3-2002

Decision Analysis with Value Focused Thinking as a Methodology to Select Force Protection Initiatives for Evaluation

David M. Jurk

DECISION ANALYSIS WITH VALUE FOCUSED THINKING AS A METHODOLOGY TO SELECT FORCE PROTECTION INITIATIVES FOR EVALUATION

THESIS

David M. Jurk, Captain, USAF

AFIT/GEE/ENV/02M-05

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U. S. Government.

AFIT/GEE/ENV/02M-05

DECISION ANALYSIS WITH VALUE FOCUSED THINKING AS A METHODOLOGY TO SELECT FORCE PROTECTION INITIATIVES FOR EVALUATION

THESIS

Presented to the Faculty

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Engineering and Environmental Management

David M. Jurk, B.S.

Captain, USAF

March 2002

AFIT/GEE/ENV/02M-05

DECISION ANALYSIS WITH VALUE FOCUSED THINKING AS A METHODOLOGY TO SELECT FORCE PROTECTION INITIATIVES FOR EVALUATION

David M. Jurk, B.S.
Captain, USAF

Approved:

Alfred E. Thal, Jr., Lt Col, USAF, Ph.D. — 6 MAR 02

Advisor — date

Stephen P. Chambal, Capt, USAF, Ph.D. — 6 MAR 02

Reader — date

John Schuliger, Capt, USAF — 6 MAR 02

Reader — date

Acknowledgments

Successful completion of this thesis and the course work at AFIT are not wholly attributable to me. I owe debts of gratitude to many. First, I thank Lord God Almighty as He has extended to me an incredible amount of grace in allowing me this opportunity. I also thank Him for the many blessings He has, and will, bestow upon me. Significant blessings often come through the people God has graciously placed in my life. I receive a continuous blessing of encouragement and unconditional love from the most important people in my life, Mom and Dad. Without their love, prayers, and understanding, nothing I've ever done would have been possible. I'm proud to be their son and would not have it any other way! I can't say enough how much I appreciate them. Incidentally Mom and Dad, I know how long it takes, and the effort involved, to make, cut, bake, and frost cookies for me…thanks! Just keep 'em comin'! You're both the best, I love you!

The Lord has allowed others to play key roles in my completion of this master's degree and thesis. There are those from the Force Protection Battlelab (FPB) who sponsored the thesis work. Colonel Regan Springs, the former FPB commander (and boss who called me "son"), believed in me enough to unquestioningly support this effort, and allow the use of the FPB as a focus case. Colonel Tommy Dillard, the current FPB commander, and members of the FPB staff provided invaluable information as they patiently endured many decision analysis data gathering sessions (thank you Jay!). The guidance and support from the professionals at AFIT was instrumental in this effort. Lieutenant Colonel Al Thal was kind enough to serve as my thesis advisor. He was always available and provided unceasing support. His faith in my abilities was stronger than my own…thanks Sir! Captain Stephen Chambal, my DA reader, took a very active

part in assisting me with this thesis. He accompanied me on four data gathering trips and provided me with necessary guidance in many marathon office meetings. Captain John Schuliger, my force protection reader, was always available for consultation, motivation, and sanity checks. I truly appreciated their willing investment of time and energy in this effort. I acknowledge their sacrifice of personal time to ensure my material remained focused with respect to its initial objective and that the final document reflected the true potential of using value-focused thinking throughout the Air Force.

I'm also thankful for many friends (new and old) God gave me to make AFIT a bit less painful. Captain Dee Jay Katzer, my classmate, friend, and brother, was always an encouragement and gladly sacrificed his time to accompany me on data gathering trips. His kind and compassionate family always kept me in their prayers and hugs from his girls always made my day. Lieutenant Commander Timothy Gilbride, the most professional and humble United States Coast Guard pilot I know, provided me with mentorship and great friendship. Thanks for your willingness to help me perfect statistical practices. Thanks also to you and your wife for allowing me the honor of being "Uncle Dave" to your new son, and for giving me a "home away from home." To my faithful gym partner and sister in Christ, thank you Carey for your encouragement, prayers, and games of catch! Know that I cherish your friendship, and that you have renewed my faith! Thank you Lt Col Mitchell for your mentorship and leadership by example… "Mitchell 101." Thank you DW for always encouraging and believing in me. I'm also thankful to each member of my class; I have learned something from each of you. To the remainder of my family, my life-long buddy Jeff (the novelist I'll never be), and my Air Force "buds," thanks for being there, you've helped! -- Dave

Table of Contents

Page

Page

Page

Page

List of Figures

Page

Page

Page

List of Tables

Page

Page

Page

List of Acronyms

AFI	Air Force Instruction
AFROC	Air Force Requirements Oversight Council
AFT	Alternative-Focused Thinking
AO	Action Officer
BPC	Battlelab Planning Cell
CE	Civil Engineer
DP	Disaster Preparedness
EOD	Explosive Ordnance Disposal
FPB	Force Protection Battlelab
IN	Intelligence
KBI	Kenney Battlelab Initiative
MBI	Mitchell Battlelab Initiative
OSI	Office of Special Investigations
POC	Proof of Concept
R&D	Research and Development
SC	Communications
SF	Security Forces
SNCO	Senior Non-Commissioned Officer
SP	Security Police
VFT	Value-Focused Thinking

Abstract

Emphasis on homeland defense is high. Decision makers responsible for enhancing the protection of both military and civilian personnel require additional insight when selecting ideas, concepts, or technologies to pursue with constrained resources. They are faced with multiple criteria and multiple objectives; yet they have no defensible, objective, and repeatable selection process to assist them in making their decisions.

This thesis explores whether the value-focused thinking (VFT) process is appropriate for providing the necessary insight to those decision makers. To prove the VFT process is appropriate and viable; this thesis focuses on constructing a value model, scoring alternatives, and analyzing the results for a focus case -- the Air Force Force Protection Battlelab (FPB). The FPB evaluates the worth of innovative force protection ideas and concepts.

The results from the focus case prove that through the VFT process, decision makers are able to make objective decisions regarding which innovative force protection ideas contribute the most value to their mission. It provides justifiable defense for their decisions and enables future decisions regarding selection of innovative protection technologies with the same objectivity and defensibility.

DECISION ANALYSIS WITH VALUE FOCUSED THINKING

AS A METHODOLOGY TO SELECT FORCE PROTECTION

INITIATIVES FOR EVALUATION

Chapter 1. Introduction

1.1 General Background

Decision analysis and the Value-Focused Thinking (VFT) process are becoming more prevalent as decision makers strive to gain as much insight as possible before committing their sparse resources to specific objectives. For example, decision analysis was used to satisfy the General Accounting Office (GAO) and Bureau of Reclamation (BOR) regarding the "impacts and trade-offs that exist for various water management alternatives [pertaining to Glen Canyon Dam]… upstream from Grand Canyon National Park" (Flug, 2000:270). Decision analysis and the VFT process are also important tools for industry. In Turkey, the VFT process was applied to the iron and steel industry, allowing their decision makers greater insight regarding which research and development (R&D) projects were the most ideal to pursue (Oral, 1991:871).

Departments within the United States government, like the Department of Energy (DOE) and the Department of Defense (DoD), also benefit from the use of decision analysis and the VFT process. Within the Air Force, the VFT process was instrumental in constructing a value model known as *Foundations 2025*. According to a research paper by Jackson et al. (1996:1), the *Foundations 2025* value model was the basis from

which the Air Force 2025 technology study attempted to answer the charge posed by the Air Force Chief of Staff to "generate ideas and concepts on the capabilities the United States will require to possess the dominant air and space force in the future" (Fogleman, 1994). *Foundations 2025* provided the methodology to examine "25 emerging technologies and 43 separate platforms and weapons systems…that offer the greatest potential to support future air and space operations" (Air University, 1996:21). Additionally, the Air Force Research Laboratories Air Vehicles Directorate (AFRL/VA) and the National Air Intelligence Center (NAIC) use the VFT process to help determine which technologies or programs they should commit their resources to in order to fulfill their DoD mission (Winthrop, 1999; Cox, 1997). The DOE, responsible for maintaining and safeguarding America's nuclear stockpile, also trusts the VFT process. One of their subsequent responsibilities includes the disposition of surplus, weapons-grade plutonium. Effectively they are charged with protecting a radioactive resource from proliferation and have successfully applied the VFT process to discern the most appropriate disposition alternative (Dyer, 1999).

While the VFT process has been applied to issues concerning selection of appropriate environmental alternatives, industrial R&D selection, governmental technology selection, and general resource protection, a thorough literature search has revealed no instances where the VFT process has been applied to force protection. A strong tie exists between rapidly evaluating the military worth of force protection ideas, concepts, or technologies and actual protection of the personnel serving in America's military. While ideas regarding force protection enhancement abound, constrained resources like time, money, and personnel place decision makers in a predicament of

deciding which idea, concept, or technology is most worthy of further scrutiny and subsequent incorporation in a force protection schema. This multi-objective problem is an ideal case for decision analysis and the VFT process. In an effort to demonstrate the effectiveness of using the VFT process to provide insight to decision makers regarding the selection of force protection technologies for further evaluation, the Force Protection Battlelab (FPB) is introduced as a focus case.

1.2 Specific Background

Inherent to service in the armed forces of the United States are characteristics like sacrifice, loyalty, professionalism, and stewardship. Consistent with these tenets, military members are responsible for the disposition of funds allocated to their services by the United States government. Since these funds are provided by United States citizens through taxes, military members have a responsibility to spend them sensibly. Military members must also ensure the expenditure of funds sustains and enhances America's military missions.

Within the military, some organizations are charged with exploring new technologies, investigating innovative concepts, studying new training techniques, or considering possible doctrinal changes. A problem these organizations face is determining which alternatives to pursue while addressing the responsibilities of good stewardship, warfighter support, and time and budget constraints. Ideally, there would be no time constraint, no budget limitations, no shortage of personnel; every effort would significantly increase warfighter capabilities and subsequently make the stewardship of taxpayers' dollars a mute issue. However, that is not reality. Careful consideration is

required by senior military leaders to balance the multiple objectives of their organizations while ensuring the monies they are entrusted with are appropriately spent in accomplishment of their specific mission. They must support the warfighter as efficiently and effectively as possible by building project portfolios that address legitimate needs in the field, while remaining cognizant of the limited funding environment inherent in today's Department of Defense.

A typical military organization facing these challenges is the US Air Force Force Protection Battlelab (FPB), which has a mission to "Rapidly identify and prove the worth of innovative [force protection] ideas which improve the ability of the Air Force to execute its core competencies and Joint Warfighting" (Department of the Air Force, 1997:2). Although they have myriad innovative ideas to pursue, the FPB is constrained by the number of personnel and amount of money available, along with the time allocated to prove a particular initiative's military worth.

Distilling the many innovative force protection ideas from across the Air Force into a portfolio for execution by the battlelab action officers (AOs) begins with a defensible, objective, and repeatable methodology that ranks the ideas according to their value. This methodology needs to reflect the values of the FPB. These values should encompass the FPB mission statement, as stated in Air Force Instruction (AFI) 10-1901, and should also consider the FPB's intrinsic constraints.

1.3 Research Problem

The FPB has been in existence for only four years and currently has no defensible, objective, and repeatable selection process in place. The FPB commander, as

the decision-maker (DM), requires a decision assistance methodology that adequately captures their fundamental AF mission, as well as the organization's intrinsic values and constraints. While constraints and mission are self-evident, the organizational values of the FPB are not well defined and are not readily inserted into any decision assistance methodology.

