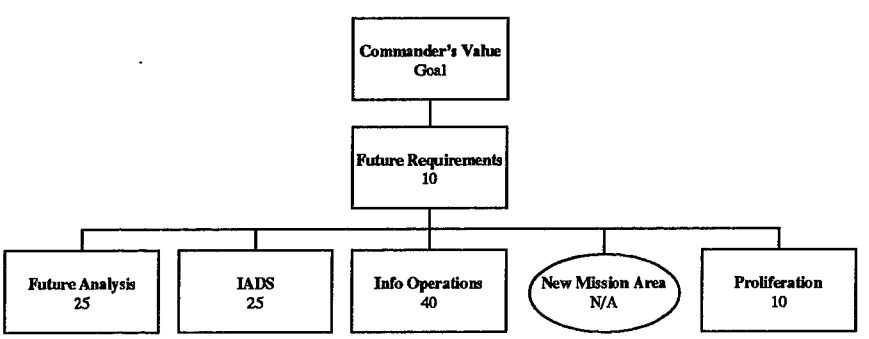

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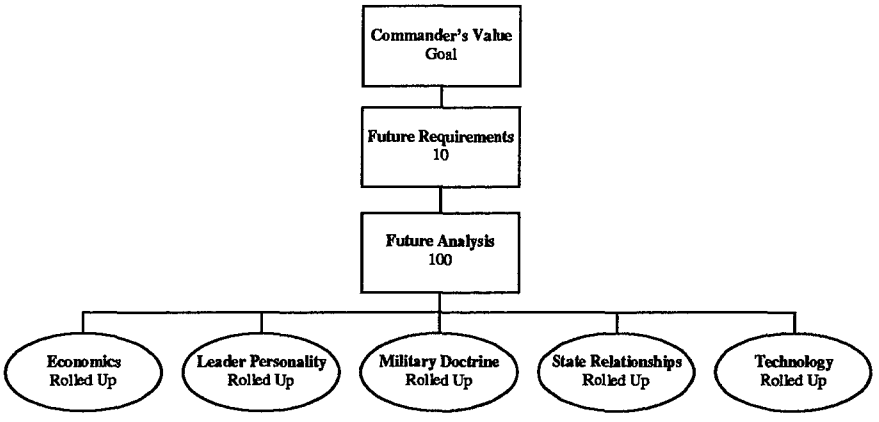

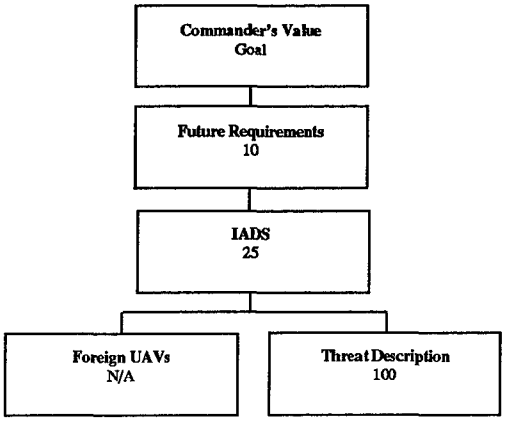

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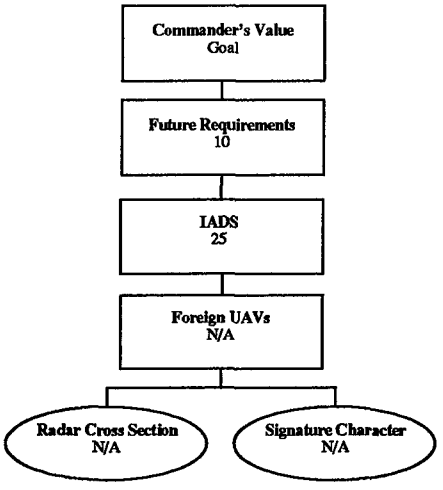
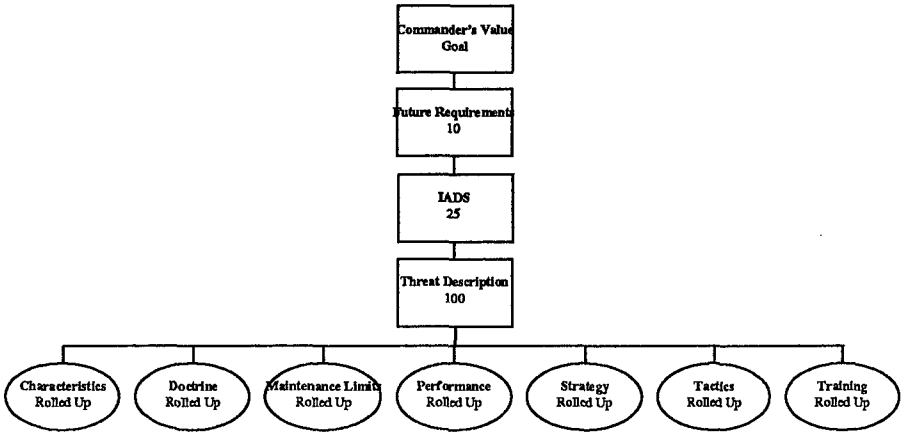
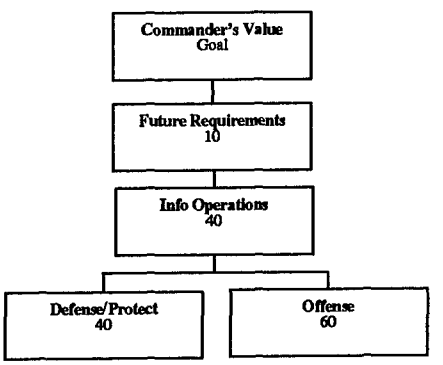
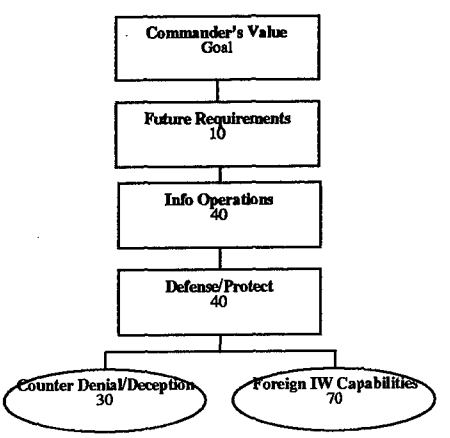




Appendix A. NAIC Commander's Value Hierarchy





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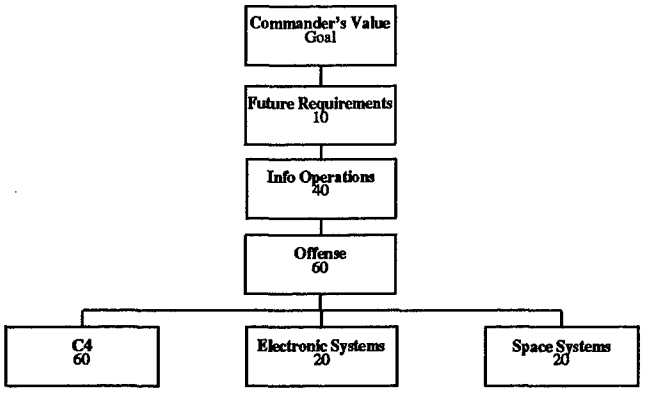
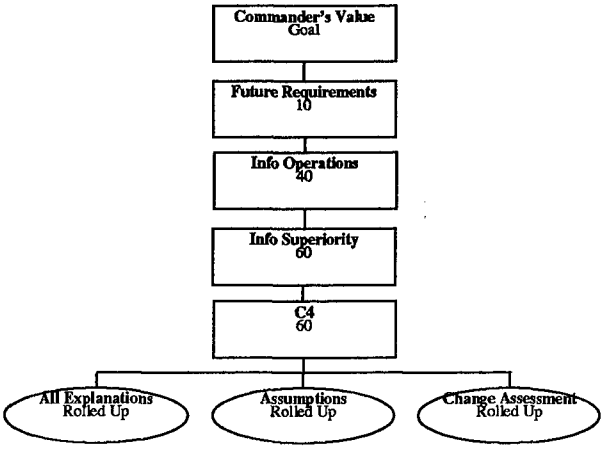
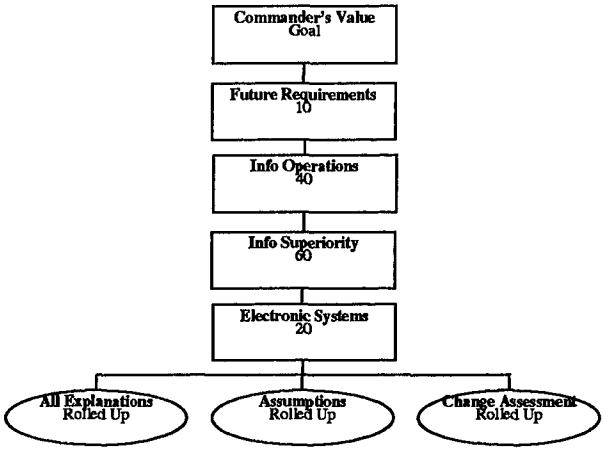
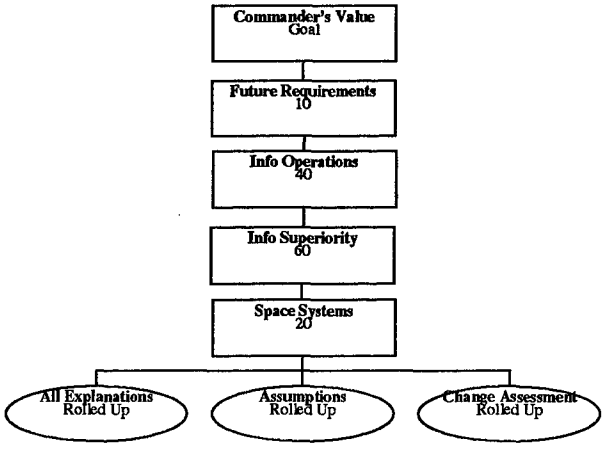


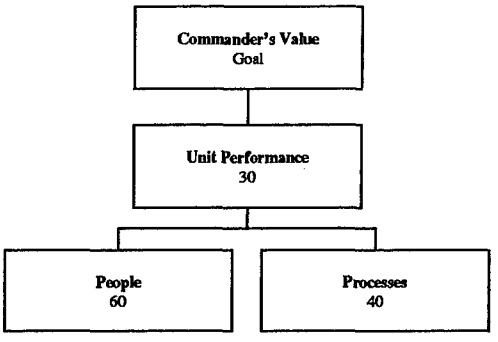


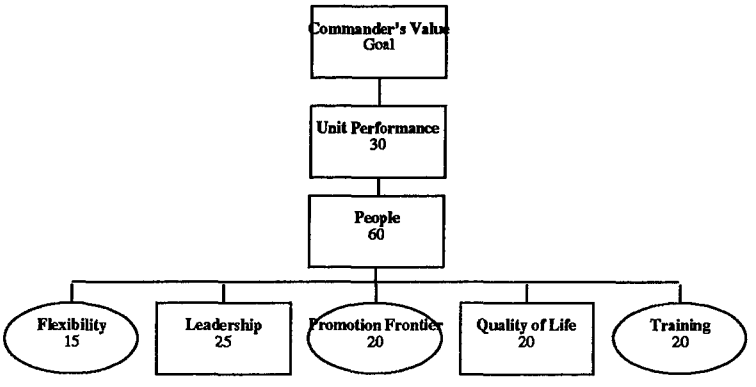
Appendix A. NAIC Commander's Value Hierarchy



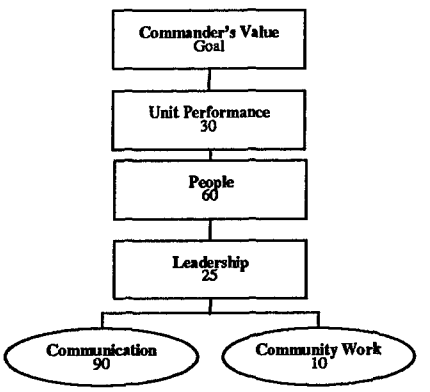


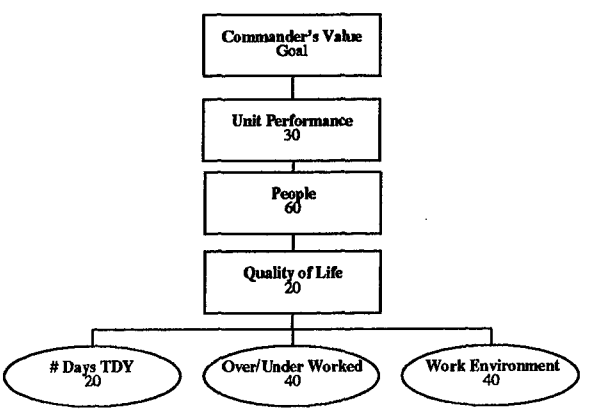
Appendix A. NAIC Commander's Value Hierarchy



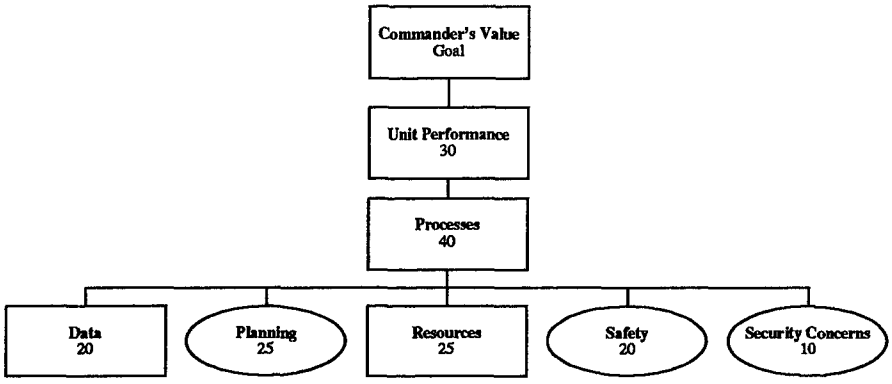


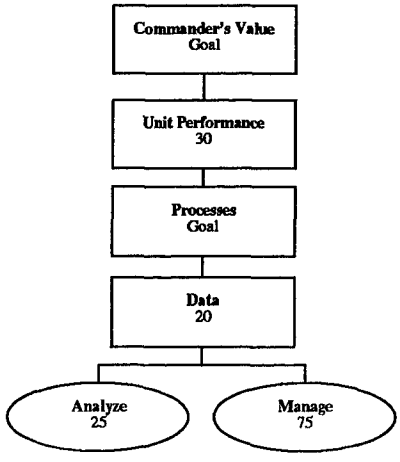
Appendix A. NAIC Commander's Value Hierarchy





Appendix A. NAIC Commander's Value Hierarchy





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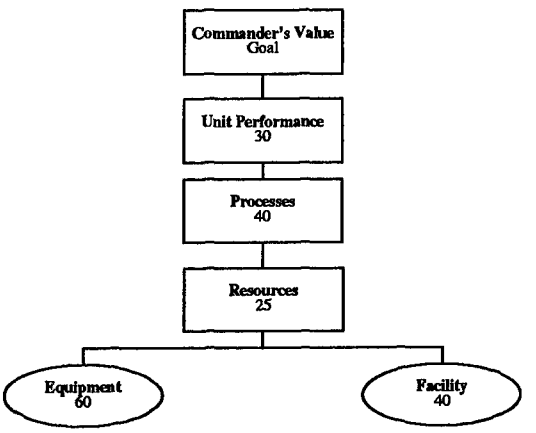


Appendix B. Scoring Sheets

INSTRUCTIONS

All questions are based on resource allocation cuts in contracts, 3400, for FY99. When gauging the impact of a contract, you should ask yourself, "How will this contract cut affect NAIC in this area?" Also, your ratings should NOT reflect where you are now. For example, NAIC may already be two weeks late getting products to the Acquisition Community and this contract cut will make your products three weeks late. This measure would be rated as only one week late because the contract cut is responsible for making the products one week late, not three. Rating the measures in this way will provide a consistent baseline.