1.4 Research Objective

Although the VFT process has been used in selecting industry R&D programs (Oral 1991), evaluating municipal solid waste (MSW) management alternatives (Shoviak 2000), and adding insight for deciding on resource protection efforts (Dyer 1999), VFT has not been explicitly applied in the force protection arena. The purpose of this research effort is to demonstrate the usefulness of the VFT process in the force protection environment. The research results will facilitate the evolution of an FPB value model that will allow the conversion of subjective organizational values into an objective methodology for ranking innovative force protection ideas according to the potential benefit (i.e., value) provided to the warfighter. This methodology will lend itself to sorting through many ideas to extract those most closely aligned with the values, and subsequently the mission, of the FPB. This methodology will ultimately aid the FPB DM in selecting the final ideas they will pursue as initiatives. This research effort will result in a process that lends insight to the FPB commander regarding the value of potential initiatives, ultimately allowing FPB initiatives to be selected in a defensible, objective, and repeatable way.

1.5 Research Question

The questions this research effort will answer are: (1) Is the VFT process a viable methodology for employment in the selection of general ideas and concepts geared at protecting military forces in the field (i.e. force protection)? and (2) Based on using the FPB as a focus case, which alternatives (i.e., ideas and concepts) should they pursue to fulfill their warfighter support mission "Rapidly identify and prove the worth of innovative [force protection] ideas…" while considering their personnel, time, and monetary constraints (Department of the Air Force, 1997:2)?

1.6 Review of Chapters

Chapter 2 will consist of a literature review to provide background on the FPB and identify methods used by other organizations to construct their value models. Chapter 2 will also discuss decision analysis and its applicability to this research. Chapter 3 will demonstrate the employment of multi-objective decision analysis (MODA), specifically the value-focused thinking (VFT) process, to construct a value model that will provide insight to the DM regarding what initiatives are appropriate for further development and exploration by FPB AOs. Chapter 4 documents an analysis of the model by using it to evaluate a sample of ongoing FPB initiatives to determine its robustness, identify potential holes in the value hierarchy, and look for value gaps in the ongoing initiatives. Chapter 5 discusses the findings of the model analysis and draws conclusions on the appropriateness of the model for use within the force protection arena. Chapter 5 also highlights the impact of this research effort and makes recommendations

for future model modifications and research. Finally, the value model is presented to the FPB for future use in their initiative selection process.

Chapter 2. Literature Review

This chapter provides background information on force protection and the Force Protection Battlelab (FPB). It also explores relevant published research addressing issues pertinent to the main thrusts of this thesis: (1) determining the appropriateness of using the value-focused thinking (VFT) process in the force protection environment and (2) constructing a value model to aid the FPB decision maker in selecting innovative ideas for pursuit as force protection initiatives.

Chapter 2 describes the inception of the battlelabs, specifically highlighting the FPB. Additionally, it details past FPB initiatives and describes how they were selected for evaluation. It also examines methods used by other organizations to objectively rank order a pool of potential projects to determine whether those methods are applicable to this research. Finally, decision analysis and the VFT process are introduced to provide an understanding of the methodology used during this research effort.

2.1 Force Protection

To lay the foundation of understanding for this research effort, an all-encompassing definition of operational force protection, found in the Universal Joint Task List (UJTL), is examined. The importance of the UJTL is underscored by the fact that it is a Chairman of the Joint Chiefs of Staff Manual (CJCSM) that "provides a standardized tool for describing requirements for the planning, conducting, assessing, and evaluating joint and multinational training" (Department of Defense, 1999:i). The UJTL "provides a common language and reference system for various users to include joint

force commanders, strategic and operational planners, combat developers, combat support personnel, and trainers." It essentially establishes a "mission-to-task-to-training connectivity…[that] will assist forces in training the way they intend to fight" (Department of Defense, 1999:1-3). Consequently, the following force protection definition taken from the UJTL carries a high degree of relevance. The UJTL defines operational force protection as what is required to

> conserve the force's fighting potential so that it can be applied at the decisive time and place. [It includes] actions taken to counter the enemy's forces by making friendly forces (including operational formations, personnel, etc.), systems, and operational facilities difficult to locate, strike, and destroy. This task includes protecting joint and multinational air, space, land, sea, and special operations forces; bases; [air and sea ports] and essential personnel; and [lines of communication]…from enemy operational maneuver and concentrated enemy air, space, ground, and sea attack; chemical and biological warfare; and terrorist attack. This task also pertains to protection of operational level forces, systems, and civil infrastructure of friendly nations and groups in military operations other than war. (Department of Defense, 1999:Ch 2, 413)

The depth and breadth of this force protection definition highlights the complexity and potential difficulty associated with providing effective force protection for military personnel. While American military forces have been the targets of asymmetrical warfare tactics for many years, only recently has the Air Force established a network of organizations dedicated to minimizing the effects of such asymmetric threats through innovative ideas and concepts. The organizations are the battlelabs and the battlelab integration office. In general, they rely on innovative ideas and concepts to further the Air Force core competencies. The Force Protection Battlelab specifically addresses force protection issues using innovative ideas and concepts.

2.2 Battlelabs

Despite being the youngest service and perhaps the one most well-known for engineering and technological emphasis, the United States Air Force received congressional criticism in the mid 1990s and suffered internal dissatisfaction because of its inability to capitalize on innovation (SAB, 2000:13). To address this criticism, the Air Force Chief of Staff directed efforts in late 1996 to: 1) institute global engagement wargaming for senior Air Force leaders, 2) conduct annual exercises with emphasis on global engagement, and 3) create six "battlelabs…[where]…innovative ideas are evaluated for their military worth" (SAB, 2000:1). Combined, this three-pronged approach highlighted warfighter deficiencies (via wargaming and exercises) and provided a vehicle (i.e., the battlelabs) for innovative solutions.

The charter document for the six battlelabs is Air Force Instruction (AFI) 10-1901, dated 1 Oct 1997. Titled *Air Force Battlelab Responsibilities, Processes, and Documentation*, it describes the battlelab mission: to "rapidly identify and prove the military worth of innovative ideas which improve the ability of the Air Force to execute its core competencies and Joint Warfighting" (Department of the Air Force, 1997:2). Each battlelab subsequently had a vision of "creating an environment where innovative ideas are rapidly harvested and evaluated -- leading to the swift fielding of proven concepts" (Department of the Air Force, 1997:3). Additionally, Air Force Vision 2020, designed to guide "America's Air Force in meeting the diverse challenges of the 21st Century as a part of America's Joint Military Team," discusses innovation and battlelabs:

> We will continue exploring both science and technology and operational concepts, identifying those ideas that offer potential for evolutionary or revolutionary increases in capability. We'll test those ideas rigorously through experimentation to determine which have practical application worthy of development.
>
> We will ensure technological innovations continue to be accompanied by innovations in doctrine, organization and training. These intellectual innovations will prepare us to conduct and sustain decisive operations in major theater war and in other forms of conflict.
>
> We'll encourage innovation in our…battle labs…and across the force—recognizing that it is in the imagination of our people, that new concepts and technologies, the key to future aerospace operations, will be born. (Department of the Air Force, 2000:7)

Air Force Vision 2020, signed by both the Air Force Chief of Staff and the Secretary of the Air Force in 2000, certainly highlights the spirit of intent for the battlelabs, and it emphasizes the potential innovation has to increase aerospace capabilities.

Appropriately, the goal of the battlelabs is to "…provide the Air Force opportunities to reach investment decisions more quickly and organize, train, equip, and program, more efficiently…the results [of battlelab initiative evaluations] will guide decisions across the spectrum of mission areas and impact organization, doctrine, training, requirements, and/or acquisitions" (Department of the Air Force, 1997:2). AFI 10-1901 stipulates that once an idea is deemed an initiative, the battlelabs have 18 months to prove its military worth and potential for meeting the previously stated goal (Department of the Air Force, 1997:11). The fundamental principles which "govern" the battlelabs are listed in Table 1.

Table 1. Battlelab Fundamental Governing Principles

Operate lean	Battlelabs have no more than 25 permanent party personnel; they seek to "borrow or lease - not buy" equipment necessary to perform initiative proofs of concept
Be unique	The battlelabs are unique because "unlike research labs and warfare centers which manage systems, programs, and projects," they evaluate concepts
Focus on innovation	Battlelabs identify, plan, and lead innovation efforts while leveraging existing expertise, technology, and contracts
Use innovation to advance Air Force core competencies	Battlelabs should prove concepts that "drive revisions to doctrine, organization, training, requirements, or acquisitions"

(Department of the Air Force, 1997:2)

To pursue advancement of the Air Force core competencies listed in Air Force Doctrine Document 1 (1997:28); which are rapid global mobility, precision engagement, global attack, air and space superiority, information superiority, and agile combat support; each of the six battlelabs have a specific focus area. This area of expertise is evidenced in their names as shown in Table 2 along with each battlelab's major operating command and location. In 1998, a seventh battlelab, Air Mobility Battlelab, was added to the conglomeration as shown in the accompanying table (UASF Battlelab Wargaming and Experimentation Division, 2001).

Table 2. Battlelabs, Major Operating Commands, and Locations

Battlelab	Major Operating Command	Location
Air Expeditionary Force Battlelab	Air Combat Command	Mountain Home AFB, ID
Air Mobility Battlelab	Air Mobility Command	Ft Dix, NJ
Command and Control Battlelab	Air Combat Command	Hurlburt Field, FL
Force Protection Battlelab	Air Force Security Forces Center	Lackland AFB, TX
Information Warfare Battlelab	Air Intelligence Agency	Kelly AFB, TX
Space Battlelab	Air Force Space Command	Schriever AFB, CO
Unmanned Aerial Vehicles Battlelab	Air Combat Command	Eglin AFB, FL

2.3 Force Protection Battlelab (FPB)

While the initial motivation for establishment of battlelabs was the inability of the Air Force to capitalize on innovation, the decision to establish a battlelab focused on protecting Air Force personnel was in direct response to information the Air Force received from the Downing Report concerning the Khobar Towers bombing (Chief of Staff USAF, 1996). Retired U.S. Army General Wayne Downing was appointed by the Secretary of Defense "to head a team to examine the facts and circumstances surrounding the June 25, 1996, bomb attack" (Downing, 1996:i). According to the *Report of the Downing Assessment Task Force*, critical issues surrounding the attack on Khobar Towers in Saudi Arabia on 25 June 1996 included: explosives detection, blast and

fragmentation mitigation, force protection training, advanced situational awareness for ground forces commanders, troop early warning and notification, intel reachback capabilities, and even Department of Defense force protection standards (Downing, 1996:x-xx). Consequently, in a November 1996 message, the Air Force Chief of Staff states, "a force protection battle lab focused on exploring and integrating technology, tactics, and training to increase force protection readiness [will be established]. This lab will be manned by SP, OSI, IN, CE, EOD, SC, and other specialties as required" (Chief of Staff USAF, 1996).

With the myriad of force protection issues stretching across the boundaries of Air Force specialty codes (AFSCs), the Security Forces component cannot be solely responsible for protecting Air Force personnel. Understanding this, the Force Protection Battlelab (FPB) includes officers and senior noncommissioned officers (SNCOs) from every applicable AFSC. The very nature of force protection necessitates a large number of security forces (SF) personnel within the FPB organizational structure; however, other AFSCs represented include civil engineer (CE), explosive ordnance disposal (EOD), readiness (DP), office of special investigations (OSI), intelligence (IN), communications (SC), flight medicine, microbiology, and operations research.