Score the questions using the scale provided for each measure. Place an X on the scale reflecting the impact of this measure on your DU if this contract were to be *cut in its entirety*. This X will later be translated into a numeric score. If this contract has no impact or is not applicable for your DU on any given measure, then place your X on the far left hand side of the scale (above No Impact).

The designator at the top of each page keeps the actual scoring sheets unclassified when they are collected. Please do not write the name of the contract on any of the following pages.

Appendix B. Scoring Sheets

CUSTOMER SUPPORT

Designator_____

Acquisition: Capability

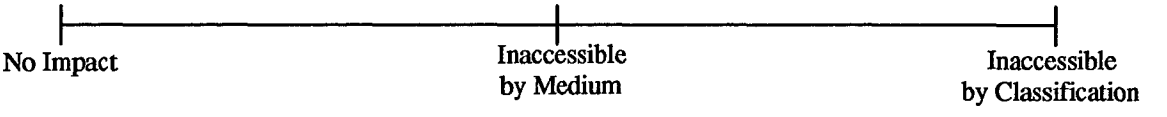
If this contract is cut, how will it affect NAIC's ability to fulfill DoDIPP requirements for the Acquisition Community?

Acquisition: Capacity

If this contract is cut, how will it reduce NAIC's ability to satisfy acquisition customer requirements? In other words, will your DU still have the ability to satisfy, fulfill, and accommodate Acquisition customer requirements that are placed on your DU?

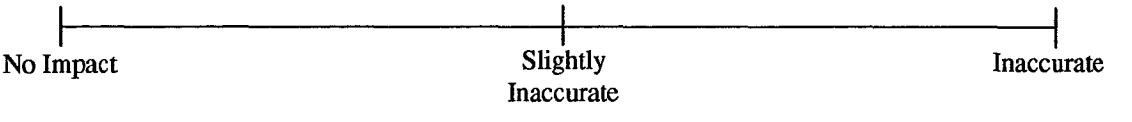
Acquisition: Quality:Accessibility

If this contract is cut, how will it affect NAIC's ability to provide an accessible product to the Acquisition Community? Inaccessible can be defined in terms of the medium, such as CD-ROM, Network linkups, etc., or classification level.



Acquisition: Quality:Accuracy

If this contract is cut, how will it affect the accuracy of products provided to the Acquisition Community? With accuracy, think in terms of the information provided. Will the information provided be any less accurate because of this cut?



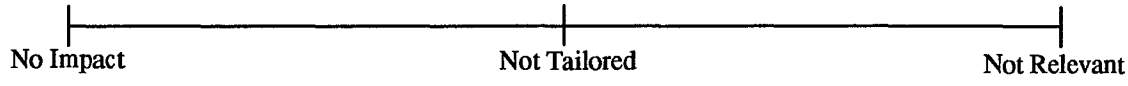
Appendix B. Scoring Sheets

CUSTOMER SUPPORT

Designator_____

Acquisition: Quality:Relevance

If this contract is cut, how will it impact the ability to provide a relevant and tailored product to the Acquisition Community?



Acquisition: Quality:Timeliness

If this contract is cut, how will it impact the ability to provide an on-time product to the Acquisition Community? Notice that the timeline on this scale is different from the timeline of Operational and Policymakers Communities. Do not mark this scale on how late your products are now, but on how much later your products will become if this contract is cut.

Operational: Capability

If this contract is cut, how will it affect your ability to fulfill DoDIPP requirements for the Operational Community?

Operational: Capacity

If this contract is cut, how will it reduce NAIC's ability to satisfy operational customer requirements? In other words, will your DU still have the ability to satisfy, fulfill, and accommodate Operational customer requirements that are placed on your DU?

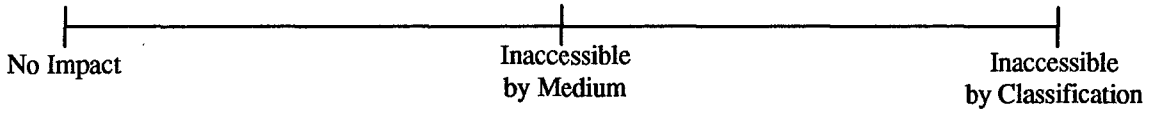
Appendix B. Scoring Sheets

CUSTOMER SUPPORT

Designator_____

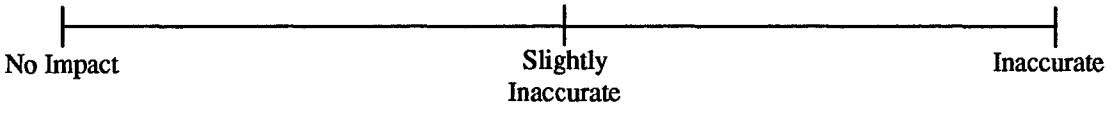
Operational: Quality:Accessibility

If this contract is cut, how will it affect your ability to provide an accessible product to the Operational Community? Inaccessible can be defined in terms of the medium, such as CD-ROM, Network linkups, etc., or classification level.



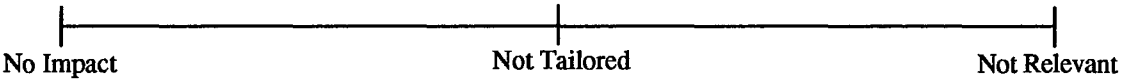
Operational: Quality:Accuracy

If this contract is cut, how will it affect the accuracy of products provided to the Operational Community? With accuracy, think in terms of the information provided. Will the information provided be any less accurate because of this cut?



Operational: Quality:Relevance

If this contract is cut, how will it impact the ability to provide a relevant and tailored product to the Operational Community?



Operational: Quality:Timeliness

If this contract is cut, how will it impact the ability to provide an on-time product to the Operational Community? Do not mark this scale on how late your products are now, but on how much later your products will become if this contract is cut.

Appendix B. Scoring Sheets

CUSTOMER SUPPORT

Designator_____

Policymakers: Capability

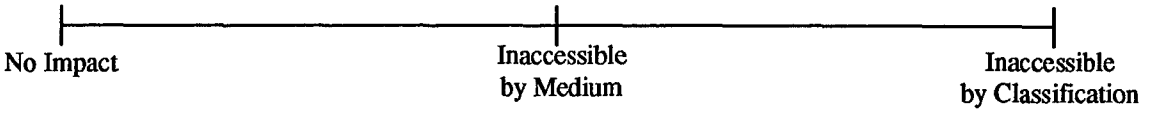
If this contract is cut, how will it affect your ability to fulfill DoDIPP requirements for the Policymakers Community?

Policymakers: Capacity

If this contract is cut, how will it reduce NAIC's ability to satisfy Policymakers customer requirements? In other words, will your DU still have the ability to satisfy, fulfill, and accommodate Policymakers customer requirements that are placed on your DU?

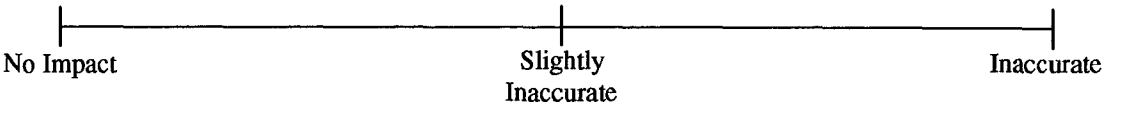
Policymakers: Quality:Accessibility

If this contract is cut, how will it affect NAIC's ability to provide an accessible product to the Policymakers Community? Inaccessible can be defined in terms of the medium, such as CD-ROM, Network linkups, etc., or classification level.



Policymakers: Quality:Accuracy

If this contract is cut, how will it affect the accuracy of products provided to the Policymakers Community? With accuracy, think in terms of the information provided. Will the information provided be any less accurate because of this cut?



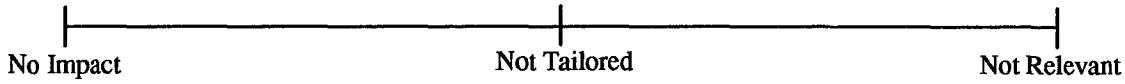
Appendix B. Scoring Sheets

CUSTOMER SUPPORT

Designator_____

Policymakers: Quality:Relevance

If this contract is cut, how will it impact NAIC's ability to provide a relevant and tailored product to the Policymakers Community?



Policymakers: Quality:Timeliness

If this contract is cut, how will it impact NAIC's ability to provide an on-time product to the Policymakers Community? Do not mark this scale on how late your products are now, but on how much later your products will become if this contract is cut.

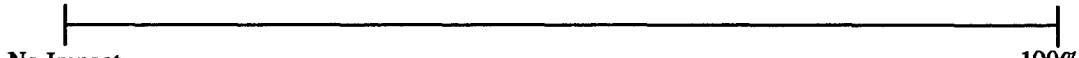
Appendix B. Scoring Sheets

FUTURE REQUIREMENTS

Designator_____

Futures Analysis

If this contract is cut, how will it affect NAIC's ability to perform futures analysis? Base your response upon the five factors listed in the Master Plan: Economics, Leadership Personality, Military Doctrine, Inter/Intrastate Relationships, and Technology. At the 100% level, all ability to perform futures analysis is lost.



No Impact — 100% Loss

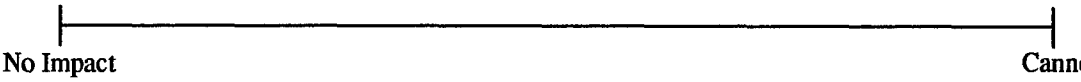
Integrated Air Defense System

If this contract is cut, how will it affect NAIC's ability to produce a threat characterization of an enemy IADS in terms of its strategy, doctrine, tactics, training, maintenance limitations, and technical characteristics?

No Impact — 100% Loss

Information Operations: Defensive

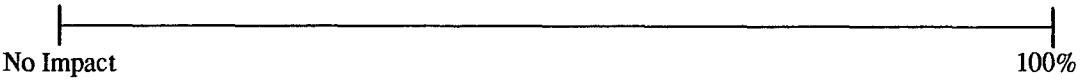
If this contract is cut, how will it affect NAIC's ability to perform counter denial/deception?



No Impact — Cannot Perform

Information Operations: Defensive

If this contract is cut, how will it affect NAIC's ability to produce intelligence about foreign countries' capabilities or intentions to conduct information warfare?



No Impact — 100% Loss

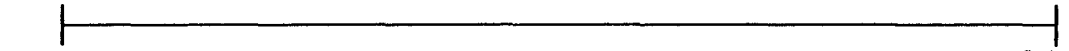
Appendix B. Scoring Sheets

FUTURE REQUIREMENTS

Designator_____

Information Operations: Offensive

If this contract is cut, how will it affect NAIC's ability to assess or produce foreign countries' capabilities and intentions associated with *command, control, communications, and computers*. Base your response on three areas: (1) Systematically examining all possible explanations for events, (2) understanding the assumptions that are critical to the assessment, and (3) identifying the types of new information or changes in events that would cause us to change the assessment?



No Impact — 3 Areas Cut

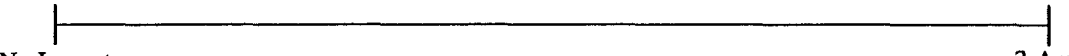
Information Operations: Offensive

If this contract is cut, how will it affect NAIC's ability to assess or produce foreign countries' capabilities and intentions associated with *electronic systems*. Base your response on three areas: (1) Systematically examining all possible explanations for events, (2) understanding the assumptions that are critical to the assessment, and (3) identifying the types of new information or changes in events that would cause us to change the assessment?

No Impact — 3 Areas Cut

Information Operations: Offensive

If this contract is cut, how will it affect NAIC's ability to assess or produce foreign countries' capabilities and intentions associated with *space systems*. Base your response on three areas: (1) Systematically examining all possible explanations for events, (2) understanding the assumptions that are critical to the assessment, and (3) identifying the types of new information or changes in events that would cause us to change the assessment?



No Impact — 3 Areas Cut

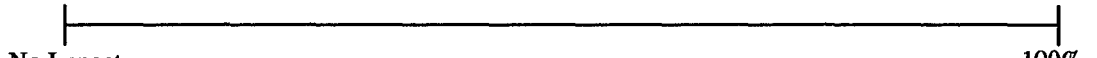
Appendix B. Scoring Sheets

UNIT PERFORMANCE

Designator_____

Proliferation

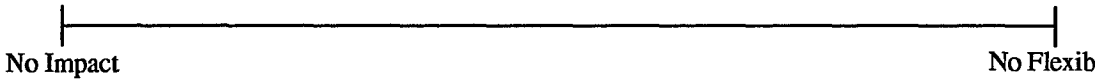
If this contract is cut, how will it decrease NAIC's understanding the ability of countries to assimilate procured or indigenously developed technology into weapon systems' development and employment?



No Impact — 100% Decrease

People:Flexibility

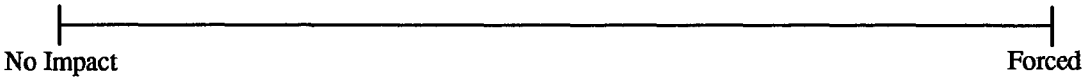
If this contract is cut, how will it affect the flexibility of the people within your DU? Your DU may already have no flexibility. However, suppose your DU had a great deal of flexibility and now this contract cut occurs. How will it affect your DU?



No Impact — No Flexibility

People:Promotion Frontier

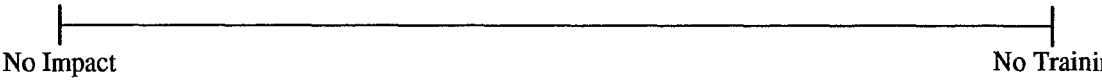
If this contract is cut, how will it affect the ability of your personnel to get promoted? In this case, consider how this cut will affect your personnel. Will they be performing tasks and jobs that would take them away from and not contribute to doing the things that are important for promotion?



No Impact — Forced Retirement

People:Training

If this contract is cut, how will it affect the amount of training your personnel receive? Your DU may already not get the training it needs. Base this rating not on where you are now, but on how this contract cut will prevent your personnel from getting the training they need.



No Impact — No Training

Appendix B. Scoring Sheets

UNIT PERFORMANCE

Designator_____

People: Leadership:Communication

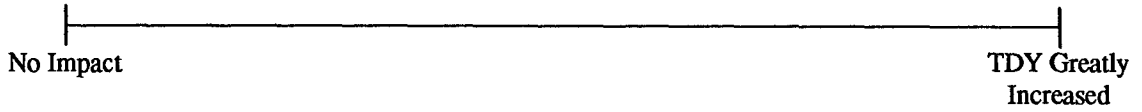
If this contract is cut, how will it affect your DU's ability to communicate with organizations internal to NAIC? Base your response upon the time available for communication, quality of communication (clear, concise, accurate), and communicating with the right person or group.

People: Leadership:Community Work

If this contract is cut, how will it affect the ability of members in your DU to perform community work? Base your response on the amount of time available for your personnel to perform community work. Not to be a broken record, but remember this rating is not focused on where your DU is now. Focus on the contract cut and how it affects this measure.

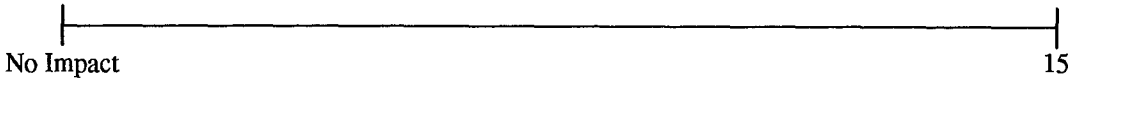
People: Quality of Life:TDY Requirements

How will this contract cut increase the TDY requirements for people in your DU? Will they be required to go TDY more because requirements have increased while manpower decreased or stayed the same?



People: Quality of Life:Workload

How will this contract add to the workload of your employees? This assumes that if your DU personnel are overworked, there is very little if any time for communication and community work. This scale is based on hours per week extra required to fulfill mission requirements.