2.4 Battlelab Initiatives

Taken directly from AFI 10-1901, the term "battlelab initiative" is defined as "an innovative or revolutionary operations or logistic concept capable of improving the Air Force's capability to execute it's core competencies and will drive changes to organization, doctrine, training, requirements, or acquisitions" (Department of the Air

Force, 1997:7). According to the AFI, there are two types of initiatives. First is the Kenney Battlelab Initiative (KBI), named after General George C. Kenney for his "skip bombing" innovation during World War II. The KBIs are innovative in nature, straightforward, fundable within an existing budget, and pursued by a single battlelab. Second is the Mitchell Battlelab Initiative (MBI), named after General Billy Mitchell for his revolutionary, strategic application of airpower in the attack on Tokyo, Japan. The MBIs are "revolutionary in nature," they are more complex than KBIs, and typically extend beyond a single battlelab's focus area or expertise (Department of the Air Force, 1997:2-3).

2.4.1 Force Protection Battlelab Initiatives

This author understands FPB personnel do not term an innovative force protection idea an "initiative" until it is selected and assigned to an action officer (AO) for an execution that culminates with a proof of its military worth (i.e., a proof of concept). However, for clarification throughout this thesis, the term "potential initiative" or "potential force protection initiative" is used to refer to that initial force protection idea.

The first "round" of initiatives undertaken by the FPB were "urgent and compelling" in the light of the Khobar Towers terrorist bombing; they were inherited with the establishment of the FPB and sought to address the terrorist bombing issues. Subsequently, they required no selection process (SAB, 2000:Appendix E, 33). These initiatives focused on:

1. Explosives detection at Air Force installation entry control points,
2. Blast and fragmentation mitigation and protection from vehicle bombs,

3. Establishment of real-time, reliable ground intelligence for deployed forces,

4. Rapid and reliable, wide-area mass notification systems,

5. Food and water anti-terrorism measures,

6. Sub-tactical unmanned aerial vehicles (UAV) to extend a ground defense force commander's sight picture, and

7. Software tools to assist deployed commanders in allocating force protection resources.

During the process of evaluating existing technology to prove the worth of the first "round" of initiatives, the FPB received potential force protection initiatives from the field as well as ones formulated internally by the action officers (AOs). Approximately 18 months after the FPB was established, the first initiatives were nearing completion and FPB personnel struggled for a method to objectively rank further potential force protection initiatives to determine which ones were most worthy of an AO's time and effort.

2.4.2 Current Force Protection Battlelab Initiative Selection Procedure

In an attempt to make the selection process for the second "round" of initiatives more objective and decrease the time and effort required for that process, the FPB constructed a Microsoft Access database of potential initiatives for review and comment by all FPB AOs. The intent of the process was for each AO to complete a series of questions concerning each potential initiative submitted within their area of expertise. For example, the EOD AO would review and provide comments on ideas relating to explosives detection. A panel of AOs would then review and comment on the recommendations, with the results being forwarded to the deputy commander for review

and consideration. The AOs were guided in their evaluation of the ideas by the series of questions, derived from fellow AOs and approved by the FPB deputy commander, shown in Table 3 (Cropsey, 2001). Each AO recommended to either "pursue" or "not pursue" the potential initiative. The final selection was based on the subjective arguments of the individual AOs for their respective ideas.

Table 3. Initial FPB Initiative Selection Questions

1	What is the underlying concern or problem described in the initiative submission?
2	What concept is at the heart of the issue described in the initiative submission?
3	Has this concept, or one similar to it, already been submitted by another individual or agency? If so, what course of action was pursued with the previous submission?
4	Does the concept fall within one of the functional areas (i.e., AFSCs) represented at the Battlelab?
5	Is the concept related to force protection?
6	Are any other organizations already working this issue? Are there other organizations who should be working this issue?
7	Can the concept be evaluated in 18 months or less?
8	Can you provide a rough idea of how this concept's military worth might be determined, either from the submitter's remarks, or from analyzing the issue yourself? Please describe the general outline of how this might be accomplished.
9	How would you characterize the risk associated with this concept? Low, Medium, High?
10	What is your general feeling for the number of unknowns that would have to be addressed if this concept were to be executed?
11	Can you provide a rough estimate of the cost associated with attempting to evaluate this concept?
12	How much additional research would be required to adequately answer any of the above questions that remain questionable or unanswerable?

While worthwhile initiatives were derived from the second "round," the comparative value between them could not be measured, nor could their anticipated contribution to the Air Force or joint warfighter mission be evaluated, as no value hierarchy existed during the selection process. In the selection of initiatives, FPB personnel have two other factors to consider: special requests and potential initiatives generated internally. An added challenge to the initiative selection procedure is the diverse, sporadic special requests the FPB receives from general officers, major commands, the Air Force Security Forces Center, and even exercise and operational commanders. These requests range from providing training on explosives detection equipment to modeling ground forces engagements. Each request, while stemming from a legitimate, urgent and compelling need, consumes a significant portion of an AO's time and usually requires substantial effort. Additionally, while working an initiative or special request, a common phenomenon is the generation of supplementary and associated force protection initiatives.

Since initiative proofs of concept often generate spin-off, potential force protection initiatives, it is helpful to understand the proof of concept process. Proving an initiative has military worth is referred to as a "proof of concept." A proof of concept begins with an AO requesting approval from the battlelab planning cell (BPC), which is comprised of all the battlelab commanders. Upon subsequent approval, an appropriate course of action is implemented to test the concept. Finally, the AO documents the results and presents them to the BPC, the initiative requestor / submitter, the Air Force Requirements Oversight Council (AFROC), or any combination of these and other interested agencies and personnel.

The aforementioned spin-off initiative concepts are frequently capable of directly enhancing Air Force force protection. Consequently, some spin-off initiatives are pursued spontaneously. While worthy, these initiatives also add to the confusion of building a force protection concept portfolio from which the FPB can allocate its resources and defend its initiative selection decisions.

2.5 Selection Methods of Other Federal Organizations

The FPB is not the only group faced with the task of building a portfolio of "projects" (e.g., initiatives) with the aim of ultimately providing the greatest value for the money it spends. This literature review uncovered articles and theses that used the value focused thinking (VFT) process to assist different organizations. The VFT process helped them in determining their values, constructing value hierarchies, assigning importance to the different tiers of those hierarchies, and ultimately rank ordering the objects of concern (e.g., potential force protection initiatives). For example, the VFT process was used for the Air Force Space Battlelab, the National Air Intelligence Center, Air Force Research Labs, and the Department of Energy.

The justification for not applying an existing value hierarchy to the FPB's situation is simple; no two value hierarchies are alike. While previous, analogous applications of the VFT process support its use for this thesis effort, the fundamental difference between the resulting value models is the realization that once the values of an organization change, their model changes and must be reconstructed to reflect the new values. It is impossible for different organizations (i.e., ones with differing mission and vision statements) to have identical organizational values. A brief synopsis of the most

closely aligned previous research efforts will show the VFT process is applicable in the FPB's situation. However, the specific value model used by those other organizations is not.

2.5.1 Selecting Alternatives for the Air Force Space Battlelab

One of the original six battlelabs, the Space Battlelab (SB) has the mission to "Identify innovative space operations and logistics concepts and rapidly measure their potential for advancing the Air Force core competencies and joint warfighting using field ingenuity, modeling and simulation, and actual employment of exploratory capabilities in operational environments" (Space Battlelab, 2000). With the help of a consultant, the SB constructed a value model addressing their overarching objective of "Transforming space concepts into AeroSpace solutions for today's warfighting" (Space Battlelab, 1998; Cassady, 2001).

The SB derived their first-tier objectives directly from a previous value hierarchy called *Foundations 2025*, which was a VFT approach to evaluating "concepts [offering] the greatest potential to provide future air and space dominance" (Parnell, 1998:1336). The concepts for evaluation stemmed from a study, *Air Force 2025*, conducted to "identify key system concepts and technologies for achieving air and space dominance in the year 2025" (Parnell, 1998:1336). *Foundations 2025* provided a relevant value hierarchy strawman for the SB. While the SB hierarchy is not an exact reflection of *Foundations 2025*, it does mirror some of the same objectives. The specific mission of the SB required the massaging of *Foundations 2025* to incorporate the "needs identified

by [theater commander in chiefs] (CINCs) at the Space Support to the Warfighter Conference, 17 - 19 Nov 98" (Space Battlelab, 1998:1).

2.5.2 Selecting Alternatives at the National Air Intelligence Center (NAIC)

The mission of the National Air Intelligence Center (NAIC) is production of "foreign aerospace intelligence [through] analyzing all available data on foreign aerospace forces and weapons systems to determine performance characteristics, capabilities, vulnerabilities, and intentions" (AIA/PA, 2001). Resource allocation difficulties faced by the commander of NAIC were examined by Cox (1997). The previous process used at NAIC was subjective and time consuming. The primary guides for evaluation of an alternative were the percentage of required NAIC resources, a consensus opinion from a "Senior Management Team," and the commander's value system. However, the commander had no "tools to help quantify the value of the different choices he [faced]" (Cox, 1997:2).

Using the VFT process, Cox (1997) developed a value model for NAIC that reflected the commander's primary objectives (i.e., values). The preliminary value hierarchy was drawn from "NAIC's Mission and Organizational Pamphlet, and NAIC's Master Plan" (Cox, 1997:19). The final value hierarchy illustrated that "Customer Support," "Future Requirements," and "Unit Performance" were the values most important to the NAIC commander. The final NAIC value hierarchy consisted of four levels of objectives and sub-objectives (i.e., values), while the fifth level comprised the means of assessing attainment of the objectives stated in previous levels (i.e., the measures). The definitions of the values and measures were derived using existing

documentation (e.g., "NAIC's Master Plan") and personal interviews with the NAIC commander.

2.5.3 Selecting Alternatives for the Air Force Research Lab

The primary mission of the Air Force Research Laboratory Air Vehicles Directorate (AFRL/VA) "is to support the USAF warfighter with dominant technology…developing improvements that provide the warfighter an advantage on the battlefield…[while being] technologically superior to any adversary the United States might face today or in the future" (Winthrop, 1999:110-111). Identification of research and development opportunities involving future technologies at AFRL/VA was investigated by Winthrop (1999). His primary objective was to "develop a method to analyze future technology selections for the Air Vehicles Directorate [resulting in selections that would be] most consistent with Air Force values" (Winthrop, 1999:3). Winthrop's (1999:110) research indicated that value-focused thinking was best suited for the AFRL/VA primarily "due to its theoretically sound foundations and because of its unique ability to allow 'out of the box' thinking."

The AFRL/VA final value hierarchy illustrated that "Supporting the Warfighter" was the fundamental objective. The first-tier values of "Reach," "Awareness," "Power," and "Technological Superiority" indicated the value of the Air Vehicles Directorate to the Air Force (Winthrop, 1999:46-49). Each of the objectives and sub-objectives in Winthrop's (1999) value model were derived from existing documentation (e.g., *Air Force 2025*, *JV 2010*, *Global Engagement*, *New World Vistas*) and personal interviews with key personnel within AFRL/VA.

2.5.4 Selecting Alternatives for the Department of Energy

The Department of Energy (DOE) is responsible for all aspects of the U.S. nuclear stockpile. One charge they delegate to their Office of Fissile Materials Disposition (OFMD) is that of "selecting and developing technologies for the disposition" of surplus weapons-grade plutonium. The goal of the disposition is to prevent the proliferation and subsequent use of weapons-grade nuclear material by transforming the plutonium "into forms that are more difficult to use in weapons" (Dyer, 1998:749).

In 1995, the OFMD requested an independent evaluation of their selected disposition alternatives. The decision analysis technique used by the independent team to analyze the alternatives was multiattribute utility theory (MAUT), coupled with the VFT process. This technique was used because of its successful application to similar complex problems involving many alternatives, multiple objectives, and multiple stakeholders. A few of these problems were "siting an electricity generation facility…and selecting a nuclear waste clean-up strategy." Additionally, MAUT "has been supported for use in similar situations by the National Research Council, an agency of the National Academy of Sciences" (Dyer, 1998:750).

Numerous meetings with DOE and OFMD facilitated the construction of a "hierarchy of objectives [which] helped organize the collected information" as the team subsequently "evaluated 13 [disposition alternatives]… and quantified the potential benefit of the simultaneous deployment of several technologies" (Dyer, 1998:750). The final value hierarchy had five levels with the fundamental objective being "Plutonium Disposition." The values of "Non-proliferation," "Operational Effectiveness," and

"Environment, Safety, and Health" comprised the first tier and indicated their importance to the OFMD and DOE. Each of the values and measures in the model were derived from a preliminary set of measures proposed by Lawrence Livermore National Laboratory (Edmunds, Koopman, and Myers, 1995) and previously published material that examined technology selection for plutonium disposition (e.g., Keeney, Lathrop, and Sicherman, 1986; Keeney and von Winterfeldt, 1994; Merkhofer and Keeney, 1987). The model also benefited from multiple personal interviews with key specialist personnel (e.g., Safeguards and Security personnel from Sandia National Labs) (Dyer, 1999:7).

2.6 Decision Analysis

The Force Protection Battlelab (FPB) must determine which concepts and ideas should comprise a portfolio of force protection initiatives. FPB personnel must do so while considering the unique overarching mission of the battlelabs: 1) "Rapidly identify and prove the worth of innovative [force protection] ideas…" and 2) "…improve the ability of the Air Force to execute its core competencies and Joint Warfighting" (Department of the Air Force, 1997:2). They are required to build their portfolio of initiatives consistent with manpower, time, and budget constraints; the ideas must also be non-duplicative and force protection related. Additionally, the selected ideas must ultimately further the core competencies of the Air Force and, if possible, exhibit joint service force protection application.

Clearly, the FPB is faced with multiple objectives and multiple alternatives (i.e., the innovative force protection ideas), making their situation ideal for multiple objective decision analysis. Therefore, subsequent sections of the literature review highlight

decision analysis and the VFT process as a means of achieving a portfolio selection model that echoes the values of the FPB commander and his organization. If the decisions were easy, a process would not be required to assist one in making them. If the consequences of the decisions (i.e., the ideas selected for the portfolio) were irrelevant or the same, "then the decision problem doesn't warrant much analysis" (Kirkwood, 1997:2).

2.7 Value Focused Thinking

Keeney (1992:3) affirms that "Values are what we care about…[they] should be the driving force for our decision making…[and] the basis for the time and effort we spend thinking about decisions." Before expounding on value-focused thinking (VFT), some of the more commonly used words and phrases are defined in Table 4. The definitions are arranged according to the order in which they are considered in the VFT process. Additional value-focused thinking terminology will be further explained as it is used in the remainder of this thesis.

Table 4. Value-Focused Thinking Terminology and Phrases

Fundamental Objective	"…an essential reason for interest in the decision situation" (Keeney, 1992:34). Also known as the "ends objective," it is the top block in the value hierarchy.
Value	What is important to the decision maker (Clemen, 1996:19). The values are the decomposition of the fundamental objective. They are the building blocks of the value hierarchy.
Value Hierarchy	A pictorial representation of a value structure (consisting of the fundamental objective, the values, and the measures) (Kirkwood, 1997:12).
Local Weight	The amount of weight a set of lower-tier values or measures contributes to the value directly above it in the hierarchy (Shoviak, 2001:57).
Global Weight	The amount of weight each lower-tier value or measure contributes to the weight of the hierarchy's fundamental objective (Shoviak, 2001:57).
Measure	Analogous to the term "metric," it notes the "degree of attainment" of a value (Kirkwood, 1997:12).
Score	A "specific numerical rating for a particular alternative with respect to a specified measure" (Kirkwood, 1997:12).
Single dimensional value function (SDVF)	A specific, monotonically increasing or decreasing function for each measure used to convert an alternative's "score" on the x-axis to a "value" on the y-axis.
Alternative	"…the means to achieve the… values" (Keeney, 1992:3).

There are two primary methods of thinking about decisions: alternative-focused thinking and value-focused thinking. The difference between the two is simple. Alternative-focused thinking (AFT) considers the available alternatives and subsequently compares them to each other, while value-focused thinking (VFT) compares alternatives to organizational values. Value-focused thinking implies that one determines what is important and subsequently "figures out how to get it" (Keeney, 1992:3-6). While making decisions based only on available alternatives gets the job done, it constrains the ability of an individual or organization to achieve their true values. Keeney (1992:3) summarizes the fundamental difference between alternatives and values this way: "It is values that are fundamentally important in any decision situation. Alternatives are relevant only because they are the means to achieve your values." He goes on to indicate that consequences are the result of decisions, and the "desirability of consequences is a concept based on values."

In the case of the FPB, alternatives exist in the form of internally or externally generated innovative force protection ideas. Recall that one of the questions posed in this thesis asks which alternatives (i.e., ideas and concepts) the FPB should pursue to fulfill their warfighter support mission while considering their personnel, time, and monetary constraints. An important dimension of this question is "What if there are no alternatives that adequately address the values in the hierarchy?" If the FPB relied on AFT, they might literally evaluate the value of inadequate or inappropriate force protection ideas. However, through VFT they have the power to modify the given alternatives to yield new, creative alternatives that address their stated values. Therefore, the VFT process is

ideal for this thesis effort since it can add tremendous benefit to the FPB initiative selection procedure.

Value-focused thinking allows for defendable initiative selections. The fundamental objective, and select values comprising it, may be taken directly from existing policy documents (e.g., Air Force Instructions). Using existing policy documents is known as the "gold standard" and yields the most defendable final decisions. Application of the VFT process highlights the value of each initiative to the Air Force.

2.8 Steps to Building a Decision Analysis Framework

The VFT process is an important tool having four primary uses. First, it assists organizations in collecting appropriate information. That is, it highlights what is important, thereby allowing an organization to focus on collecting relevant data vice information with which the decision maker is not concerned. Second, when there are no preexisting alternatives, the VFT process facilitates focused brainstorming that leads to the development of alternatives which address values important to a decision. Third, the VFT process promotes clear communication. It demonstrates to stakeholders what the decision makers consider important. In so doing, it facilitates the objective defense of specific alternative selections. Finally, the VFT process provides the model for evaluating, and subsequently ranking, the alternatives with respect to the value added to an organization (or individual) (Kirkwood, 1997:22-23).

The construction of a decision analysis framework, based on the VFT process, fits into 10 steps compiled by Shoviak (2001:63). To expound on these 10 steps and clearly

relate them to the objective of this thesis, which is to "demonstrate the use of the VFT process in the force protection environment," the assumption is made that every step is specifically directed toward the FPB focus case and a senior decision maker. A flow chart depicting the sequential order of the 10-Step process is shown in Figure 1. The 10-Step process annotating the dates each step was accomplished for this thesis is shown in Appendix A.

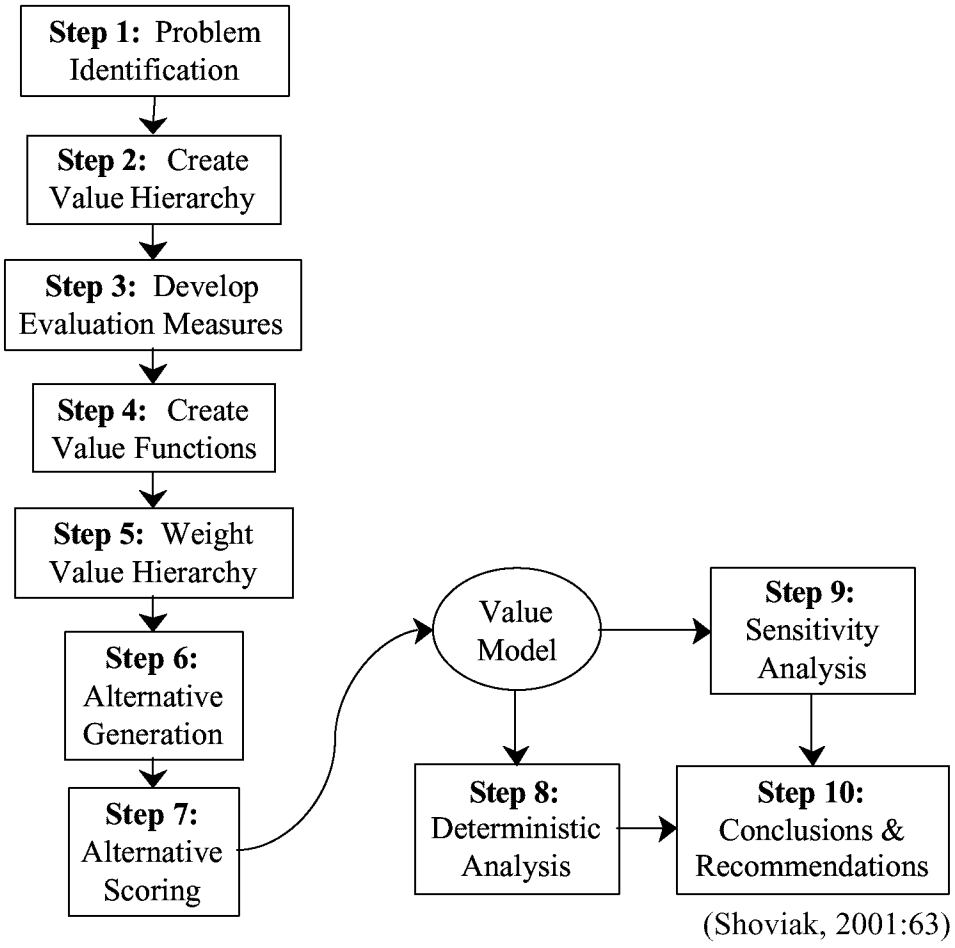

Figure 1. VFT 10-Step Process Flow Chart

2.8.1 Step 1 - Problem Identification

Always obvious in hindsight, yet often overlooked, is the proper identification of the reason a decision must be made in the first place. In other words, what problem is the decision maker addressing? If the problem is incorrectly identified, the resulting solution will have no value and ultimately be considered wasted effort.

2.8.2 Step 2 - Construct the Value Hierarchy

The value hierarchy serves the decision maker (and organization) as a model for evaluating alternatives. It structures the organizational values, beginning with the overarching value (e.g., the organization's reason for existing) and ending with the measures used during the evaluation process. Additionally, placing values in a hierarchy aids an organization in identifying whether any values are missing and, in doing so, specifies the type of value needed (Keeney, 1992:69). Since the value hierarchy will be used by the organization to make decisions, it must be defendable. In other words, the hierarchy cannot be interpreted as a compilation of meaningless values when scrutinized by organizational leadership, particularly if the leadership has previously documented the fundamental objective (i.e., mission) of the organization.