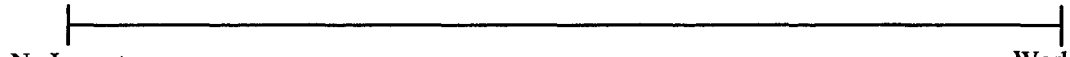
Appendix B. Scoring Sheets

UNIT PERFORMANCE

Designator_____

People: Quality of Life:Work Environment

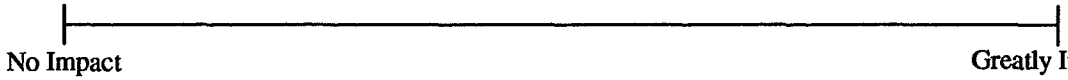
How does this contract cut affect your work environment? Is the stress level preventing work from being accomplished? Does air quality, poor ventilation, desk/chair quality and/or placement hinder work being accomplished?



No Impact — Work is Seriously Hindered

Processes:Planning

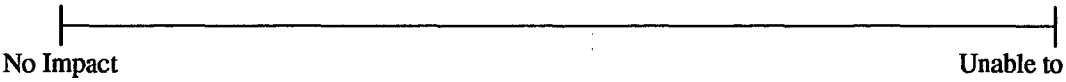
If this contract is cut, how will it affect your DU's ability to produce plans and/or respond to plans? Producing plans pertains to methods for collecting metrics, providing continuity folders, and any other type of plan that would organize or run your DU more efficiently. Responding to plans is what you are doing now through this scoring sheet and may be external or internal for your DU.



No Impact — Greatly Impacts Ability to Plan

Processes:Safety

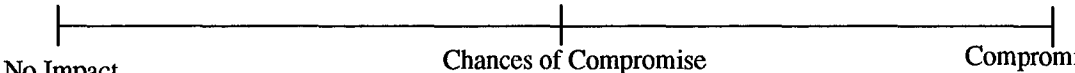
If this contract is cut, how will it affect your DU's ability to adhere to safety standards? This rating does not distinguish between tripping over a power cord, producing an environmental hazard, and other safety hazards. It applies only to an inability to adhere to safety standards. An inability to adhere is also different from attention to detail.



No Impact — Unable to Adhere to Safety Standards

Processes:Security

If this contract is cut, how will it affect the possibility of compromising information for your DU? Consider information, physical, and personnel security along with OPSEC, COMPUSEC, COMSEC, EMSEC, etc. when rating this measure.



No Impact — Chances of Compromise Slightly Increased — Compromise Highly Likely

Appendix B. Scoring Sheets

UNIT PERFORMANCE

Designator_____

Processes: Data:Management

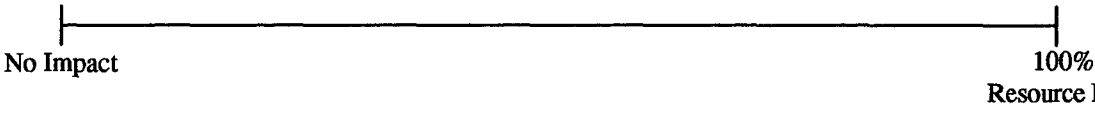
If this contract is cut, how will it affect your DU's ability to manage data? Is there too much data to manage, technicians unavailable to manage the data, or data management software unavailable?

Process: Resources:Equipment

If this contract is cut, how will it affect your DU's equipment resources? Will the equipment collect dust because it is outdated, no longer necessary or no one understands how to use it?

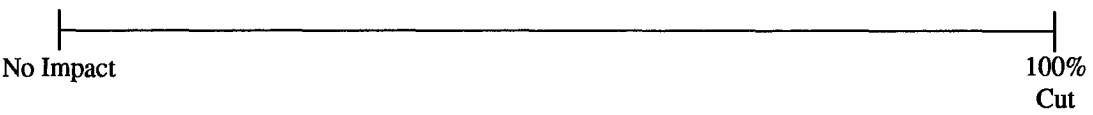
Process: Resources:Facility

If this contract is cut, how will it affect your DU's facility resources? Consider whether facility resources are being used inefficiently or not at all and whether upgrades are needed to complete a job?

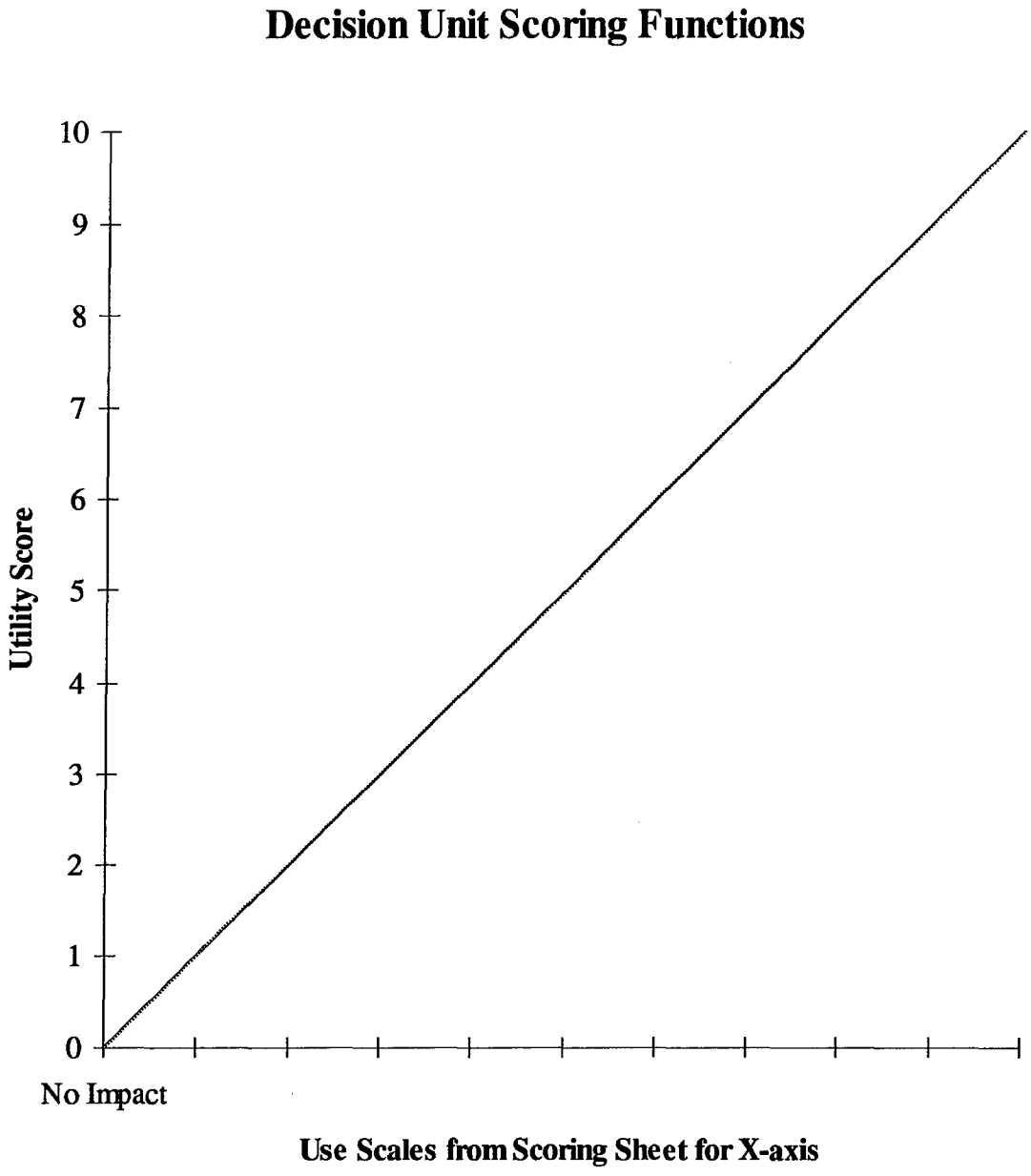


Processes: Data:Analysis

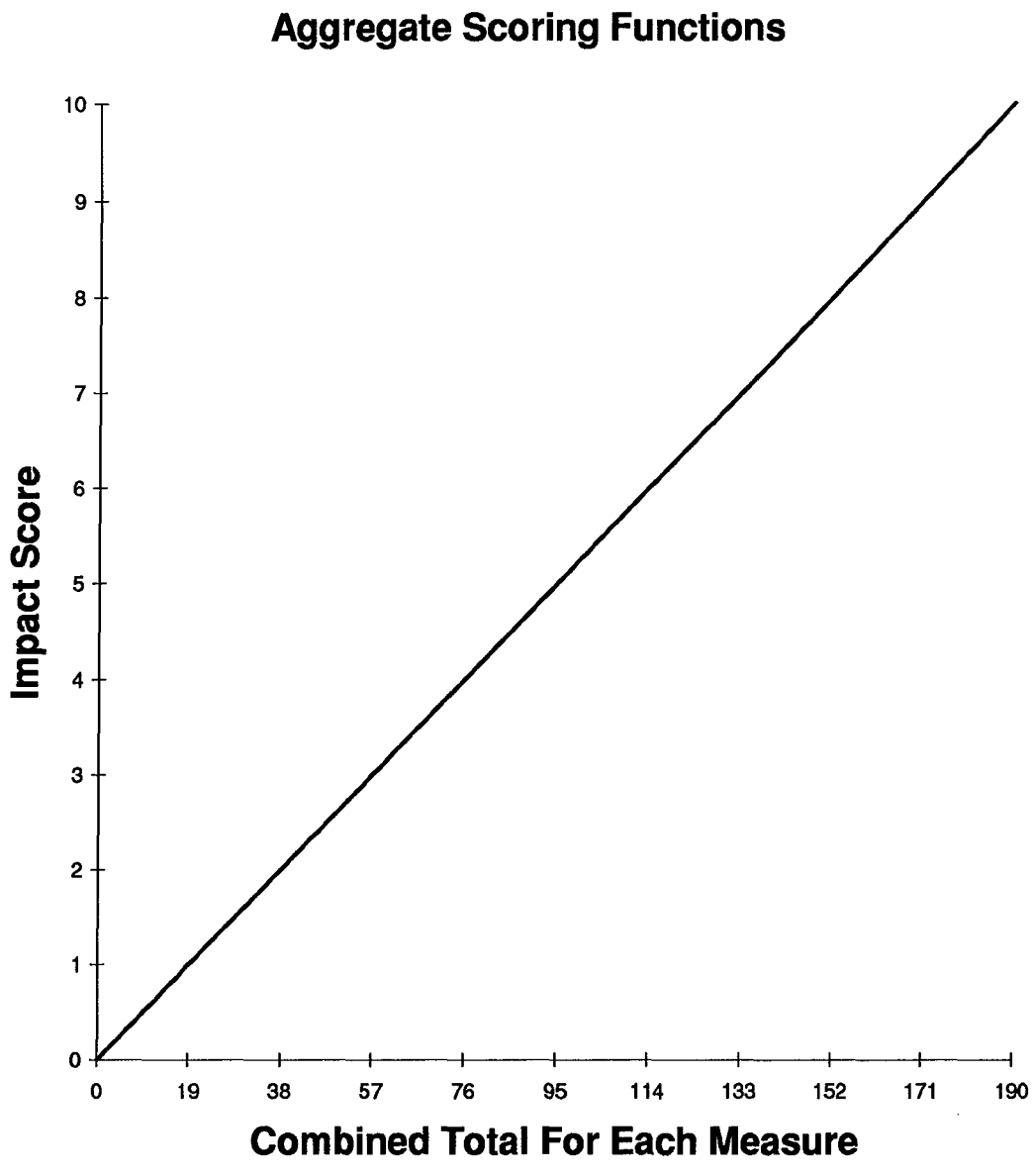
If this contract is cut, how will it affect your DU's ability to analyze data? For this scale consider the accuracy, reliability, and accessibility of the data. Would data no longer be available or would data analysis no longer be possible.?



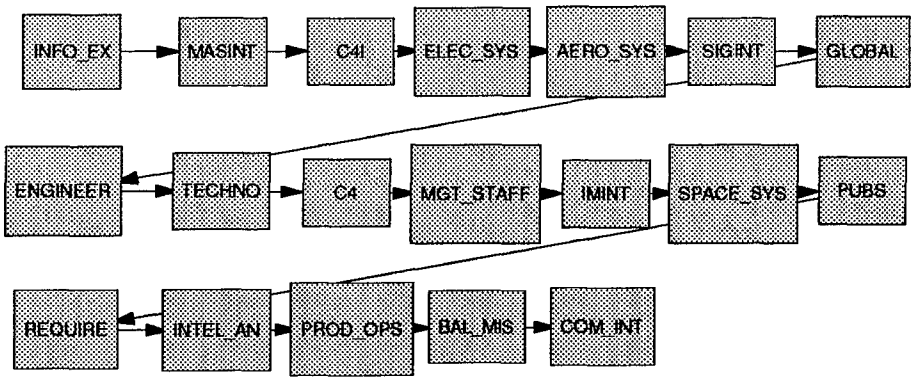
Appendix C. Scoring Functions at DU Level

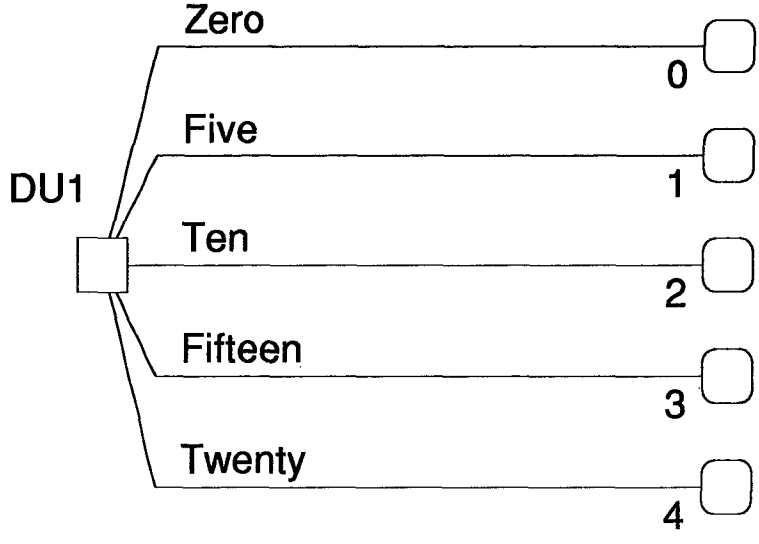


Appendix D. Scoring Functions for Aggregate Measures



Appendix E. Influence Diagram





Appendix F. Attributes

Information Exploitation Attributes

INFOEX[0][INFO_EX],INFOEX[1][INFO_EX],INFOEX[2][INFO_EX],INFOEX[3][INFO_EX],INFOEX[4][INFO_EX],INFOEX[5][INFO_EX],INFOEX[6][INFO_EX],INFOEX[7][INFO_EX],INFOEX[8][INFO_EX],INFOEX[9][INFO_EX],INFOEX[10][INFO_EX],INFOEX[11][INFO_EX],INFOEX[12][INFO_EX],INFOEX[13][INFO_EX],INFOEX[14][INFO_EX],INFOEX[15][INFO_EX],INFOEX[16][INFO_EX],INFOEX[17][INFO_EX],INFOEX[18][INFO_EX],INFOEX[19][INFO_EX],INFOEX[20][INFO_EX],INFOEX[21][INFO_EX],INFOEX[22][INFO_EX],INFOEX[23][INFO_EX],INFOEX[24][INFO_EX],INFOEX[25][INFO_EX],INFOEX[26][INFO_EX],INFOEX[27][INFO_EX],INFOEX[28][INFO_EX],INFOEX[29][INFO_EX],INFOEX[30][INFO_EX],INFOEX[31][INFO_EX],INFOEX[32][INFO_EX],INFOEX[33][INFO_EX],INFOEX[34][INFO_EX],INFOEX[35][INFO_EX],INFOEX[36][INFO_EX],INFOEX[37][INFO_EX],INFOEX[38][INFO_EX],INFOEX[39][INFO_EX],INFOEX[40][INFO_EX],INFOEX[41][INFO_EX],INFOEX[42][INFO_EX],INFOEX[43][INFO_EX]

MASINT Attributes:

MASIN[0][MASINT],MASIN[1][MASINT],MASIN[2][MASINT],MASIN[3][MASINT],MASIN[4][MASINT],MASIN[5][MASINT],MASIN[6][MASINT],MASIN[7][MASINT],MASIN[8][MASINT],MASIN[9][MASINT],MASIN[10][MASINT],MASIN[11][MASINT],MASIN[12][MASINT],MASIN[13][MASINT],MASIN[14][MASINT],MASIN[15][MASINT],MASIN[16][MASINT],MASIN[17][MASINT],MASIN[18][MASINT],MASIN[19][MASINT],MASIN[20][MASINT],MASIN[21][MASINT],MASIN[22][MASINT],MASIN[23][MASINT],MASIN[24][MASINT],MASIN[25][MASINT],MASIN[26][MASINT],MASIN[27][MASINT],MASIN[28][MASINT],MASIN[29][MASINT],MASIN[30][MASINT],MASIN[31][MASINT],MASIN[32][MASINT],MASIN[33][MASINT],MASIN[34][MASINT],MASIN[35][MASINT],MASIN[36][MASINT],MASIN[37][MASINT],MASIN[38][MASINT],MASIN[39][MASINT],MASIN[40][MASINT],MASIN[41][MASINT],MASIN[42][MASINT]-INFOEX[42][INFO_EX],MASIN[43][MASINT]

C4I Attributes:

CFOURI[0][C4I],CFOURI[1][C4I],CFOURI[2][C4I],CFOURI[3][C4I],CFOURI[4][C4I],CFOURI[5][C4I],CFOURI[6][C4I],CFOURI[7][C4I],CFOURI[8][C4I],CFOURI[9][C4I],CFOURI[10][C4I],CFOURI[11][C4I],CFOURI[12][C4I],CFOURI[13][C4I],CFOURI[14][C4I],CFOURI[15][C4I],CFOURI[16][C4I],CFOURI[17][C4I],CFOURI[18][C4I],CFOURI[19][C4I],CFOURI[20][C4I],CFOURI[21][C4I],CFOURI[22][C4I],CFOURI[23][C4I],CFOURI[24][C4I],CFOURI[25][C4I],CFOURI[26][C4I],CFOURI[27][C4I],CFOURI[28][C4I],CFOURI[29][C4I],CFOURI[30][C4I],CFOURI[31][C4I],CFOURI[32][C4I],CFOURI[33][C4I],CFOURI[34][C4I],CFOURI[35][C4I],CFOURI[36][C4I],CFOURI[37][C4I],CFOURI[38][C4I],CFOURI[39][C4I],CFOURI[40][C4I],CFOURI[41][C4I],CFOURI[42][C4I]-MASIN[42][MASINT],CFOURI[43][C4I]

Appendix F. Attributes

Electronic Systems Attributes:

ELEC[0][ELEC_SYS],ELEC[1][ELEC_SYS],ELEC[2][ELEC_SYS],ELEC[3][ELEC_SYS],ELEC[4][ELEC_SYS],ELEC[5][ELEC_SYS],ELEC[6][ELEC_SYS],ELEC[7][ELEC_SYS],ELEC[8][ELEC_SYS],ELEC[9][ELEC_SYS],ELEC[10][ELEC_SYS],ELEC[11][ELEC_SYS],ELEC[12][ELEC_SYS],ELEC[13][ELEC_SYS],ELEC[14][ELEC_SYS],ELEC[15][ELEC_SYS],ELEC[16][ELEC_SYS],ELEC[17][ELEC_SYS],ELEC[18][ELEC_SYS],ELEC[19][ELEC_SYS],ELEC[20][ELEC_SYS],ELEC[21][ELEC_SYS],ELEC[22][ELEC_SYS],ELEC[23][ELEC_SYS],ELEC[24][ELEC_SYS],ELEC[25][ELEC_SYS],ELEC[26][ELEC_SYS],ELEC[27][ELEC_SYS],ELEC[28][ELEC_SYS],ELEC[29][ELEC_SYS],ELEC[30][ELEC_SYS],ELEC[31][ELEC_SYS],ELEC[32][ELEC_SYS],ELEC[33][ELEC_SYS],ELEC[34][ELEC_SYS],ELEC[35][ELEC_SYS],ELEC[36][ELEC_SYS],ELEC[37][ELEC_SYS],ELEC[38][ELEC_SYS],ELEC[39][ELEC_SYS],ELEC[40][ELEC_SYS],ELEC[41][ELEC_SYS],ELEC[42][ELEC_SYS]-CFOURI[42][C4I],ELEC[43][ELEC_SYS]

Aerodynamic Systems Attributes:

AERO[0][AERO_SYS],AERO[1][AERO_SYS],AERO[2][AERO_SYS],AERO[3][AERO_SYS],AERO[4][AERO_SYS],AERO[5][AERO_SYS],AERO[6][AERO_SYS],AERO[7][AERO_SYS],AERO[8][AERO_SYS],AERO[9][AERO_SYS],AERO[10][AERO_SYS],AERO[11][AERO_SYS],AERO[12][AERO_SYS],AERO[13][AERO_SYS],AERO[14][AERO_SYS],AERO[15][AERO_SYS],AERO[16][AERO_SYS],AERO[17][AERO_SYS],AERO[18][AERO_SYS],AERO[19][AERO_SYS],AERO[20][AERO_SYS],AERO[21][AERO_SYS],AERO[22][AERO_SYS],AERO[23][AERO_SYS],AERO[24][AERO_SYS],AERO[25][AERO_SYS],AERO[26][AERO_SYS],AERO[27][AERO_SYS],AERO[28][AERO_SYS],AERO[29][AERO_SYS],AERO[30][AERO_SYS],AERO[31][AERO_SYS],AERO[32][AERO_SYS],AERO[33][AERO_SYS],AERO[34][AERO_SYS],AERO[35][AERO_SYS],AERO[36][AERO_SYS],AERO[37][AERO_SYS],AERO[38][AERO_SYS],AERO[39][AERO_SYS],AERO[40][AERO_SYS],AERO[41][AERO_SYS],AERO[42][AERO_SYS]-ELEC[42][ELEC_SYS],AERO[43][AERO_SYS]

SIGINT Attributes:

SIGIN[0][SIGINT],SIGIN[1][SIGINT],SIGIN[2][SIGINT],SIGIN[3][SIGINT],SIGIN[4][SIGINT],SIGIN[5][SIGINT],SIGIN[6][SIGINT],SIGIN[7][SIGINT],SIGIN[8][SIGINT],SIGIN[9][SIGINT],SIGIN[10][SIGINT],SIGIN[11][SIGINT],SIGIN[12][SIGINT],SIGIN[13][SIGINT],SIGIN[14][SIGINT],SIGIN[15][SIGINT],SIGIN[16][SIGINT],SIGIN[17][SIGINT],SIGIN[18][SIGINT],SIGIN[19][SIGINT],SIGIN[20][SIGINT],SIGIN[21][SIGINT],SIGIN[22][SIGINT],SIGIN[23][SIGINT],SIGIN[24][SIGINT],SIGIN[25][SIGINT],SIGIN[26][SIGINT],SIGIN[27][SIGINT],SIGIN[28][SIGINT],SIGIN[29][SIGINT],SIGIN[30][SIGINT],SIGIN[31][SIGINT],SIGIN[32][SIGINT],SIGIN[33][SIGINT],SIGIN[34][SIGINT],SIGIN[35][SIGINT],SIGIN[36][SIGINT],SIGIN[37][SIGINT],SIGIN[38][SIGINT],SIGIN[39][SIGINT],SIGIN[40][SIGINT],SIGIN[41][SIGINT],SIGIN[42][SIGINT]-AERO[42][AERO_SYS],SIGIN[43][SIGINT]

Appendix F. Attributes

Global Threat Attributes:

GLOBA[0][GLOBAL],GLOBA[1][GLOBAL],GLOBA[2][GLOBAL],GLOBA[3][GLOBAL],GLOBA[4][GLOBAL],GLOBA[5][GLOBAL],GLOBA[6][GLOBAL],GLOBA[7][GLOBAL],GLOBA[8][GLOBAL],GLOBA[9][GLOBAL],GLOBA[10][GLOBAL],GLOBA[11][GLOBAL],GLOBA[12][GLOBAL],GLOBA[13][GLOBAL],GLOBA[14][GLOBAL],GLOBA[15][GLOBAL],GLOBA[16][GLOBAL],GLOBA[17][GLOBAL],GLOBA[18][GLOBAL],GLOBA[19][GLOBAL],GLOBA[20][GLOBAL],GLOBA[21][GLOBAL],GLOBA[22][GLOBAL],GLOBA[23][GLOBAL],GLOBA[24][GLOBAL],GLOBA[25][GLOBAL],GLOBA[26][GLOBAL],GLOBA[27][GLOBAL],GLOBA[28][GLOBAL],GLOBA[29][GLOBAL],GLOBA[30][GLOBAL],GLOBA[31][GLOBAL],GLOBA[32][GLOBAL],GLOBA[33][GLOBAL],GLOBA[34][GLOBAL],GLOBA[35][GLOBAL],GLOBA[36][GLOBAL],GLOBA[37][GLOBAL],GLOBA[38][GLOBAL],GLOBA[39][GLOBAL],GLOBA[40][GLOBAL],GLOBA[41][GLOBAL],GLOBA[42][GLOBAL]-SIGIN[42][SIGINT],GLOBA[43][GLOBAL]

Engineering Systems Attributes:

ENGI[0][ENGINEER],ENGI[1][ENGINEER],ENGI[2][ENGINEER],ENGI[3][ENGINEER],ENGI[4][ENGINEER],ENGI[5][ENGINEER],ENGI[6][ENGINEER],ENGI[7][ENGINEER],ENGI[8][ENGINEER],ENGI[9][ENGINEER],ENGI[10][ENGINEER],ENGI[11][ENGINEER],ENGI[12][ENGINEER],ENGI[13][ENGINEER],ENGI[14][ENGINEER],ENGI[15][ENGINEER],ENGI[16][ENGINEER],ENGI[17][ENGINEER],ENGI[18][ENGINEER],ENGI[19][ENGINEER],ENGI[20][ENGINEER],ENGI[21][ENGINEER],ENGI[22][ENGINEER],ENGI[23][ENGINEER],ENGI[24][ENGINEER],ENGI[25][ENGINEER],ENGI[26][ENGINEER],ENGI[27][ENGINEER],ENGI[28][ENGINEER],ENGI[29][ENGINEER],ENGI[30][ENGINEER],ENGI[31][ENGINEER],ENGI[32][ENGINEER],ENGI[33][ENGINEER],ENGI[34][ENGINEER],ENGI[35][ENGINEER],ENGI[36][ENGINEER],ENGI[37][ENGINEER],ENGI[38][ENGINEER],ENGI[39][ENGINEER],ENGI[40][ENGINEER],ENGI[41][ENGINEER],ENGI[42][ENGINEER]-GLOBA[42][GLOBAL],ENGI[43][ENGINEER]

Technologies Attributes:

TECH[0][TECHNO],TECH[1][TECHNO],TECH[2][TECHNO],TECH[3][TECHNO],TECH[4][TECHNO],TECH[5][TECHNO],TECH[6][TECHNO],TECH[7][TECHNO],TECH[8][TECHNO],TECH[9][TECHNO],TECH[10][TECHNO],TECH[11][TECHNO],TECH[12][TECHNO],TECH[13][TECHNO],TECH[14][TECHNO],TECH[15][TECHNO],TECH[16][TECHNO],TECH[17][TECHNO],TECH[18][TECHNO],TECH[19][TECHNO],TECH[20][TECHNO],TECH[21][TECHNO],TECH[22][TECHNO],TECH[23][TECHNO],TECH[24][TECHNO],TECH[25][TECHNO],TECH[26][TECHNO],TECH[27][TECHNO],TECH[28][TECHNO],TECH[29][TECHNO],TECH[30][TECHNO],TECH[31][TECHNO],TECH[32][TECHNO],TECH[33][TECHNO],TECH[34][TECHNO],TECH[35][TECHNO],TECH[36][TECHNO],TECH[37][TECHNO],TECH[38][TECHNO],TECH[39][TECHNO],TECH[40][TECHNO],TECH[41][TECHNO],TECH[42][TECHNO]-ENGI[42][ENGINEER],TECH[43][TECHNO]

Appendix F. Attributes

C4 Attributes:

CFOUR[0][C4],CFOUR[1][C4],CFOUR[2][C4],CFOUR[3][C4],CFOUR[4][C4],CFOUR[5][C4],CFOUR[6][C4],CFOUR[7][C4],CFOUR[8][C4],CFOUR[9][C4],CFOUR[10][C4],CFOUR[11][C4],CFOUR[12][C4],CFOUR[13][C4],CFOUR[14][C4],CFOUR[15][C4],CFOUR[16][C4],CFOUR[17][C4],CFOUR[18][C4],CFOUR[19][C4],CFOUR[20][C4],CFOUR[21][C4],CFOUR[22][C4],CFOUR[23][C4],CFOUR[24][C4],CFOUR[25][C4],CFOUR[26][C4],CFOUR[27][C4],CFOUR[28][C4],CFOUR[29][C4],CFOUR[30][C4],CFOUR[31][C4],CFOUR[32][C4],CFOUR[33][C4],CFOUR[34][C4],CFOUR[35][C4],CFOUR[36][C4],CFOUR[37][C4],CFOUR[38][C4],CFOUR[39][C4],CFOUR[40][C4],CFOUR[41][C4],CFOUR[42][C4]-TECH[42][TECHNO],CFOUR[43][C4]

Management and Staff Attributes:

MGT[0][MGT_STAFF],MGT[1][MGT_STAFF],MGT[2][MGT_STAFF],MGT[3][MGT_STAFF],MGT[4][MGT_STAFF],MGT[5][MGT_STAFF],MGT[6][MGT_STAFF],MGT[7][MGT_STAFF],MGT[8][MGT_STAFF],MGT[9][MGT_STAFF],MGT[10][MGT_STAFF],MGT[11][MGT_STAFF],MGT[12][MGT_STAFF],MGT[13][MGT_STAFF],MGT[14][MGT_STAFF],MGT[15][MGT_STAFF],MGT[16][MGT_STAFF],MGT[17][MGT_STAFF],MGT[18][MGT_STAFF],MGT[19][MGT_STAFF],MGT[20][MGT_STAFF],MGT[21][MGT_STAFF],MGT[22][MGT_STAFF],MGT[23][MGT_STAFF],MGT[24][MGT_STAFF],MGT[25][MGT_STAFF],MGT[26][MGT_STAFF],MGT[27][MGT_STAFF],MGT[28][MGT_STAFF],MGT[29][MGT_STAFF],MGT[30][MGT_STAFF],MGT[31][MGT_STAFF],MGT[32][MGT_STAFF],MGT[33][MGT_STAFF],MGT[34][MGT_STAFF],MGT[35][MGT_STAFF],MGT[36][MGT_STAFF],MGT[37][MGT_STAFF],MGT[38][MGT_STAFF],MGT[39][MGT_STAFF],MGT[40][MGT_STAFF],MGT[41][MGT_STAFF],MGT[42][MGT_STAFF]-
CFOUR[42][C4],MGT[43][MGT_STAFF]

IMINT Attributes:

IMIN[0][IMINT],IMIN[1][IMINT],IMIN[2][IMINT],IMIN[3][IMINT],IMIN[4][IMINT],IMIN[5][IMINT],IMIN[6][IMINT],IMIN[7][IMINT],IMIN[8][IMINT],IMIN[9][IMINT],IMIN[10][IMINT],IMIN[11][IMINT],IMIN[12][IMINT],IMIN[13][IMINT],IMIN[14][IMINT],IMIN[15][IMINT],IMIN[16][IMINT],IMIN[17][IMINT],IMIN[18][IMINT],IMIN[19][IMINT],IMIN[20][IMINT],IMIN[21][IMINT],IMIN[22][IMINT],IMIN[23][IMINT],IMIN[24][IMINT],IMIN[25][IMINT],IMIN[26][IMINT],IMIN[27][IMINT],IMIN[28][IMINT],IMIN[29][IMINT],IMIN[30][IMINT],IMIN[31][IMINT],IMIN[32][IMINT],IMIN[33][IMINT],IMIN[34][IMINT],IMIN[35][IMINT],IMIN[36][IMINT],IMIN[37][IMINT],IMIN[38][IMINT],IMIN[39][IMINT],IMIN[40][IMINT],IMIN[41][IMINT],IMIN[42][IMINT]-MGT[42][MGT_STAFF],IMIN[43][IMINT]