2.8.2.1 Desirable Properties of Value Hierarchies

"Completeness, nonredundancy, decomposability, operability, and small size" are five properties of value hierarchies recognized by Kirkwood (1997:16-19). Completeness speaks to the "collectively exhaustive" nature of each tier of a value hierarchy. In other words, all values in a single tier must include everything important to

the "evaluation of the overall objective" (Kirkwood, 1997:16). Additionally, the evaluation measures must "adequately measure the degree of attainment of their associated objectives" (Kirkwood, 1997:16). Completeness assures the alternatives are adequately evaluated and ranked accordingly.

The principle of nonredundancy implies that the values of a single tier are considered "mutually exclusive." That is, no relation can be drawn between the measure associated with a specific value and other values on the hierarchy. Nonredundancy is necessary to avoid "double counting," the phenomena of a particular alternative receiving "more weight than was [originally] intended" (Kirkwood, 1997:17).

Decomposability is commonly referred to as "independence." It means the score an alternative receives for one evaluation measure should not influence its score in another measure. An example taken from Kirkwood illustrates this concept. Assume a value of "economic issues" with lower-tier values of "salary," "pension benefits," and "medical coverage." Note that for any one of these lower-tier values, the "value attached to variations in the score… depends on the levels of the other two lower-tier values." That is, if the "salary" were $500,000 a year, there would be no value to slight increases in "pension benefits" and "medical coverage." Thus, the values are not independent (Kirkwood, 1997:17-18).

Operability is simply defined as the understandability a value hierarchy exhibits to the individual or organization that must use it. Since the value hierarchy facilitates communication and has potential to be used in defense of the selection of specific alternatives, it should be constructed as much as practical with the nonspecialist in mind (Kirkwood, 1997:18). In other words, when values and their associated measures address

sophisticated technical areas familiar only to specialists, a compromise needs to be reached that allows the nonspecialist to speak as intelligently about the hierarchy as the specialist.

Finally, a small value hierarchy is more easily communicated and "requires fewer resources" to score the alternatives with respect to the evaluation measures (Kirkwood, 1997:18). A gauge to determine whether a value should be a part of a value hierarchy is known as the "test of importance." This test indicates, with respect to the final ranking of alternatives, that a value should be included in the value hierarchy if it could lead to a difference in the top ranked alternative (Kirkwood, 1997:18-19).

2.8.2.2 Generation of Values

Keeney (1992:56) notes, "The most obvious way to identify [values] is to engage in a discussion of the decision situation." This emphasizes that there is a high degree of interaction required to establish an individual's or group's values. To aid in the interaction, Keeney (1994:34-35) developed a list of "techniques for identifying" values and accompanying questions that "may be asked to aid the decision-maker during the process" (Shoviak, 2001:48). These are shown in Table 5. Keeney (1994:34) admits that if one uses each technique in discerning values, a certain amount of redundancy will be generated. However, he notes "redundancy is not a shortcoming in this endeavor. It is much easier to recognize redundant [values] when they are explicitly listed than it is to identify missing [values]."

Table 5. Techniques for Identifying Values

Technique	Questions
Develop a wish list	What do you want? What do you value? What should you want?
Identify alternatives	What is a perfect alternative, a terrible alternative, some reasonable alternative? What is good or bad about each?
Consider problems and shortcomings	What is wrong or right with your organization? What needs fixing?
Predict consequences	What has occurred that was good or bad? What might occur that you care about?
Identify goals, constraints, and guidelines	What are your aspirations? What limitations are placed on you?
Consider different perspectives	What would your competitor or constituency be concerned about? At some time in the future what would concern you?
Determine strategic [values]	What are your ultimate [values]? What are your values that are absolutely fundamental?
Determine generic [values]	What [values] do you have for your customers, your employees, your shareholders, yourself? What environmental, social, economic, or health and safety objectives are important?

(Keeney, 1994:34-35; Shoviak, 2001:48)

According to Chambal (2001), there are different degrees of interaction for the different listed in Table 5. If the values are simply arrived at through interviews and discussions with the individual or group, the term "silver standard" is used to describe

that degree of interaction. However, if interviews and discussions with the individual or group indicate values that precisely coincide with documented principles (e.g., Air Force Instructions), the term "gold standard" is used to describe that degree of interaction. Using the "gold standard" degree of interaction, or simply the "gold standard," to construct a value hierarchy therefore leads to policy-based decisions, which leads to improved defensibility of the final decision.

2.8.2.3 Structuring the Values

The value hierarchy is so named because the values are structured in hierarchical fashion. At the top is the overarching, fundamental objective of the organization. Immediately below the fundamental objective are the first-tier of values. Each value equidistant from the top of the hierarchy constitutes a tier. The second-tier is comprised of values that better define (or decompose) those values in the tier above. As the tier structure of a value hierarchy continues, the lower-tier values describe the important attributes of those values higher in the hierarchy. To facilitate a better understanding of the value hierarchy, consider the following simplified example in Figure 2. First, note that Figure 2 is not displayed in traditional horizontal hierarchical fashion. It is displayed in vertical fashion to facilitate fitting it readably on one page. The fundamental objective, displayed at the top of a horizontal hierarchy, is displayed to the far left in this vertical hierarchy. The first-tier values, displayed immediately under the fundamental objective in a horizontal hierarchy, are displayed immediately to the right of the fundamental objective in this vertical hierarchy. That pattern is repeated through the vertical hierarchy until the measures are finally reached. In a horizontal hierarchy, the bottom-tier is

comprised of the measures. The vertical hierarchy displays the measures to the far right. This thesis takes advantage of both the horizontal and vertical hierarchy display conventions to maximize readability and understandability for the reader.

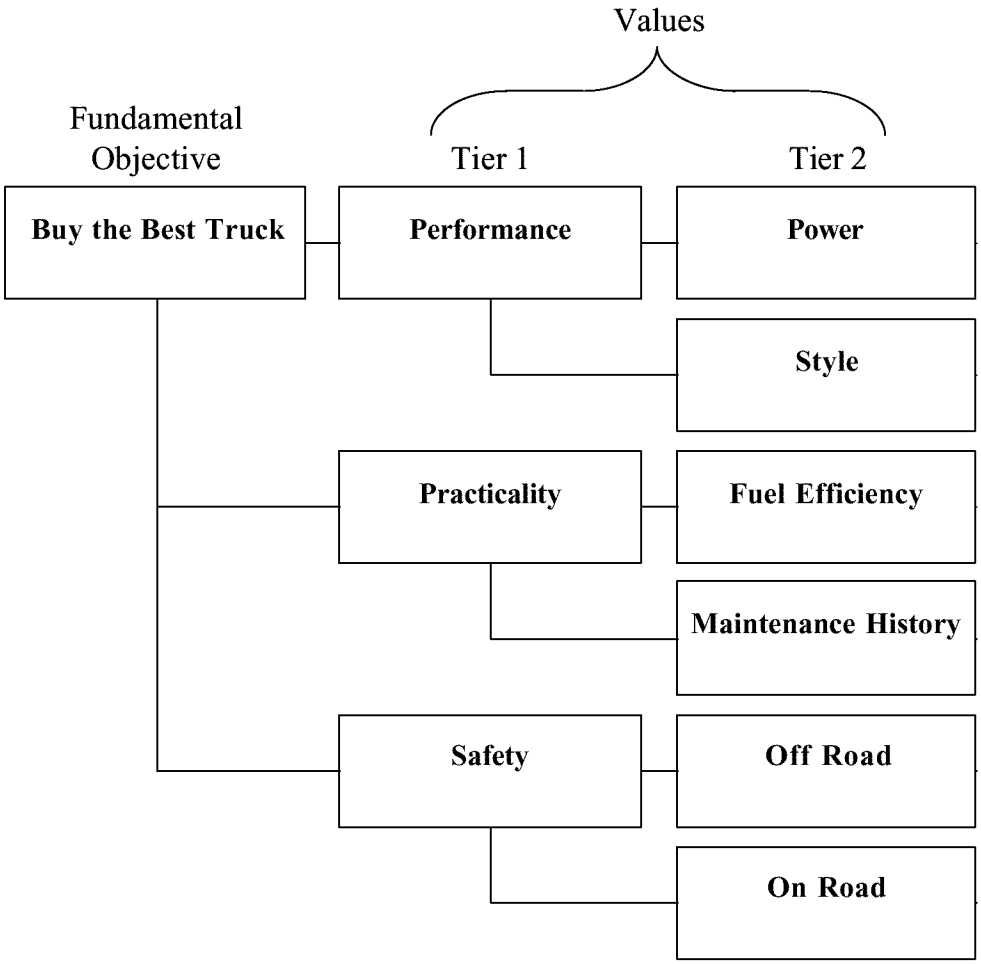

Figure 2. *Buy the Best Truck* Value Hierarchy

In Figure 2, the fundamental objective of this hierarchy is to *Buy the Best Truck*. The first tier values are *performance*, *practicality*, and *safety*. The second tier contains values that more specifically define the values in the first tier.

2.8.3 Step 3 - Develop Evaluation Measures

Recall that evaluation measures specify the "…degree of attainment of objectives. Evaluation measures allow an unambiguous rating of how well an alternative does with respect to each [value]" (Kirkwood, 1997:24). When a value cannot be further refined into values that are more specific, a determination of "what measure adequately captures that value?" must be made. It may require more than one measure to completely address a specific value. For instance, in Figure 3, notice that the second-tier value of *Off-Road* has two measures (i.e., *Four-wheel Drive* and *Frame Clearance*) that are used to capture its meaning for the decision maker. Through the example hierarchy, it is clearly shown that the last-tier, of any particular branch, contains the measures.

It may be difficult to determine how many evaluation measures are needed and how specific they should be. Kirkwood (1997:26) addresses this issue by stating, "Using several evaluation measure scales could give a misleading indication of the relative importance [of the particular value being measured]." In the same vein, he notes that "subdividing [a particular value into multiple measures] could require more effort than is warranted to obtain scores for the lower-tier evaluation measure scales…the resulting scores could give an unwarranted indication of accuracy." The final concept to understand about evaluation measures is that they have scales that are either natural or

constructed and either direct or proxy. The following examples will refer to the *Buy the Best Truck* value hierarchy depicted in Figure 3.

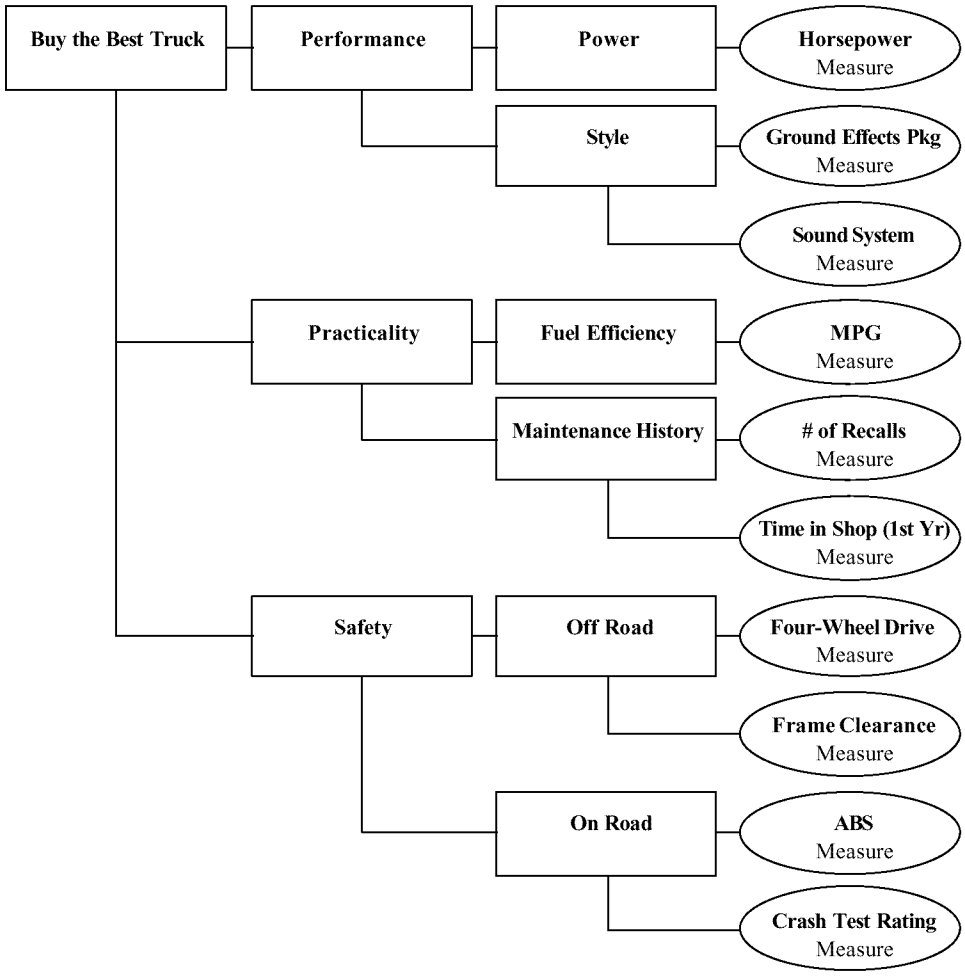

Figure 3. *Buy the Best Truck* Value Hierarchy, with Measures

2.8.3.1 Natural or Constructed Measure Scales

An evaluation measure may have either a natural scale or a constructed scale. A natural scale "has a common interpretation to everyone" and is thus "less controversial" (Keeney, 1992:101; Kirkwood, 1997:25). For example, *inches* would be a natural measure scale for the evaluation measure, *Frame Clearance*. Thus, a natural scale could be relevant for many decision contexts. A constructed scale on the other hand is "developed specifically for a given decision context" (Keeney, 1992:102). An example of a constructed scale is one that is categorical, consisting of the categories *full-time*, *on-demand*, or *none* for the evaluation measure, *Four-Wheel Drive.*

2.8.3.2 Direct or Proxy Measure Scales

To coincide with the evaluation measure scale being either natural or constructed, the scale will also be either direct or proxy. A direct scale "directly measures the degree of attainment of an objective" (Kirkwood, 1997:24). An example of a direct scale is *miles per gallon* for the evaluation measure, *MPG*. On the other hand, a proxy scale "…reflects the degree of attainment of its associated objective, but does not directly measure [it]" (Kirkwood, 1997:24). An example of a proxy scale is *the number of stars* for the evaluation measure, *Crash Test Rating*.

2.8.3.3 Desirable Properties of Evaluation Measures

Keeney (1992:112) identifies three desirable properties of evaluation measures: "measurability," "operationality," and "understandability." Measurability "defines the associated [value] in more detail than that provided by the [value] alone" (Keeney,

1992:113). In other words, the evaluation measure must clearly and appropriately quantify what the decision-maker (DM) is interested in and nothing more. Operationality implies that a measure needs to specify consequences with respect to its specific value and "provide a sound basis for value judgments" regarding the "desirability of the various degrees to which [that value] might be achieved." Features of operationality include definitive locations, methods, and measurement frequencies (Keeney, 1992:114). Understandability implies there is "no loss of information when one person assigns [a measure] level to describe a consequence and another person interprets that [measure] level" (Keeney, 1992:116).

A concept integrated with each desirable property is that of being "unambiguous." That is, every measure should have precise "levels of achievement" (Keeney, 1992:112). For example, 18 inches is unambiguous for the measure *Frame Clearance*. To further illustrate these properties, consider the example shown in Figure 4, as adopted from Keeney (1992:116). Measure 1 is unambiguous and a score of 25 fits specifically on the scale. Therefore, a score plotted on the x-axis cannot be misinterpreted. However, Measure 2 is vague and ambiguous. In other words, what is specifically meant by "low" or "moderate?" A definition of "low" for one individual can be very different for another. If Measure 2 were used, it would be necessary to quantify the levels. For example, "none" might mean 0 to 4, "minimal" might mean 5 to 15, and so on.

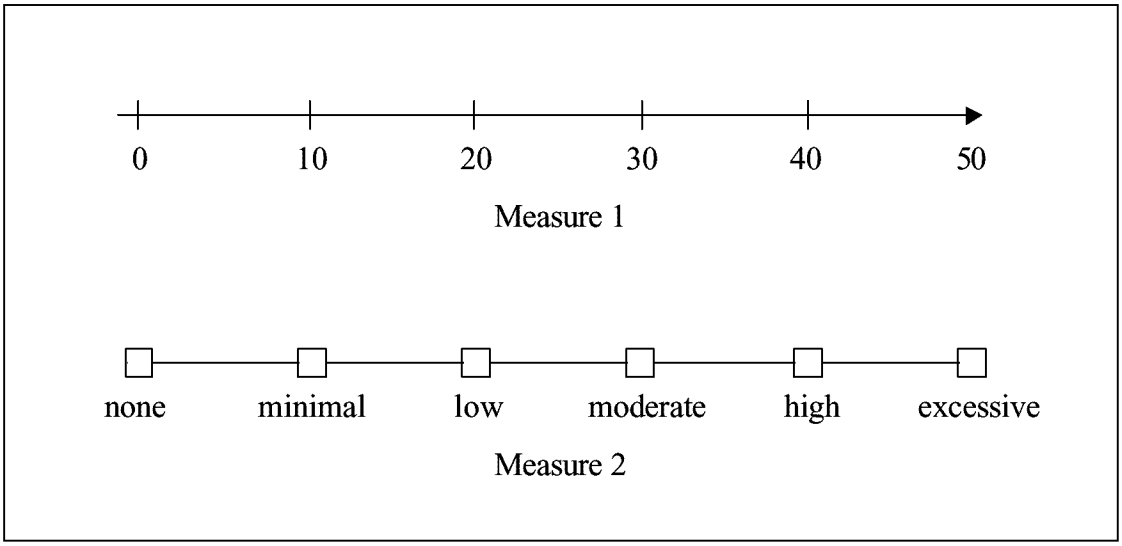

Figure 4. Measurement Scales

Additionally, careful selection of measures is required to ensure all potential alternatives have a related attribute that is measurable and reasonably available to the researcher. For example, assume one of the truck brands being considered in the *Buy the Best Truck* example did not track the average time each of their trucks spent in the shop for maintenance problems during the first year of ownership. Then the measure *Time in Shop (1st Year)* is inadequate, as it does not have a related score available for each alternative.

2.8.4 Step 4 - Create Value Functions

Each evaluation measure discussed in Step 3 has specific units. To properly analyze alternatives, the individual evaluation measure scores must be converted to a

common score having units of "value" between 0 and 1. Using this convention, "the least preferred score being considered for a particular evaluation measure will have a single dimensional value of zero, and the most preferred score will have a single dimensional value of one" (Kirkwood, 1997:61). While the least preferred and most preferred scores could be fixed with any set of numbers, e.g., 0 and 10 or 0 and 100, the 0 and 1 scale is the accepted standard in decision analysis practice. Fixing the worst score at 0 and the best score at 1 forces separation between the final value scores for each alternative (Chambal, 2001). In other words, an alternative having the least preferred scores for each measure will have an overall value ranking of 0, and an alternative having the most preferred score for each measure will have an overall value ranking of 1 (Kirkwood, 1997:61).

Converting the scores to units of value is accomplished through single-dimensional value functions (SDVFs). The SDVFs allow the analyst to determine the "common value" for alternatives not scoring at either extreme and are the functions that ultimately remove subjectivity from the value model. The analyst develops SDVFs by soliciting the DM's experience and judgment.

2.8.4.1 Value Function Type

While there are numerous types of SDVFs the two primary types are piecewise linear (PL) and exponential (E). Kirkwood (1997:61) notes that "…a piecewise linear single-dimensional value function [is usually used when the measure] has a small number of possible different scoring levels." However, he also notes that either SDVF form (i.e., PL or E) may be used for an evaluation measure with a "difference [that] is often not of

practical significance." A discrete SDVF is used when the data available for the alternatives is non-specific. Samples are shown in Figure 5 and Figure 6.

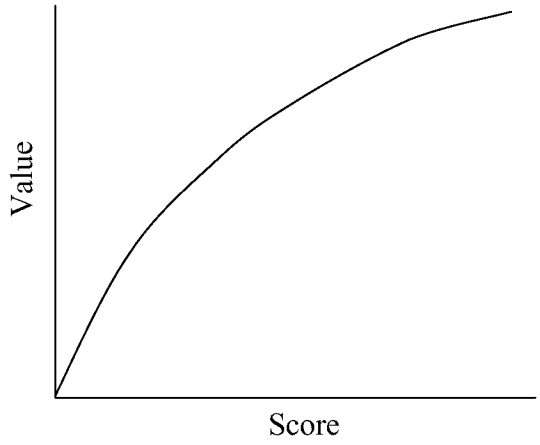

Figure 5. Monotonically Increasing Exponential SDVF

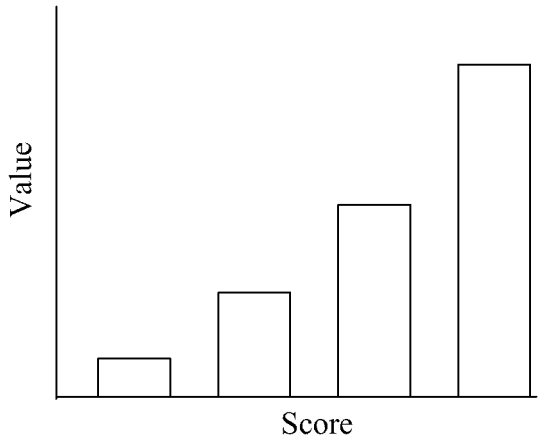

Figure 6. Monotonically Increasing Discrete SDVF

2.8.4.2 Value Function Monotonicity

Typically, within a particular value model, SDVFs are preferred to be either all monotonically increasing or all monotonically decreasing to establish consistency (Chambal 2001). For example, a monotonically increasing SDVF means that the "score" along the x-axis increases as the "value" along the y-axis also increases. Subsequently, a value model having SDVFs that are all monotonically increasing aids those responsible for scoring the alternatives because they will know that "more is always better." It is opposite for a monotonically decreasing SDVF. That is, the "score" along the x-axis

increases as the "value" along the y-axis decreases. In order to simplify comprehension of the SDVFs used in this thesis, they will all be monotonically increasing.