Appendix F. Attributes

Space Systems Attributes:

SPACE[0][SPACE_SYS],SPACE[1][SPACE_SYS],SPACE[2][SPACE_SYS],SPACE[3][SPACE_SYS],SPACE[4][SPACE_SYS],SPACE[5][SPACE_SYS],SPACE[6][SPACE_SYS],SPACE[7][SPACE_SYS],SPACE[8][SPACE_SYS],SPACE[9][SPACE_SYS],SPACE[10][SPACE_SYS],SPACE[11][SPACE_SYS],SPACE[12][SPACE_SYS],SPACE[13][SPACE_SYS],SPACE[14][SPACE_SYS],SPACE[15][SPACE_SYS],SPACE[16][SPACE_SYS],SPACE[17][SPACE_SYS],SPACE[18][SPACE_SYS],SPACE[19][SPACE_SYS],SPACE[20][SPACE_SYS],SPACE[21][SPACE_SYS],SPACE[22][SPACE_SYS],SPACE[23][SPACE_SYS],SPACE[24][SPACE_SYS],SPACE[25][SPACE_SYS],SPACE[26][SPACE_SYS],SPACE[27][SPACE_SYS],SPACE[28][SPACE_SYS],SPACE[29][SPACE_SYS],SPACE[30][SPACE_SYS],SPACE[31][SPACE_SYS],SPACE[32][SPACE_SYS],SPACE[33][SPACE_SYS],SPACE[34][SPACE_SYS],SPACE[35][SPACE_SYS],SPACE[36][SPACE_SYS],SPACE[37][SPACE_SYS],SPACE[38][SPACE_SYS],SPACE[39][SPACE_SYS],SPACE[40][SPACE_SYS],SPACE[41][SPACE_SYS],SPACE[42][SPACE_SYS]-IMIN[42][IMINT],SPACE[43][SPACE_SYS]

Publications Attributes:

PUB[0][PUBS],PUB[1][PUBS],PUB[2][PUBS],PUB[3][PUBS],PUB[4][PUBS],PUB[5][PUBS],PUB[6][PUBS],PUB[7][PUBS],PUB[8][PUBS],PUB[9][PUBS],PUB[10][PUBS],PUB[11][PUBS],PUB[12][PUBS],PUB[13][PUBS],PUB[14][PUBS],PUB[15][PUBS],PUB[16][PUBS],PUB[17][PUBS],PUB[18][PUBS],PUB[19][PUBS],PUB[20][PUBS],PUB[21][PUBS],PUB[22][PUBS],PUB[23][PUBS],PUB[24][PUBS],PUB[25][PUBS],PUB[26][PUBS],PUB[27][PUBS],PUB[28][PUBS],PUB[29][PUBS],PUB[30][PUBS],PUB[31][PUBS],PUB[32][PUBS],PUB[33][PUBS],PUB[34][PUBS],PUB[35][PUBS],PUB[36][PUBS],PUB[37][PUBS],PUB[38][PUBS],PUB[39][PUBS],PUB[40][PUBS],PUB[41][PUBS],PUB[42][PUBS]-SPACE[42][SPACE_SYS],PUB[43][PUBS]

Requirements Attributes:

REQ[0][REQUIRE],REQ[1][REQUIRE],REQ[2][REQUIRE],REQ[3][REQUIRE],REQ[4][REQUIRE],REQ[5][REQUIRE],REQ[6][REQUIRE],REQ[7][REQUIRE],REQ[8][REQUIRE],REQ[9][REQUIRE],REQ[10][REQUIRE],REQ[11][REQUIRE],REQ[12][REQUIRE],REQ[13][REQUIRE],REQ[14][REQUIRE],REQ[15][REQUIRE],REQ[16][REQUIRE],REQ[17][REQUIRE],REQ[18][REQUIRE],REQ[19][REQUIRE],REQ[20][REQUIRE],REQ[21][REQUIRE],REQ[22][REQUIRE],REQ[23][REQUIRE],REQ[24][REQUIRE],REQ[25][REQUIRE],REQ[26][REQUIRE],REQ[27][REQUIRE],REQ[28][REQUIRE],REQ[29][REQUIRE],REQ[30][REQUIRE],REQ[31][REQUIRE],REQ[32][REQUIRE],REQ[33][REQUIRE],REQ[34][REQUIRE],REQ[35][REQUIRE],REQ[36][REQUIRE],REQ[37][REQUIRE],REQ[38][REQUIRE],REQ[39][REQUIRE],REQ[40][REQUIRE],REQ[41][REQUIRE],REQ[42][REQUIRE]-
PUB[42][PUBS],REQ[43][REQUIRE]

Appendix F. Attributes

Intelligence Analysis Attributes:

INTEL[0][INTEL_AN],INTEL[1][INTEL_AN],INTEL[2][INTEL_AN],INTEL[3][INTEL_AN],INTEL[4][INTEL_AN],INTEL[5][INTEL_AN],INTEL[6][INTEL_AN],INTEL[7][INTEL_AN],INTEL[8][INTEL_AN],INTEL[9][INTEL_AN],INTEL[10][INTEL_AN],INTEL[11][INTEL_AN],INTEL[12][INTEL_AN],INTEL[13][INTEL_AN],INTEL[14][INTEL_AN],INTEL[15][INTEL_AN],INTEL[16][INTEL_AN],INTEL[17][INTEL_AN],INTEL[18][INTEL_AN],INTEL[19][INTEL_AN],INTEL[20][INTEL_AN],INTEL[21][INTEL_AN],INTEL[22][INTEL_AN],INTEL[23][INTEL_AN],INTEL[24][INTEL_AN],INTEL[25][INTEL_AN],INTEL[26][INTEL_AN],INTEL[27][INTEL_AN],INTEL[28][INTEL_AN],INTEL[29][INTEL_AN],INTEL[30][INTEL_AN],INTEL[31][INTEL_AN],INTEL[32][INTEL_AN],INTEL[33][INTEL_AN],INTEL[34][INTEL_AN],INTEL[35][INTEL_AN],INTEL[36][INTEL_AN],INTEL[37][INTEL_AN],INTEL[38][INTEL_AN],INTEL[39][INTEL_AN],INTEL[40][INTEL_AN],INTEL[41][INTEL_AN],INTEL[42][INTEL_AN]-REQ[42][REQUIRE],INTEL[43][INTEL_AN]

Production Operations Attributes:

PROD[0][PROD_OPS],PROD[1][PROD_OPS],PROD[2][PROD_OPS],PROD[3][PROD_OPS],PROD[4][PROD_OPS],PROD[5][PROD_OPS],PROD[6][PROD_OPS],PROD[7][PROD_OPS],PROD[8][PROD_OPS],PROD[9][PROD_OPS],PROD[10][PROD_OPS],PROD[11][PROD_OPS],PROD[12][PROD_OPS],PROD[13][PROD_OPS],PROD[14][PROD_OPS],PROD[15][PROD_OPS],PROD[16][PROD_OPS],PROD[17][PROD_OPS],PROD[18][PROD_OPS],PROD[19][PROD_OPS],PROD[20][PROD_OPS],PROD[21][PROD_OPS],PROD[22][PROD_OPS],PROD[23][PROD_OPS],PROD[24][PROD_OPS],PROD[25][PROD_OPS],PROD[26][PROD_OPS],PROD[27][PROD_OPS],PROD[28][PROD_OPS],PROD[29][PROD_OPS],PROD[30][PROD_OPS],PROD[31][PROD_OPS],PROD[32][PROD_OPS],PROD[33][PROD_OPS],PROD[34][PROD_OPS],PROD[35][PROD_OPS],PROD[36][PROD_OPS],PROD[37][PROD_OPS],PROD[38][PROD_OPS],PROD[39][PROD_OPS],PROD[40][PROD_OPS],PROD[41][PROD_OPS],PROD[42][PROD_OPS]-INTEL[42][INTEL_AN],PROD[43][PROD_OPS]

Ballistic Missiles Attributes:

BAL[0][BAL_MIS],BAL[1][BAL_MIS],BAL[2][BAL_MIS],BAL[3][BAL_MIS],BAL[4][BAL_MIS],BAL[5][BAL_MIS],BAL[6][BAL_MIS],BAL[7][BAL_MIS],BAL[8][BAL_MIS],BAL[9][BAL_MIS],BAL[10][BAL_MIS],BAL[11][BAL_MIS],BAL[12][BAL_MIS],BAL[13][BAL_MIS],BAL[14][BAL_MIS],BAL[15][BAL_MIS],BAL[16][BAL_MIS],BAL[17][BAL_MIS],BAL[18][BAL_MIS],BAL[19][BAL_MIS],BAL[20][BAL_MIS],BAL[21][BAL_MIS],BAL[22][BAL_MIS],BAL[23][BAL_MIS],BAL[24][BAL_MIS],BAL[25][BAL_MIS],BAL[26][BAL_MIS],BAL[27][BAL_MIS],BAL[28][BAL_MIS],BAL[29][BAL_MIS],BAL[30][BAL_MIS],BAL[31][BAL_MIS],BAL[32][BAL_MIS],BAL[33][BAL_MIS],BAL[34][BAL_MIS],BAL[35][BAL_MIS],BAL[36][BAL_MIS],BAL[37][BAL_MIS],BAL[38][BAL_MIS],BAL[39][BAL_MIS],BAL[40][BAL_MIS],BAL[41][BAL_MIS],BAL[42][BAL_MIS]-
PROD[42][PROD_OPS],BAL[43][BAL_MIS]

Appendix F. Attributes

Combat Intelligence Attributes:

COM[0][COM_INT],COM[1][COM_INT],COM[2][COM_INT],COM[3][COM_INT],COM[4][COM_INT],COM[5][COM_INT],COM[6][COM_INT],COM[7][COM_INT],COM[8][COM_INT],COM[9][COM_INT],COM[10][COM_INT],COM[11][COM_INT],COM[12][COM_INT],COM[13][COM_INT],COM[14][COM_INT],COM[15][COM_INT],COM[16][COM_INT],COM[17][COM_INT],COM[18][COM_INT],COM[19][COM_INT],COM[20][COM_INT],COM[21][COM_INT],COM[22][COM_INT],COM[23][COM_INT],COM[24][COM_INT],COM[25][COM_INT],COM[26][COM_INT],COM[27][COM_INT],COM[28][COM_INT],COM[29][COM_INT],COM[30][COM_INT],COM[31][COM_INT],COM[32][COM_INT],COM[33][COM_INT],COM[34][COM_INT],COM[35][COM_INT],COM[36][COM_INT],COM[37][COM_INT],COM[38][COM_INT],COM[39][COM_INT],COM[40][COM_INT],COM[41][COM_INT],COM[42][COM_INT]-BAL[42][BAL_MIS],COM[43][COM_INT]

Appendix G. Constraints and Objective Function

Constraints:

((\$43+\$44) <= 22927.5 ? 0 : halt(-2)) && (\$42 <= 2547.5 ? 0 : halt(-1))

Objective Function:

((\$43+\$44)<=22927.5 && (\$42 <= 2547.5) ?
(D1*(C1*(B4*A1*\$1/130+B5*A4*\$4/130+B6*(A7*\$7/130+A8*\$8/130+A9*\$9/130+A
10*\$10/130))+C2*(B1*A2*\$2/130+B2*A5*\$5/130+B3*(A11*\$11/130+A12*\$12/130+
A13*\$13/130+A14*\$14/130))+C3*(B7*A3*\$3/130+B8*A6*\$6/130+B9*(A15*\$15/130
+A16*\$16/130+A17*\$17/130+A18*\$18/130)))+D2*(A19*\$19/130+C6*A20*\$20/130+
C7*(B11*(A21*\$21/130+A22*\$22/130)+B12*(A23*\$23/130+A24*\$24/130+A25*\$25/1
30))+C8*A26*\$26/130)+D3*(C9*(A27*\$27/130+B13*(A28*\$28/130+A29*\$29/130)+A
30*\$30/130+B14*(A31*\$31/130+A32*\$32/130+A33*\$33/130)+A34*\$34/130)+C10*(B
15*(A35*\$35/130+A36*\$36/130)+A37*\$37/130+B16*(A38*\$38/130+A39*\$39/130)+A
40*\$40/130+A41*\$41/130))) : 0)

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU1-1	DU1-2	DU1-3	DU1-4	DU1-5
Throughput(ACQ)	5	7.1	6.8		7.4
Accessibility(ACQ)	0	3.4	2.9		3.1
Accuracy(ACQ)	8.7	8	8.1		8.2
Relevance(ACQ)	9	8.1	8.3		8.2
Timeliness(ACQ)	10	10	10		10
Throughput(OPS)	6.5	3	2		2.7
Accessibility(OPS)	0	3	1.5		2.8
Accuracy(OPS)	8.6	5.8	3.8		6
Relevance(OPS)	8.5	5	5		5
Timeliness(OPS)	10	10	8.6		10
Throughput(PMK)	1.5	0.8	6.7		1.3
Accessibility(PMK)	0	1.1	1.1		1.2
Accuracy(PMK)	5	1.2	7.6		0.9
Relevance(PMK)	5	1.3	7.4		1.5
Timeliness(PMK)	0	1.1	10		1.2
Futures Analysis	0	0	3.1		0
Threat Description	1.4	0	3.1		0
Counter Denial/Deception	4.6	0	0.5		0
Foreign IW Capabilities	3	0.5	0.8		0.5
C4	0.1	0	0		0
Electronic Systems	0	0	0		0
Space Systems	0	0	0		0
Tech Assimilation	1.4	1	2.6		1
Flexibility	2.2	2.1	2.3		1.6
Training	0	0	0		0
Community Work	0.1	0	0		0
# Days TDY	0	0	0		0
Over/Under Worked	0	0	0		0

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU1-6	DU2-1	DU2-2	DU2-3	DU2-4
Throughput(ACQ)	6.8	9.7	9.1	9.7	9.3
Accessibility(ACQ)	5	0.7	0.8	0.8	1
Accuracy(ACQ)	6.6	9.7	9.8	9.8	9.5
Relevance(ACQ)	6.3	9.8	9.8	9.8	9.7
Timeliness(ACQ)	10	9.8	9.7	9.8	9.7
Throughput(OPS)	5.8	9.8	9.7	9.8	9.8
Accessibility(OPS)	1.9	0.9	0.6	0.8	0.9
Accuracy(OPS)	7.7	9.7	9.7	9.8	9.7
Relevance(OPS)	5	9.8	9.8	9.8	9.8
Timeliness(OPS)	10	9.8	9.8	9.8	9.8
Throughput(PMK)	2.8	9.8	6.6	6.2	9.8
Accessibility(PMK)	0	0.8	0.6	0.7	0.5
Accuracy(PMK)	5	9.7	7.9	6.9	9.7
Relevance(PMK)	5	9.7	7.2	6.9	9.6
Timeliness(PMK)	10	9.7	9.8	9.6	9.6
Futures Analysis	3.4	9.8	9.8	9.8	9.8
Threat Description	3.4	9.8	9.8	9.8	9.9
Counter Denial/Deception	0	9.7	9.8	9.8	9.8
Foreign IW Capabilities	0.2	9.6	9.8	9.8	9.8
C4	0	9.7	9.8	9.8	9.6
Electronic Systems	0	6.7	5.8	6.7	3.7
Space Systems	0	9.8	9.8	9.6	8.7
Tech Assimilation	0.1	9.7	9.6	9.6	9
Flexibility	2.9	8.1	8.5	8.6	9.4
Training	0	0.8	0.7	1.2	0.7
Community Work	0	1.8	1.3	1.7	0.7
# Days TDY	0	2.9	3.1	3.4	0.8
Over/Under Worked	0	2.6	4.7	3.7	6.7

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU3-1	DU3-2	DU3-3	DU3-4	DU3-5
Throughput(ACQ)	3.5	9.4	6.2	5.4	7.6
Accessibility(ACQ)	8.8	9.3	6.5	3.9	9.4
Accuracy(ACQ)	5.6	7	5.9	3.6	9
Relevance(ACQ)	7	7.9	6.7	3.4	8.7
Timeliness(ACQ)	4.6	8.5	6	4.4	8.1
Throughput(OPS)	5.4	9.4	6.7	2.7	8.4
Accessibility(OPS)	9.1	9.3	5.7	3.7	9.1
Accuracy(OPS)	5.8	8	5.9	3.1	6.3
Relevance(OPS)	6.6	9.5	6.4	5.7	6.2
Timeliness(OPS)	9.8	7	8	6.7	8.5
Throughput(PMK)	5.8	4.4	3.1	6.5	6.2
Accessibility(PMK)	9.6	9.4	5.4	6.1	5.7
Accuracy(PMK)	4.1	5.6	4.5	4.2	6.4
Relevance(PMK)	5.7	6	4	4.4	6.4
Timeliness(PMK)	5.2	8.4	2.4	5.4	6.9
Futures Analysis	6.3	2.1	2.2	6.5	7.6
Threat Description	8.1	8.9	3.6	6.1	9.3
Counter Denial/Deception	7.9	8.9	3	5.9	8.7
Foreign IW Capabilities	7.9	9.4	4.6	6.3	8.5
C4	6.2	7.7	2.6	5.5	8.9
Electronic Systems	7.3	7.5	7.6	5.1	9.3
Space Systems	4.9	6.5	1.3	3.9	5.2
Tech Assimilation	6.3	7.9	5.1	5.2	6.6
Flexibility	6.9	3.7	3	6.7	6
Training	1.6	2.7	2	6.9	6.5
Community Work	8.5	7.2	3.5	7	5.1
# Days TDY	2.6	4	1.7	5.3	3.4
Over/Under Worked	3.7	4.3	2.7	4.6	3.8

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU3-6	DU3-7	DU4-1	DU4-2	DU4-3
Throughput(ACQ)	3.8	8.7	7.8	7.9	7.6
Accessibility(ACQ)	2.6	9.2	7.3	7.1	6.2
Accuracy(ACQ)	1.7	9.4	10	7.1	7.5
Relevance(ACQ)	1.8	9.1	10	7.3	6.8
Timeliness(ACQ)	3.5	9.5	10	10	10
Throughput(OPS)	2.7	9.8	10	7.5	7.4
Accessibility(OPS)	1.8	9.6	7.2	7.2	7.5
Accuracy(OPS)	1.4	8	9.9	7.5	9
Relevance(OPS)	1.2	9.6	9.9	6.5	6.4
Timeliness(OPS)	0.8	9.2	10	10	10
Throughput(PMK)	2.4	7.3	7	8.5	8.8
Accessibility(PMK)	1.9	7.7	7.3	7.1	6.9
Accuracy(PMK)	1.2	6.5	10	6.3	6.1
Relevance(PMK)	1.3	6.6	7.3	7.9	7.9
Timeliness(PMK)	2.3	6.6	10	10	9.8
Futures Analysis	1.8	9.5	4.8	3.3	2.8
Threat Description	0.3	9.5	4.4	2.5	2.5
Counter Denial/Deception	0.2	8.4	6.4	2.5	3
Foreign IW Capabilities	0.3	9.4	6.4	3.5	3.8
C4	1.9	9.7	1.9	2.7	2.1
Electronic Systems	0.3	9.7	9.9	10	10
Space Systems	0.4	4.8	1.5	1.9	1.7
Tech Assimilation	0.3	8.3	3.9	3.5	3.1
Flexibility	2.6	9.7	7.9	6.7	7.7
Training	3.6	6.5	8.3	9.8	9.8
Community Work	3.3	7.1	0	0	0
# Days TDY	2.5	4	1.9	2.7	2.7
Over/Under Worked	2.8	8.5	10	10	10

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU4-4	DU4-5	DU4-6	DU4-7	DU5-1
Throughput(ACQ)	6.6	6.4	4.75	8.8	6.3
Accessibility(ACQ)	8.9	6.3	4.6	10	5
Accuracy(ACQ)	9.9	5	9	10	7.5
Relevance(ACQ)	7.9	5	10	10	5
Timeliness(ACQ)	7.9	6.5	6.6	10	5
Throughput(OPS)	8.8	6.6	10	10	0
Accessibility(OPS)	10	5	7.3	9.9	5
Accuracy(OPS)	8.3	5	10	10	8.3
Relevance(OPS)	8.3	6.6	10	10	5
Timeliness(OPS)	9.9	7.9	10	10	5
Throughput(PMK)	7.3	5.6	5.1	7.7	6
Accessibility(PMK)	9.8	4.9	5.1	10	5.1
Accuracy(PMK)	8.8	5	10	7.9	7.7
Relevance(PMK)	8.3	7.6	8.5	10	5
Timeliness(PMK)	9.9	8.4	10	10	6.6
Futures Analysis	1.9	6.9	2.7	3.3	6.3
Threat Description	2.1	2.5	4.8	4.4	6.3
Counter Denial/Deception	3.5	3.8	7.1	3.1	6.5
Foreign IW Capabilities	3.5	2.1	4.8	3.1	1.9
C4	3.3	2.3	0	2.1	1.7
Electronic Systems	10	9.9	10	9.9	1.5
Space Systems	1.9	1.8	1.2	1.9	5
Tech Assimilation	3.3	5.5	4.6	3.8	6.9
Flexibility	9.2	6.9	4.6	6.7	7
Training	10	7.1	8.3	10	1.5
Community Work	0	0	0	0	0.3
# Days TDY	4.8	2.2	1.5	4	0.3
Over/Under Worked	10	7.1	10	8.9	4.8

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU5-2	DU5-3	DU6-1	DU6-2	DU6-3
Throughput(ACQ)	5.2	5.1	3	4	0.4
Accessibility(ACQ)	5	5.1	0	5	0
Accuracy(ACQ)	7.7	6.9	5	7.6	7.5
Relevance(ACQ)	5	5.1	0	8.7	0.6
Timeliness(ACQ)	5.2	10	10	10	3.5
Throughput(OPS)	5.2	5	0.2	3.5	2.7
Accessibility(OPS)	5	5	0	5.1	0
Accuracy(OPS)	6.9	7.7	5	6.5	8.5
Relevance(OPS)	5.2	5	0.2	4.6	8.6
Timeliness(OPS)	10	10	0.5	10	10
Throughput(PMK)	5.2	5.1	3	3.7	0.8
Accessibility(PMK)	5	5.2	0	5	0
Accuracy(PMK)	6.7	7.7	5	6.9	7.5
Relevance(PMK)	5	5.1	2.8	8.3	0.6
Timeliness(PMK)	10	10	5.1	10	4
Futures Analysis	5.2	7.4	1.5	4.8	0
Threat Description	5.2	5	0	5	5
Counter Denial/Deception	5.4	5.1	0	1.6	0
Foreign IW Capabilities	2.9	5.2	0	1.5	0
C4	0.8	0.5	0	1.5	4.8
Electronic Systems	3.3	2.6	0	6.6	4.6
Space Systems	4.8	4.4	0.3	0.7	0
Tech Assimilation	7.1	3.2	2	0.4	5
Flexibility	6	3.4	7.5	2.7	4.8
Training	1	0.5	0	2.1	0
Community Work	0.4	0.4	0	0	0
# Days TDY	0.4	0.4	5	2.4	4.8
Over/Under Worked	3.8	3		9.8	10

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU6-4	DU6-5	DU6-6	DU6-7	DU7-1
Throughput(ACQ)	0.7	0.3	1.7	2.1	8.5
Accessibility(ACQ)	0	0.3	0	0.3	4.9
Accuracy(ACQ)	5	0.3	7.1	7.3	4.7
Relevance(ACQ)	2	0.2	7.3	7.3	7.3
Timeliness(ACQ)	1.6	0.3	10	10	10
Throughput(OPS)	0.3	0.4	1.4	1.5	8
Accessibility(OPS)	0	5	0	0	5
Accuracy(OPS)	2.7	7.9	7.5	7.3	7.8
Relevance(OPS)	2.3	5	8.8	8.5	7.6
Timeliness(OPS)	1.5	10	10	10	10
Throughput(PMK)	2.5	2.9	3	2.5	8.5
Accessibility(PMK)	0.1	5.2	8	8.5	5
Accuracy(PMK)	5	8.3	7.6	7.5	8.3
Relevance(PMK)	2.4	9.8	5.1	5	5
Timeliness(PMK)	1.3	10	10	10	10
Futures Analysis	1.3	1.7	1	1.5	9.7
Threat Description	0.3	0.8	1	0.8	9.7
Counter Denial/Deception	0	0.8	1	1	8.7
Foreign IW Capabilities	0	0.8	0.9	0.8	4.6
C4	0	0.3	2.4	1.9	8.6
Electronic Systems	0.4	0.6	2.5	1.9	9
Space Systems	0.6	0.3	0	0	9.4
Tech Assimilation	1.9	5.8	3.9	3.8	9.2
Flexibility	3	5.2	5.6	5	7.1
Training	0	2.7	0.1	0	10
Community Work	0	0.3	0.1	0.3	0
# Days TDY	0	0.4	0.1	0	5.2
Over/Under Worked	0.2	0.4	0	0.1	4.8

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU8-1	DU8-2	DU8-3	DU8-4	DU8-5
Throughput(ACQ)	6.9	10	8.3	7.1	9.6
Accessibility(ACQ)	5	5	5	10	5
Accuracy(ACQ)	6.7	10	8.5	8.7	8.1
Relevance(ACQ)	6.9	10	5.1	5.1	5
Timeliness(ACQ)	10	10	10	10	10
Throughput(OPS)	4.4	10	7.7	8.5	9.2
Accessibility(OPS)	5	5.1	5	10	5.1
Accuracy(OPS)	7.3	10	8.1	7.7	7.7
Relevance(OPS)	5	10	5.2	6.5	5
Timeliness(OPS)	10	10	10	10	10
Throughput(PMK)	7.3	10	8.1	8.4	9
Accessibility(PMK)	5	5	5	10	5
Accuracy(PMK)	7.9	10	8.3	7.7	6.7
Relevance(PMK)	5.6	10	5	5.2	5.2
Timeliness(PMK)	9.8	9.9	10	10	10
Futures Analysis	9	10	9	6.4	9.4
Threat Description	4.8	2.8	5.6	6.9	7.5
Counter Denial/Deception	5	7.7	5.2	7.4	7.3
Foreign IW Capabilities	9.4	5.5	5.2	7.6	7.3
C4	4.4	5.1	4.4	6.9	6.3
Electronic Systems	5	4.8	4.4	7.2	6.5
Space Systems	4.8	5.8	4.7	7.3	6.5
Tech Assimilation	7.9	8.5	8.3	6.8	8.5
Flexibility	5.8	10	10	7.1	10
Training	0	0	0	0	0.1
Community Work	0	0	0	0	1
# Days TDY	0	0	0	0	0
Over/Under Worked	8.6	0	10	9.9	10

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU9-1	DU9-2	DU9-3	DU9-4	DU9-5
Throughput(ACQ)	1.2	2.1	7.5	1.3	4.8
Accessibility(ACQ)	1.2	1.9	7.4	1.1	5
Accuracy(ACQ)	1.5	5	7.5	2.2	6.9
Relevance(ACQ)	0	2.1	5	0	5
Timeliness(ACQ)	0	2.2	4.6	0	7.1
Throughput(OPS)	1.4	2.4	2.7	1	8.2
Accessibility(OPS)	1.5	0	5	0	5.1
Accuracy(OPS)	3.5	2.3	5	1	6.8
Relevance(OPS)	0	1.8	5	0	5
Timeliness(OPS)	0	0	10	0	6.3
Throughput(PMK)	3.3	4.5	5.1	4.7	7.7
Accessibility(PMK)	0	2	7.3	6.5	7.4
Accuracy(PMK)	3.2	2.6	7.4	7.9	7.2
Relevance(PMK)	0	2.4	6.5	5	5
Timeliness(PMK)	2.4	2.2	6.5	2.2	2.9
Futures Analysis	0	0	0	0	0
Threat Description	0	1.9	2.4	2.5	4.6
Counter Denial/Deception	0	0	2.6	2.3	4.8
Foreign IW Capabilities	0	0	0	0	0
C4	0	0	0	0	0
Electronic Systems	0	0	0	0	0.1
Space Systems	1.3	1.9	2.8	4.9	4.8
Tech Assimilation	1.4	1.6	4.4	4.8	4.8
Flexibility	0	0	2.2	0	0
Training	0	0	0	0	0
Community Work	0	0	0	0.1	0
# Days TDY	0	0	0	0.1	4.8
Over/Under Worked	1.9	0	3.4	3.5	4.5

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU9-6	DU9-7	DU9-8	DU9-9	DU9-10
Throughput(ACQ)	8.3	2.5	2.3	1.3	1.7
Accessibility(ACQ)	10	5	2.4	1.5	5
Accuracy(ACQ)	10	5	5	0	2.2
Relevance(ACQ)	7.9	7.3	5	1.7	2.1
Timeliness(ACQ)	10	7.3	6.4	1.1	3
Throughput(OPS)	10	6.9	4.6	0	3.9
Accessibility(OPS)	0.1	5	2.3	0	2.3
Accuracy(OPS)	1.7	2.5	7.3	0	5
Relevance(OPS)	2.5	2.3	5.1	0	1.9
Timeliness(OPS)	0.1	0	5.1	0.1	4.2
Throughput(PMK)	2.5	2.5	7	4.6	6.2
Accessibility(PMK)	5	7.1	5	5.1	5
Accuracy(PMK)	5	5	7.2	2.7	6.7
Relevance(PMK)	5	5	5	5	5
Timeliness(PMK)	2.4	2.3	6.7	6.3	6.5
Futures Analysis	0	0.1	0	0	0
Threat Description	4.7	2.3	2.2	0	2.2
Counter Denial/Deception	1.9	2.7	4.8	2.5	4.7
Foreign IW Capabilities	0	0	0	0	1.2
C4	0	0.1	0	0	0
Electronic Systems	0	0	0	0	0
Space Systems	0	2.1	2.7	0	0
Tech Assimilation	2.7	4.2	7	2.3	4.8
Flexibility	1.8	4.6	4.7	2.5	1.7
Training	0	0	0	0.1	0.1
Community Work	0	0.1	0	0.1	0
# Days TDY	2.1	2.1	2.4	4.2	1.8
Over/Under Worked	4.4	4.8	4.5	4.4	2.8

Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU9-11	DU9-12	DU9-13	DU9-14	DU9-15
Throughput(ACQ)	4.8	4.7	0	0	0
Accessibility(ACQ)	5	5	0	0	0
Accuracy(ACQ)	6	7.4	0	0	0
Relevance(ACQ)	6	7.3	0	0	0
Timeliness(ACQ)	4.8	7	0	0	0
Throughput(OPS)	6	7.1	1.5	4.8	5
Accessibility(OPS)	5	9	1.5	5	5
Accuracy(OPS)	6.3	9	1.5	5	5
Relevance(OPS)	6	7.5	1	5	5
Timeliness(OPS)	6.3	7.5	1	4.8	4.8
Throughput(PMK)	8.3	5.1	1	7.1	5
Accessibility(PMK)	8.3	5	1	6.9	5
Accuracy(PMK)	8.5	6.7	1	7.2	5
Relevance(PMK)	8.3	6.6	1.3	7.1	5
Timeliness(PMK)	5.2	5	1.5	7.4	2.9
Futures Analysis	0	1.3	0	0	0
Threat Description	5.2	7.3	2.7	4.6	2.5
Counter Denial/Deception	5	7.6	0	2.1	1.1
Foreign IW Capabilities	0.1	1	0	0	0
C4	0.1	1.2	0	0	0
Electronic Systems	0	1.4	0	0	0
Space Systems	5.2	5.1	0	4.6	0
Tech Assimilation	7.5	7.7	2.1	4.7	2.7
Flexibility	4.8	7.1	0	2.6	2.3
Training	0	1.6	0	0	0
Community Work	0	0	0	0	0
# Days TDY	5	5.2	0	2	4.8
Over/Under Worked	6.9	7	0	4.9	2.1