2.8.5 Step 5 - Weight the Value Hierarchy

A useful value model requires the DM to indicate the degree of importance for every value and measure, comprising each branch and tier of the hierarchy, by assigning them local weights. An important property of the hierarchy is that the local weights for each branch and each tier, taken separately, must sum to 1.0. Consider the first-tier values of *Performance*, *Practicality*, and *Safety* in Figure 7. Their local weights sum to one. The second-tier values comprising *Safety* (i.e., *Off-Road* and *On-Road*) also sum to one. In addition, the measures for the second-tier value *Off-Road*, (i.e., *Four-Wheel Drive* and *Frame Clearance*) sum to one.

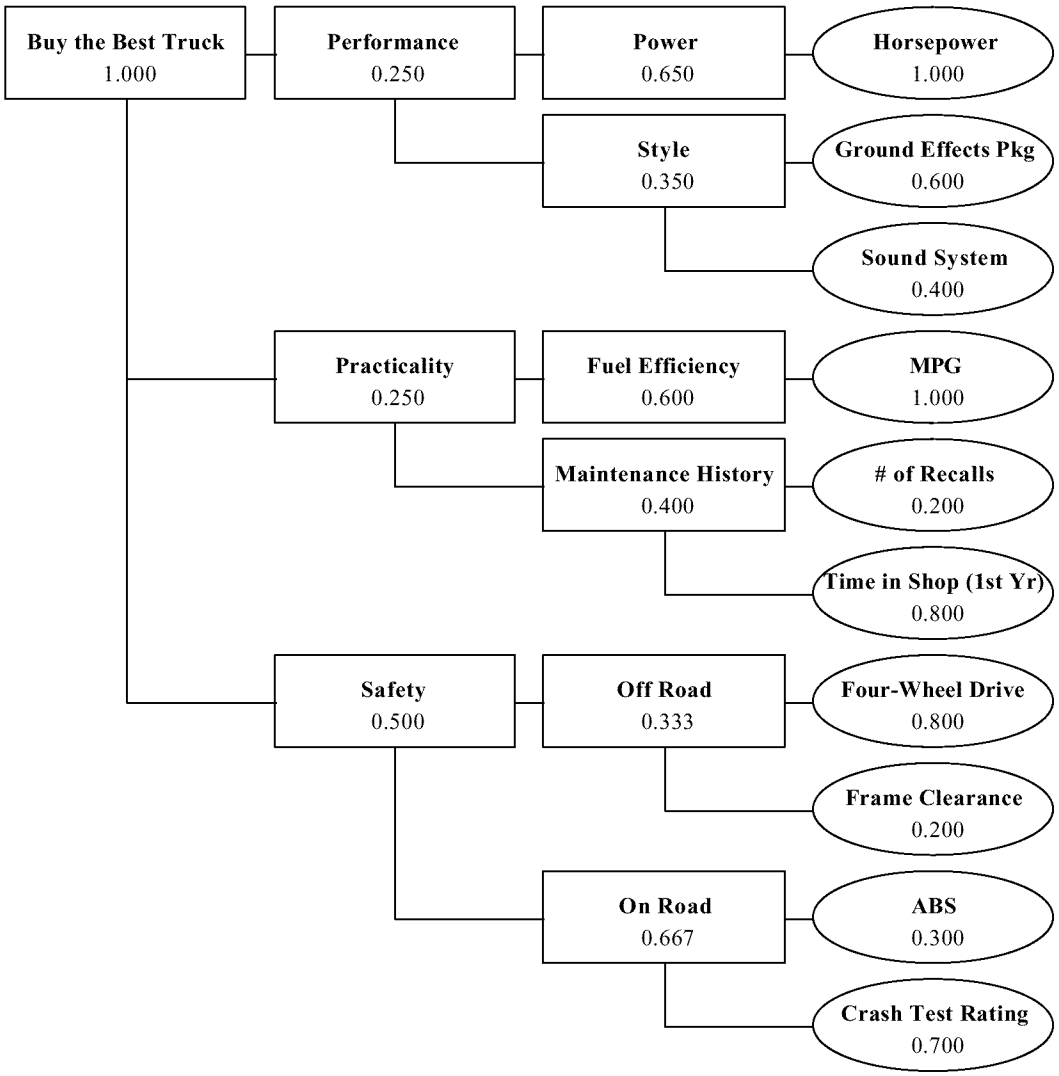

Figure 7. *Buy the Best Truck* Value Hierarchy with Local Weights

The method for determining local weights requires value judgments from the DM. To illustrate this, the following example will be used (Shoviak, 2001:57). The DM begins by determining the weights of the values at the lowest-tier for each branch of the hierarchy and progresses upward to the first-tier. This technique allows a more organized

flow for the DM to conceptualize exactly where in the hierarchy the value being weighted falls. Referring again to the *Buy the Best Truck* example, *Off-Road* and *On-Road* are the lowest-tier values under the *Safety* branch of the hierarchy (see Figure 7). The DM must determine which is least important, *Off-Road* or *On-Road*, as they relate to the value of *Safety*. Suppose the DM indicates that *Off-Road* is least important. *Off-road* is subsequently assigned a value of "x." The DM must next determine how much more important *On-Road* is in relation to *Off-Road*. The DM indicates *On-Road* is twice as important as *Off-Road*. *On-Road* is then assigned a value of "2x." Recall the local weights for one tier of a branch must sum to one. Therefore, an equation can be written to solve for "x" and subsequently indicate the local weights. For example, notice that if $x + 2x = 1$ then $3x = 1$ and $x = 1/3$. The weights for *Off-Road* and *On-Road*, with respect to the value of *Safety* as shown in Figure 8, are therefore 0.333 and 0.667, respectively. This process is repeated for each tier of values and the measures. A single measure inherits the entire weight of importance for its associated value.

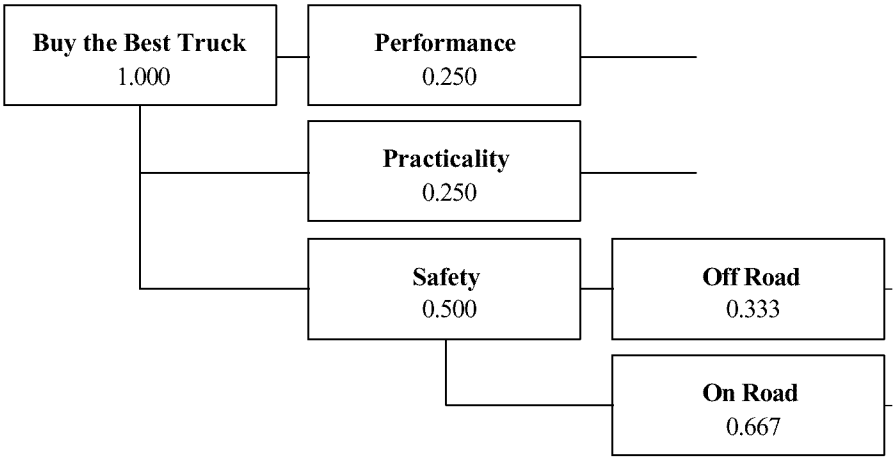

Figure 8. Determining Local Weights Example

Another method for determining local weights is called "swing weighting." Swing weighting requires the DM to "compare individual attributes [i.e., measures] directly by imagining (typical) hypothetical outcomes" (Clemen, 1996:547). The procedure for using the swing weighting method is compiled from Chambal (2001) and Kirkwood (1997:70). Essentially, the DM must examine each tier of values or measures individually and "consider the increments in value that would occur by increasing (or "swinging") each [value] or measure from the least preferred end of its range to the most preferred…" The resulting increments are sequentially ordered by increasing value. Each increment is assigned a factor of importance as it relates to the smallest increment. The smallest value increment is then set so the "total of all the increments is 1." The resulting increments that sum to one are solved as a system of equations with the same number of equations and unknowns.

A DM can also use a technique known as the "100 ball" technique (i.e., direct weighting) to assign weights of importance to values and measures. This entails the apportioning of an imagined set of 100 balls to each value or measure, in a particular tier and branch, according to the importance placed on each by the DM. The number of balls (e.g., 67) assigned to one value or measure is interpreted as the DM saying, "67 percent of the emphasis is on this value when compared to others on the same tier and in the same branch."

While the local weights indicate the importance placed on each value or measure by the DM, the global weights are a multiplicative function of the local weights and refer to how much weight each value or measure contributes to the overall fundamental objective in the hierarchy. For instance, in the *Buy the Best Truck* example, shown again

with the local weights in Figure 9, the first-tier value of *Safety* carries a local weight of 0.5 and its more specific values in the second-tier, *Off-Road* and *On-Road*, carry local weights of 0.333 and 0.667, respectively. Also, the measures, *Four-Wheel Drive* and *Frame Clearance* have local weights of 0.8 and 0.2, respectively.

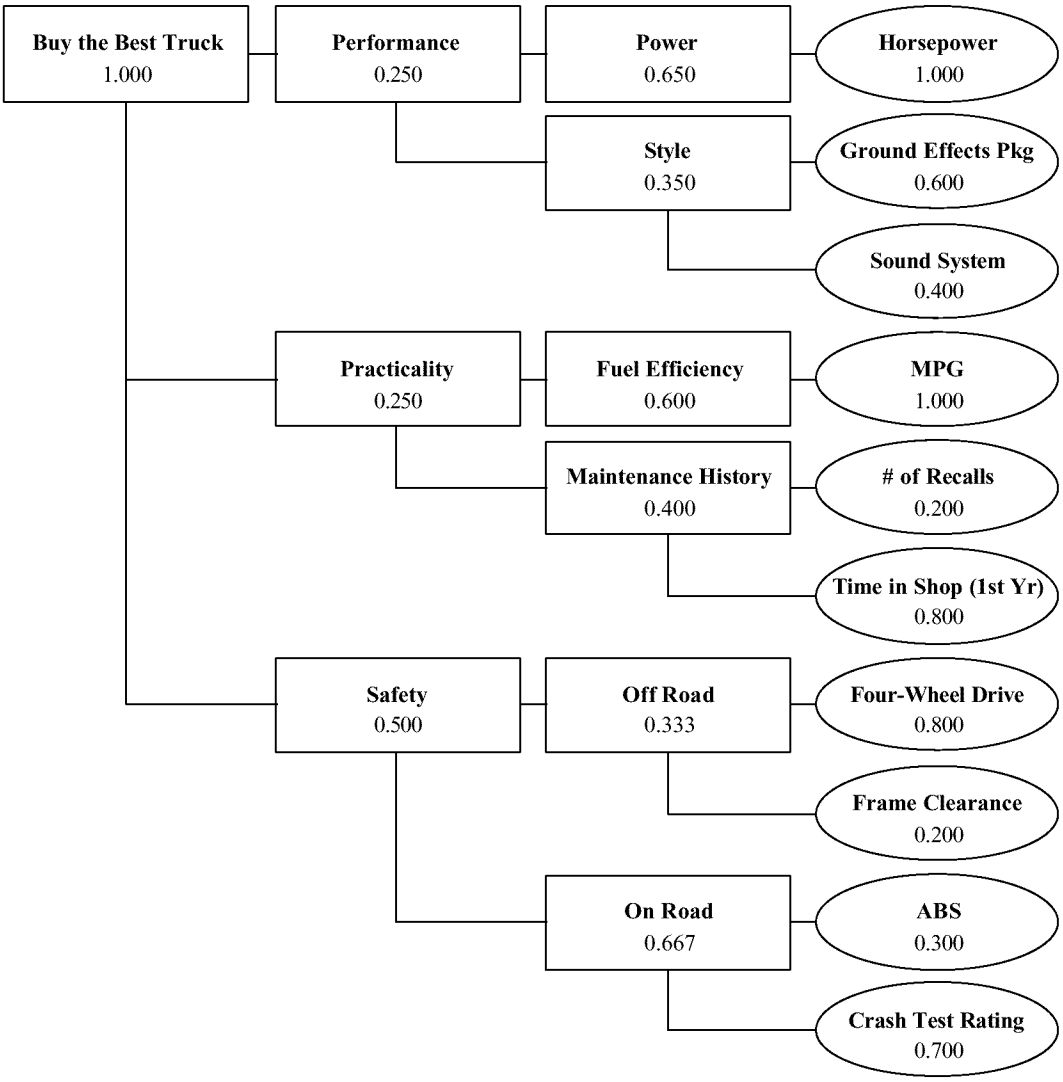

Figure 9. *Buy the Best Truck* Value Hierarchy with Local Weights (repeat)

Figure 10 subsequently shows the hierarchy with the global weights. The global weights for *Off-Road* and *On-Road* are (0.5 x 0.333) = 0.167 and (0.5 x 0.667) = 0.333, respectively. Likewise, the global weights for the measures *Four-Wheel Drive* and *Frame Clearance* are the products of the local weights for *Safety*, *Off-Road*, and the respective measures. That is, (0.5 x 0.333 x 0.8) = 0.133 and (0.5 x 0.333 x 0.2) = 0.033. Any value or measure's global weight is the product of its local weight and the local weights of the values that build up to the fundamental objective.