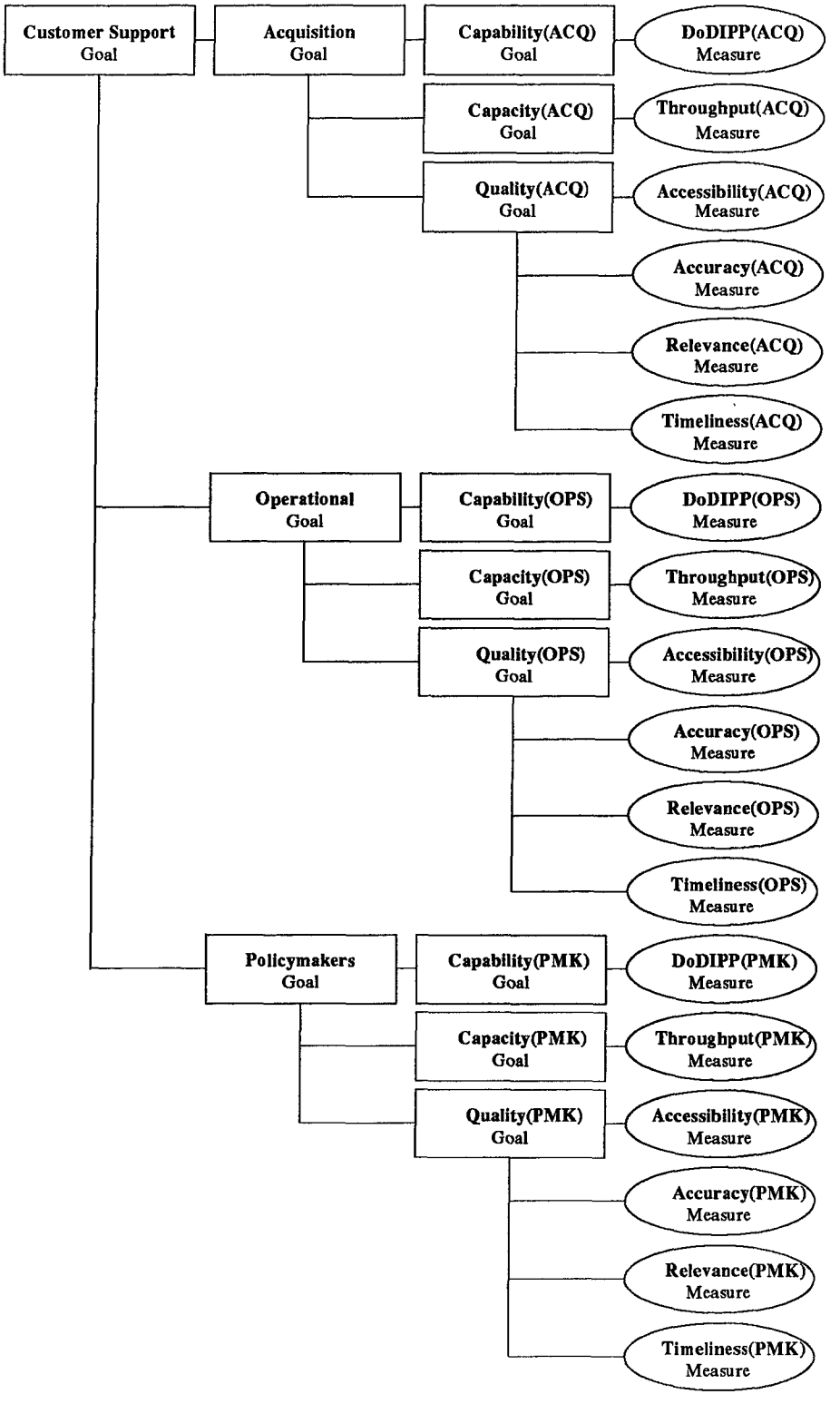
Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes				
	DU9-16	DU9-17	DU9-18	DU9-19	DU9-20
Throughput(ACQ)	0.8	1.3	2	1.5	7
Accessibility(ACQ)	0.8	1.3	1.8	0	6.9
Accuracy(ACQ)	0.8	1.3	2	1.3	8.6
Relevance(ACQ)	0.8	1.1	0	1.5	8.5
Timeliness(ACQ)	0.9	1.3	3.5	1.3	10
Throughput(OPS)	5	4.9	1.8	4.6	8.2
Accessibility(OPS)	5	5	1.8	4.8	1.2
Accuracy(OPS)	5	5	1.8	5	1.2
Relevance(OPS)	5	5	0	5	1
Timeliness(OPS)	5	4.8	3.8	5	0.1
Throughput(PMK)	7.6	7.5	1.5	1	0.9
Accessibility(PMK)	8	7.5	1.7	0	0.9
Accuracy(PMK)	8	7.7	1.6	0	0
Relevance(PMK)	8	7.3	0	0	0.8
Timeliness(PMK)	8	7.3	3.9	0.8	0
Futures Analysis	0	0	0	0	0
Threat Description	2.1	4.8	1.8	4.8	1.5
Counter Denial/Deception	4.5	5	1.8	1.9	1.6
Foreign IW Capabilities	0	1.7	0	0.1	0
C4	0	1.9	0	0	0
Electronic Systems	0	2.3	0	0	0
Space Systems	0	0	1.4	0.1	0
Tech Assimilation	5	7.5	3.3	4.6	2.6
Flexibility	1.3	1.5	4.8	1.5	4.6
Training	0	0.1	4.9	0	1
Community Work	0.1	0.1	0	0	0.1
# Days TDY	0	4.8	0	0	0
Over/Under Worked	2.3	4.8	8.1	1.1	4.3

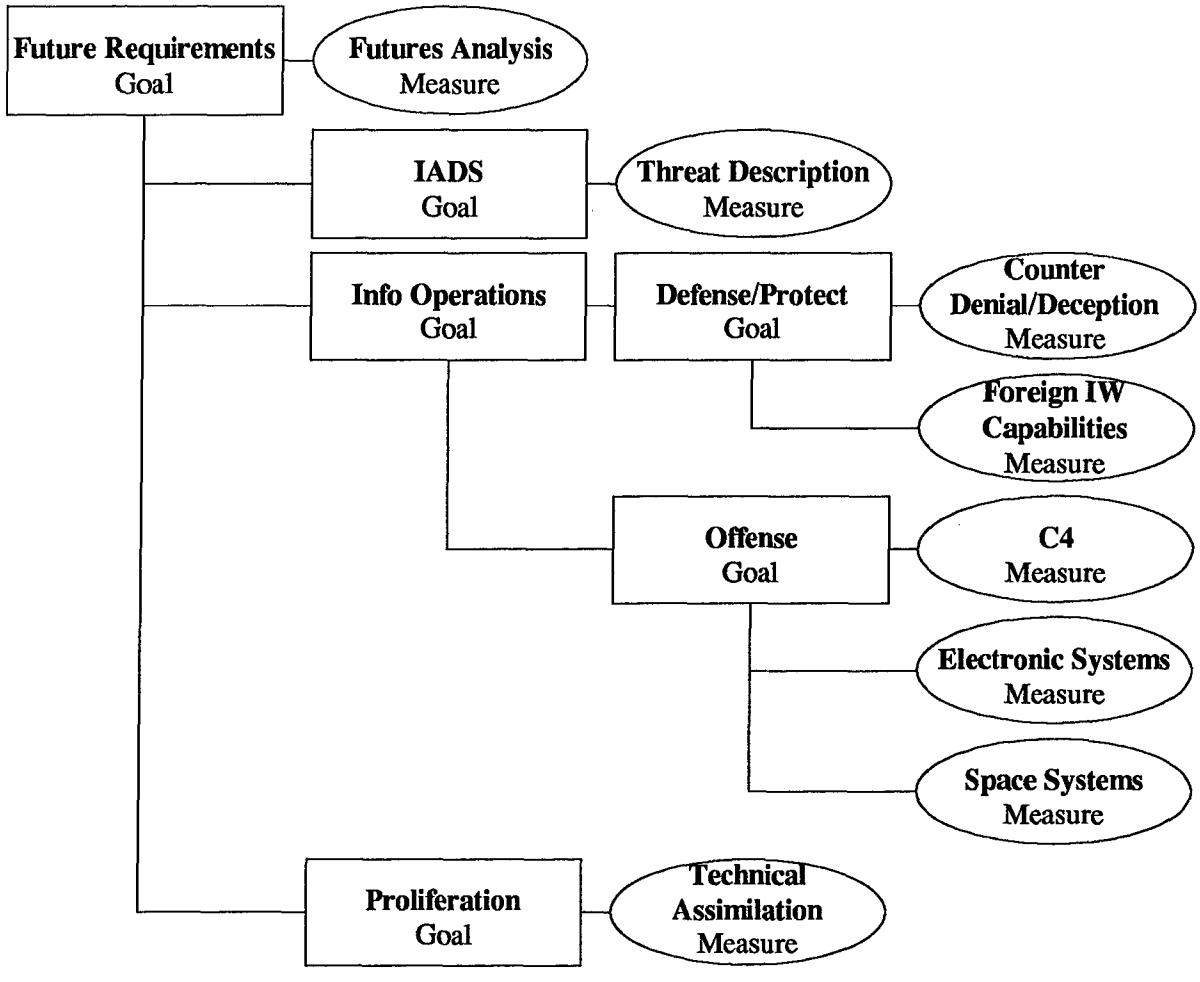
Appendix H. Spreadsheet Values

MEASURES	Decision Unit Funding Cut Codes		
	DU9-21	DU10-1	DU10-2
Throughput(ACQ)	3.5	8.4	9.3
Accessibility(ACQ)	5	6.9	0
Accuracy(ACQ)	5	8.4	9.3
Relevance(ACQ)	5	8.5	7.3
Timeliness(ACQ)	5.2	10	9.2
Throughput(OPS)	3.5	8.7	9
Accessibility(OPS)	1.1	8.9	7.5
Accuracy(OPS)	5	7.6	8.9
Relevance(OPS)	1	7.5	7.7
Timeliness(OPS)	1.3	9.9	0
Throughput(PMK)	4.8	8.3	9.1
Accessibility(PMK)	5	6.6	7.7
Accuracy(PMK)	5	4.6	8.9
Relevance(PMK)	5	9	7.7
Timeliness(PMK)	5.1	9.9	0
Futures Analysis	1.7	8	9.5
Threat Description	4.4	6.9	9.4
Counter Denial/Deception	1.7	0.2	9.5
Foreign IW Capabilities	1.7	0.2	9.5
C4	0	0.8	9.4
Electronic Systems	0	9.9	9.2
Space Systems	0	8.1	9.2
Tech Assimilation	4.6	4.5	9.2
Flexibility	1.3	9.8	8.4
Training	0.1	5.8	0
Community Work	0	6.1	0.2
# Days TDY	3.5	9.5	0
Over/Under Worked	4.4	9.7	9.4

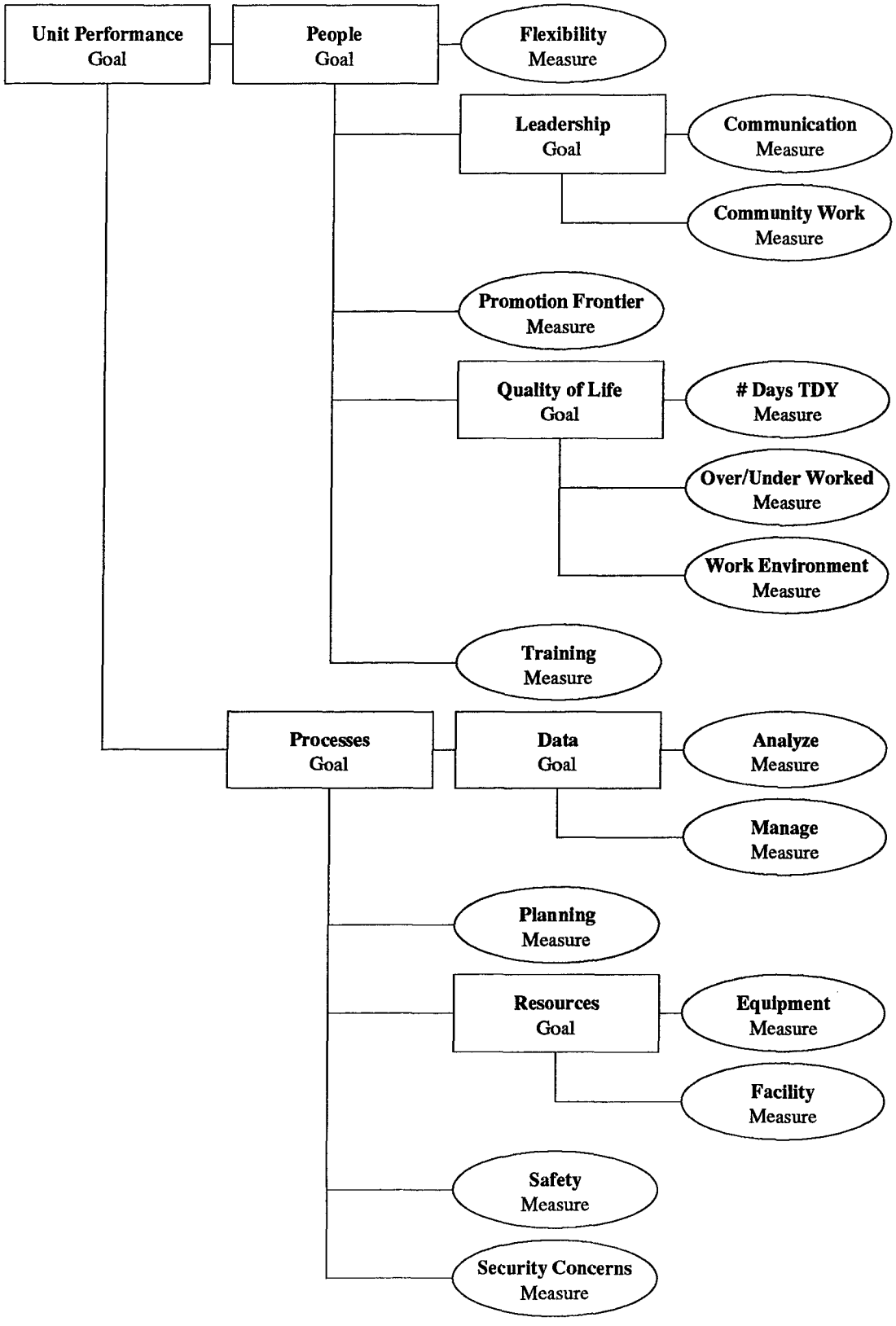
Appendix I. Logical Decision Value Hierarchy



Appendix I. Logical Decisions Value Hierarchy



Appendix I. Logical Decisions Value Hierarchy



Appendix J. LINDO Code

```
MIN    2.279 X1 + 0.435 X2 + 2.041 X3 + 4.469 X4 + 0.837 X5
     + 1.839 X6 + 1.971 X7 + 0.478 X8 + 1.066 X9 + 2.723 X10
     + 0.884 X11 + 1.199 X12 + 2.986 X13 + 2.959 X14 + 4.078 X15
     + 1.591 X16 + 3.228 X17 + 1.123 X18 + 2.255 X19 + 3.908 X20
     + 3.97 X21 + 4.438 X22 + 2.61 X23 + 5.395 X24 + 3.285 X25
     + 4.757 X26 + 3.247 X27 + 1.232 X28 + 4.968 X29 + 5.534 X30
     + 3.317 X31 + 3.834 X32 + 4.628 X33 + 3.288 X34 + 2.125 X35
     + 5.024 X36 + 2.741 X37 + 3.633 X38 + 1.509 X39 + 4.576 X40
     + 4.558 X41 + 3.348 X42 + 2.05 X43 + 4.561 X44 + 4.938 X45
     + 2.736 X46 + 1.402 X47 + 3.529 X48 + 3.214 X49 + 5.232 X50
     + 2.614 X51 + 5.507 X52 + 3.2 X53 + 5.234 X54 + 5.377 X55
     + 5.003 X56 + 2.401 X57 + 3.812 X58 + 5.372 X59 + 4.326 X60
     + 5.25 X61 + 3.382 X62

SUBJECT TO
      2)  1396 X1 + 233 X2 + 932 X3 + 1834 X4 + 326 X5 + 698 X6
     + 716 X7 + 173 X8 + 384 X9 + 931 X10 + 281 X11 + 298 X12
     + 714 X13 + 696 X14 + 933 X15 + 359 X16 + 671 X17 + 218 X18
     + 417 X19 + 699 X20 + 698 X21 + 775 X22 + 445 X23 + 903 X24
     + 524 X25 + 758 X26 + 495 X27 + 187 X28 + 735 X29 + 791 X30
     + 465 X31 + 512 X32 + 567 X33 + 390 X34 + 218 X35 + 463 X36
     + 247 X37 + 322 X38 + 130 X39 + 378 X40 + 372 X41 + 257 X42
     + 154 X43 + 342 X44 + 347 X45 + 182 X46 + 93 X47 + 233 X48
     + 211 X49 + 311 X50 + 130 X51 + 261 X52 + 135 X53 + 218 X54
     + 208 X55 + 192 X56 + 70 X57 + 110 X58 + 110 X59 + 87 X60
     + 87 X61 + 24 X62 >=  8544
END
INTE   62
```

Appendix J. LINDO Code

VARIABLE	PROPOSAL	IMPACT(b_i)	FUNDING(c_i)
X1	DU9-17	2.279	1396
X2	DU9-13	0.435	233
X3	DU9-16	2.041	932
X4	DU8-5	4.469	1834
X5	DU9-9	0.837	326
X6	DU9-10	1.839	698
X7	DU9-14	1.971	716
X8	DU9-1	0.478	173
X9	DU9-2	1.066	384
X10	DU9-8	2.723	931
X11	DU9-4	0.884	281
X12	DU3-6	1.199	298
X13	DU9-3	2.986	714
X14	DU9-5	2.959	696
X15	DU8-1	4.078	933
X16	DU9-15	1.591	359
X17	DU3-3	3.228	671
X18	DU6-4	1.123	218
X19	DU9-7	2.255	417
X20	DU3-1	3.908	699
X21	DU9-12	3.970	698
X22	DU10-2	4.438	775
X23	DU1-2	2.610	445
X24	DU2-4	5.395	903
X25	DU5-1	3.285	524
X26	DU3-5	4.757	758
X27	DU1-3	3.247	495
X28	DU9-18	1.232	187
X29	DU4-6	4.968	735
X30	DU3-7	5.534	791
X31	DU9-11	3.317	465
X32	DU6-2	3.834	512
X33	DU3-2	4.628	567
X34	DU1-1	3.288	390
X35	DU9-20	2.125	218

X36	DU10-1	5.024	463
X37	DU6-3	2.741	247
X38	DU5-3	3.633	322
X39	DU6-1	1.509	130
X40	DU4-3	4.576	378
X41	DU8-4	4.558	372
X42	DU6-7	3.348	257
X43	DU9-21	2.050	154
X44	DU4-2	4.561	342
X45	DU7-1	4.938	347
X46	DU9-6	2.736	182
X47	DU9-19	1.402	93
X48	DU5-2	3.529	233
X49	DU1-6	3.214	211
X50	DU2-3	5.232	311
X51	DU1-5	2.614	130
X52	DU4-7	5.507	261
X53	DU3-4	3.200	135
X54	DU2-2	5.234	218
X55	DU2-1	5.377	208
X56	DU4-4	5.003	192
X57	DU6-5	2.401	70
X58	DU4-5	3.812	110
X59	DU4-1	5.372	110
X60	DU8-3	4.326	87
X61	DU8-2	5.250	87
X62	DU6-6	3.382	24

Appendix K. Sensitivity Analysis

Customer Support .5 Future Requirements .125 Unit Performance .375

Dynamic Sensitivity of Commanders Values Ranking

Alternative	Utility
DU9_13	0.399125
DU9_1	0.418075
DU9_9	0.780888
DU9_4	0.818363
DU9_2	0.918412
DU6_4	0.997350
DU3_6	1.150950
DU9_18	1.241388
DU9_19	1.265275
DU6_1	1.381700
DU9_15	1.418475
DU9_10	1.632963
DU9_16	1.781525
DU9_14	1.787650
DU9_21	1.855175
DU9_20	1.893050
DU9_7	2.019238
DU9_17	2.076013
DU6_5	2.163550
DU1_5	2.202950
DU1_2	2.204788
DU9_6	2.397338
DU9_8	2.422975
DU6_3	2.523563
DU9_3	2.588000
DU9_5	2.594488
DU1_6	2.782887
DU1_1	2.809138
DU1_3	2.811613
DU6_7	2.908325
DU3_3	2.924325

Alternative	Utility
DU6_6	2.946150
DU9_11	2.981200
DU5_1	3.074463
DU3_4	3.147625
DU5_2	3.231175
DU5_3	3.287363
DU6_2	3.460387
DU4_5	3.585338
DU9_12	3.631813
DU3_1	3.694488
DU8_1	3.791438
DU8_3	4.043063
DU8_5	4.224325
DU8_4	4.225238
DU4_2	4.228013
DU10_2	4.241263
DU4_3	4.242800
DU3_2	4.273750
DU3_5	4.514913
DU4_6	4.537275
DU4_4	4.619200
DU10_1	4.698075
DU8_2	4.749325
DU7_1	4.757038
DU2_2	4.907600
DU2_3	4.911588
DU4_1	4.944675
DU2_1	5.011225
DU4_7	5.032825
DU2_4	5.046288
DU3_7	5.274963

Customer Support .7 Future Requirements .075 Unit Performance .225

Dynamic Sensitivity of Commanders Values Ranking

Alternative	Utility
DU9_13	0.470275
DU9_1	0.537705
DU9_9	0.893092
DU9_4	0.949078
DU9_2	1.213158
DU9_18	1.221943
DU3_6	1.247820
DU6_4	1.248610
DU9_19	1.538325
DU6_1	1.636940
DU9_15	1.764185
DU9_10	2.044367
DU9_14	2.153390
DU9_21	2.244285
DU9_16	2.301365
DU9_20	2.356520
DU9_17	2.481747
DU9_7	2.491563
DU6_5	2.639440
DU6_3	2.958627
DU1_2	3.014403
DU9_8	3.022185
DU1_5	3.025330
DU9_6	3.075573
DU3_4	3.253195
DU9_5	3.323362
DU9_3	3.384920
DU5_1	3.496457
DU3_3	3.532105
DU1_6	3.644502
DU9_11	3.652200

Alternative	Utility
DU1_3	3.681797
DU1_1	3.766823
DU6_7	3.788125
DU6_6	3.818200
DU5_2	3.826445
DU5_3	3.979107
DU4_5	4.038453
DU3_1	4.120893
DU6_2	4.207522
DU9_12	4.308838
DU8_1	4.363893
DU8_3	4.608048
DU10_2	4.634527
DU8_5	4.714535
DU8_4	4.890973
DU4_2	4.894877
DU4_3	4.908920
DU3_2	4.982950
DU3_5	4.999507
DU7_1	5.119153
DU10_1	5.349755
DU4_4	5.386280
DU4_6	5.399285
DU2_3	5.553253
DU2_2	5.561290
DU2_1	5.741835
DU2_4	5.743353
DU8_2	5.751175
DU3_7	5.793018
DU4_1	5.799285
DU4_7	5.981115

Appendix K. Sensitivity Analysis

Customer Support .667 Future Requirements 0 Unit Performance .333

Dynamic Sensitivity of Commanders Values Ranking

Alternative	Utility
DU9_13	0.384667
DU9_1	0.508500
DU9_4	0.820733
DU9_9	0.891100
DU9_2	1.103517
DU6_4	1.176867
DU3_6	1.232050
DU9_18	1.264783
DU9_19	1.361200
DU6_1	1.611533
DU9_15	1.662833
DU9_10	1.888517
DU9_14	1.973733
DU9_21	2.026700
DU9_16	2.130383
DU9_17	2.224933
DU9_20	2.281783
DU9_7	2.365467
DU6_5	2.510617
DU6_3	2.749883
DU9_8	2.846200
DU9_6	2.869817
DU1_2	2.882217
DU1_5	2.887267
DU3_4	2.902367
DU9_5	3.054850
DU5_1	3.103667
DU9_3	3.173933
DU3_3	3.206817
DU1_6	3.378283
DU1_3	3.393717
DU9_11	3.400200
DU5_2	3.432233
DU5_3	3.519683
DU1_1	3.535400
DU6_7	3.558317
DU3_1	3.567167
DU6_6	3.590817
DU4_5	3.767617
DU8_1	3.793317
DU10_2	3.886350
DU6_2	3.893150
DU9_12	3.980183
DU8_3	4.097017
DU8_5	4.102233
DU8_4	4.297783
DU3_5	4.371100
DU3_2	4.386967
DU7_1	4.506283
DU4_2	4.704717
DU4_3	4.743333
DU2_3	4.744733
DU2_2	4.750717
DU2_1	4.907300
DU2_4	4.953067
DU10_1	5.005883
DU4_6	5.103533
DU3_7	5.134567
DU8_2	5.135967
DU4_4	5.232333
DU4_1	5.465000
DU4_7	5.711100

Customer Support .5333 Future Requirements .2 Unit Performance .2667

Dynamic Sensitivity of Commanders Values Ranking

Alternative	Utility
DU9_1	0.447280
DU9_13	0.484733
DU9_9	0.782880
DU9_4	0.946707
DU9_2	1.028053
DU6_4	1.069093
DU3_6	1.166720
DU9_18	1.198547
DU6_1	1.407107
DU9_19	1.442400
DU9_15	1.519827
DU9_10	1.788813
DU9_16	1.952507
DU9_14	1.967307
DU9_20	1.967787
DU9_21	2.072760
DU9_7	2.145333
DU6_5	2.292373
DU9_17	2.332827
DU1_2	2.336973
DU1_5	2.341013
DU9_8	2.598960
DU9_6	2.603093
DU6_3	2.732307
DU9_3	2.798987
DU9_5	2.863000
DU1_1	3.040560
DU1_6	3.049107
DU1_3	3.099693
DU6_7	3.138133
DU6_6	3.173533
DU9_11	3.233200
DU3_3	3.249613
DU5_1	3.467253
DU3_4	3.498453
DU5_2	3.625387
DU5_3	3.746787
DU6_2	3.774760
DU4_5	3.856173
DU9_12	3.960467
DU3_1	4.248213
DU8_1	4.362013
DU4_3	4.408387
DU4_2	4.418173
DU8_3	4.554093
DU4_4	4.773147
DU8_4	4.818427
DU4_6	4.833027
DU8_5	4.836627
DU3_2	4.869733
DU10_2	4.989440
DU10_1	5.041947
DU3_5	5.143320
DU4_1	5.278960
DU4_7	5.302840
DU8_2	5.364533
DU7_1	5.369907
DU2_2	5.718173
DU2_3	5.720107
DU2_4	5.836573
DU2_1	5.845760
DU3_7	5.933413

Appendix K. Sensitivity Analysis

Customer Support .685714 Future Requirements .114286 Unit Performance .2

Dynamic Sensitivity of Commanders Values Ranking

Alternative	Utility
DU9_13	0.496800
DU9_1	0.533131
DU9_9	0.877917
DU9_4	0.985409
DU9_18	1.206360
DU9_2	1.218040
DU3_6	1.240740
DU6_4	1.243463
DU9_19	1.575229
DU6_1	1.611366
DU9_15	1.758234
DU9_10	2.052389
DU9_14	2.178137
DU9_21	2.281949
DU9_16	2.300380
DU9_20	2.322340
DU9_7	2.478129
DU9_17	2.533849
DU6_5	2.626666
DU1_2	2.955394
DU1_5	2.967017
DU6_3	2.985937
DU9_8	3.012006
DU9_6	3.066863
DU9_5	3.334314
DU9_3	3.361497
DU3_4	3.388469
DU3_3	3.584689
DU5_1	3.604511
DU1_6	3.635509
DU9_11	3.664343

Alternative	Utility
DU1_3	3.680949
DU1_1	3.729191
DU6_7	3.760929
DU6_6	3.791071
DU5_2	3.910354
DU5_3	4.077183
DU4_5	4.089794
DU6_2	4.235520
DU3_1	4.297289
DU9_12	4.352971
DU8_1	4.526646
DU8_3	4.746349
DU4_2	4.881109
DU4_3	4.884726
DU10_2	4.898994
DU8_5	4.906920
DU8_4	5.050091
DU3_2	5.137057
DU3_5	5.199597
DU7_1	5.330080
DU4_4	5.342674
DU4_6	5.402891
DU10_1	5.404031
DU2_3	5.808094
DU2_2	5.815294
DU4_1	5.820463
DU8_2	5.871714
DU4_7	5.961366
DU2_4	5.982466
DU2_1	5.995120
DU3_7	6.001203

Customer Support .514286 Future Requirements .85714 Unit Performance .4

Dynamic Sensitivity of Commanders Values Ranking

Alternative	Utility
DU9_13	0.372600
DU9_1	0.422649
DU9_4	0.782031
DU9_9	0.796063
DU9_2	0.913530
DU6_4	1.002497
DU3_6	1.158030
DU9_19	1.228371
DU9_18	1.256970
DU6_1	1.407274
DU9_15	1.424426
DU9_10	1.624941
DU9_14	1.762903
DU9_16	1.782510
DU9_21	1.817511
DU9_20	1.927230
DU9_17	2.023911
DU9_7	2.032671
DU6_5	2.176324
DU1_5	2.261263
DU1_2	2.263796
DU9_6	2.406047
DU9_8	2.433154
DU6_3	2.496253
DU9_5	2.583536
DU9_3	2.611423
DU1_6	2.791881
DU1_3	2.812461
DU1_1	2.846769
DU3_3	2.871741
DU6_7	2.935521

Alternative	Utility
DU5_1	2.966409
DU9_11	2.969057
DU6_6	2.973279
DU3_4	3.012351
DU5_2	3.147266
DU5_3	3.189287
DU6_2	3.432390
DU3_1	3.518091
DU4_5	3.533996
DU9_12	3.587679
DU8_1	3.628684
DU8_3	3.904761
DU10_2	3.976796
DU8_5	4.031940
DU8_4	4.066119
DU3_2	4.119643
DU4_2	4.241781
DU4_3	4.266994
DU3_5	4.314823
DU4_6	4.533669
DU7_1	4.546110
DU8_2	4.628786
DU10_1	4.643799
DU2_2	4.653596
DU2_3	4.656746
DU4_4	4.662806
DU2_1	4.757940
DU2_4	4.807174
DU4_1	4.923497
DU4_7	5.052574
DU3_7	5.066777

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13. ABSTRACT *(Maximum 200 words)* Allocating resources is never an easy task, especially when requirements call for more resources than those available. It gets more difficult when the availability of resources shrinks from year to year. This is the case at the National Air Intelligence Center (NAIC). In each of the past five years, NAIC has been forced to make their resource allocation decision with fewer dollars and less manpower. This decision has been time consuming, manpower intensive, and sometimes very heated. In an effort to lessen these three consequences, a resource allocation model, based upon the NAIC Commander's values and preferences, was developed. The methodology for the model is founded upon decision analysis with value-focused thinking. Using multi-attribute utility theory, measures were scored using scoring functions and then multiplied by the commander's preferences to determine an overall utility score. For the FY99 budget cycle at NAIC, 62 unique funding proposals were scored and ranked using 28 measures for each proposal. The developed value hierarchy allows NAIC to choose their own alternatives based on this ranked list. Significant differences in perceived impact exist between recommended proposal cuts and the list of proposals approved for cuts by NAIC. Some sensitivity analysis was performed on the commander's preferences.

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