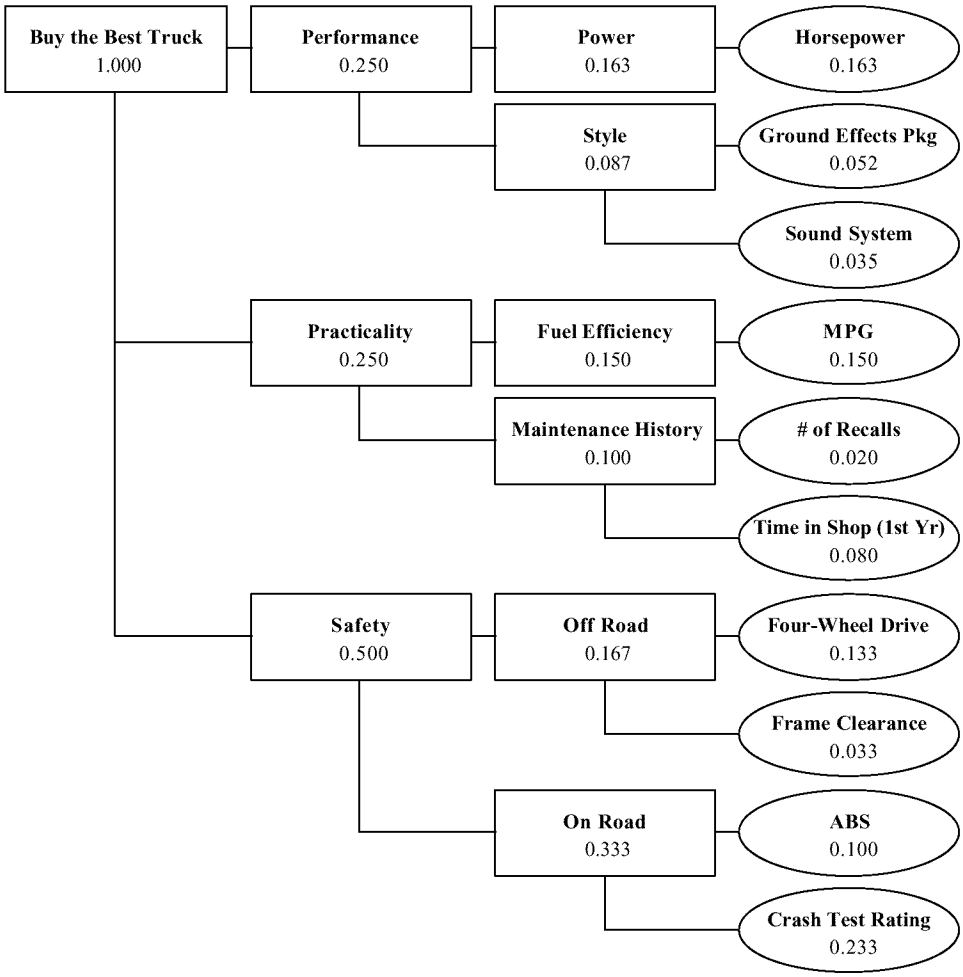

Figure 10. *Buy the Best Truck* Value Hierarchy with Global Weights

2.8.6 Step 6 - Alternative Generation

Keeney (1992:9) notes "the range of alternatives people identify for a given decision situation is often unnecessarily narrow…the first alternatives that come to mind in a given situation are the obvious ones…" One of the advantages of the VFT methodology is that it encourages development of creative alternatives, guided by the knowledge of the organizational values (i.e., the value hierarchy). Keeney (1992:198) echoes, "…alternatives should be created that best achieve the values specified for the decision situation…[In fact], alternatives themselves can trigger thought processes that generate new alternatives." Depending on the situation, there are different techniques for actually generating the alternatives. Note that sometimes alternative generation is not necessary because the alternatives come from an outside source. Kirkwood (1997:44-50) highlights potential alternative generation dilemmas and gives proposed solutions, both of which are captured in Table 6.

Table 6. Common Alternative Dilemmas and Solutions

Alternative Dilemma	Proposed Solution(s)
Too many alternatives (Combinatorial problems)	Mathematical programming or optimization routines (e.g., integer linear programming).
Too many alternatives (Data collection problems)	Screening criteria capturing all probable alternatives so the most preferred alternative meets the criteria with ease.
	Strategy generation table (see Figure 9) to highlight which alternatives make sense and deserve a more detailed look.
Too few alternatives	Strategy generation table (see Figure 9) to highlight other potential column entries that may result in better alternatives.
	Develop a value hierarchy, if not already accomplished, and think of alternatives to maximize a higher-tier value.
Developing alternatives when there is uncertainty	Hedge against uncertainty by taking the middle ground (e.g., a mutual fund adds a certain amount of protection whether a single stock rises or falls in the future).
	Allow for sequential decisions in the future (e.g., spend more money up front to preserve options in light of uncertainty in the future).
	Share the risk generated by the uncertainty with a partner.

(Kirkwood, 1997:44-50)

Figure 11 is a strategy generation table for use with the *Buy the Best Truck* example. The strategy generation table method is suggested by Howard (1988:684) and Kirkwood (1997:47-48) to both highlight alternatives that make the most sense (in the case of too many alternatives) and to stimulate creative thinking (in the case of too few alternatives). For each strategy theme shown in Figure 11, the DM must decide which type of truck, whether it is new or used, whether it has two or four-wheel drive, the amount available to spend, and the long term goal for the vehicle. The strategy generation table depicts different alternatives for each of these decisions. The table subsequently prompts the DM to consider different combinations of the alternatives to meet the strategy theme.

Strategy Theme	**Type of Truck**	**New or Used**	**Utility**	**Prepared to Spend**	**Long Term Vehicle Goal**
Vehicle to use while at college and on camping trips	Sport Utility Vehicle	New	Two-wheel drive	< = $5,000	Drive until it's dead with no preventative maintenance
Vehicle to commute around city as a young professional	Small pickup (e.g., Ford Ranger)	Used	Four-wheel drive	< = $20,000	Turn in for new vehicle after two years
Vehicle to use on the farm or construction site	Full size pickup (e.g., Ford F-150)			< = $30,000	Treat as lifelong investment

Figure 11. Strategy Generation Table for *Buy the Best Truck* Example

2.8.7 Step 7 - Score the Alternatives

To properly use the value model and score the given alternatives, data coinciding with the information required for the measures must be collected for each alternative. This may be a time consuming process as credible data sources for each alternative must be found, researched, and used. Subsequent to obtaining the data, the alternatives are evaluated for each measure. Typically, a forum of subject matter experts considers each alternative for a particular measure before advancing to the next measure. This allows the subject matter experts to maintain clarity for each measure definition and its associated categories along the x-axis and ensures each alternative is scored with consistency. Ideally, the forum of subject matter experts arrives at a consensus for each score an alternative receives. This adds defensibility to the final value ranking of the alternatives because it eliminates the uncertainty factor associated with each score an alternative receives.

2.8.8 Step 8 - Perform Deterministic Analysis

Deterministic analysis is the mathematical process of combining the score of every measure (per the SDVFs) and the associated weights of importance for each alternative. This process requires a mathematical equation known as the value function "which combines the multiple evaluation measures into a single measure" depicting the overall value attained by each alternative (Kirkwood, 1997:53). Kirkwood (1997:53) highlights two requirements for determining a value function: "single dimensional value functions be specified for each evaluation measure [and] weights be specified for each single dimensional value function."

There are two primary value function types used in VFT: additive and multiplicative. The additive value function is simplistic and encourages easy, detailed sensitivity analysis; it is also the most commonly used type in decision analysis practice (Kirkwood, 1997:230; Shoviak, 2001:60). A key assumption for the additive value function is that each SDVF allows a value of "0 for the worst …and 1 for the best evaluation measure score" (Shoviak, 2001:60). The additive value function v(x), read as the value of the x alternative, shown in Equation 1, is the weighted sum of the translated measure scores.

$$v(x) = \sum_{i=1}^{n} \lambda_i \cdot v_i \cdot (x_i) \tag{1}$$

That is, the value function, v(x), is the sum of the individual products obtained when the translated score for each evaluation measure, $v_i(x_i)$, is multiplied by its associated weight, λ_i (Katzer, 2002; Kirkwood, 1997:230). The expression $v_i(x_i)$ is interpreted as the translation, to a common "value" unit, of a particular alternative score, x_i, by the i^{th} measure's single dimensional value function, v_i.

2.8.9 Step 9 - Perform Sensitivity Analysis

The sensitivity analysis (SA) is performed as a "post deterministic analysis." The SA highlights the "impact on the ranking of alternatives [based on] changes in the modeling assumptions" (Kirkwood, 1997:82). The predominant form of SA examines

the impact of changes to the weights assigned by the DM to the higher tiers of the hierarchy. This is valuable because it shows how each alternative changes in ranking as the weight of any higher-tier value varies. The weight of the remaining values in that tier are held proportional and still sum to 1. Sensitivity analysis can be accomplished at any level in the hierarchy. Typically, it focuses on higher-tier values because changes in the weights of the lower-tier values do not have as much impact on the overall ranking of the alternatives. Sensitivity analysis may be of interest to a DM because of the potential disagreement between stakeholders regarding the weights and the affect on the final ranking of the alternatives. An SA indicates the range in weights a value may assume before the ranking position of alternatives change and ultimately affect the DM's final decision.

2.8.10 Step 10 - Recommendations and Presentation

Upon completion of the deterministic and sensitivity analysis, the results are presented to the DM and the associated organization. The analysis provides insight that serves to guide the decisions of the DM. It is important to note that the VFT process does not replace the DM. Values identified at the beginning of the process determine the ranking of alternatives according to those values.

2.9 Summary

Chapter 2 provided background information on force protection and Air Force battlelabs, specifically the FPB. The chapter detailed how the FPB currently selects its initiatives and highlighted methods used by other organizations faced with a similar challenge (i.e., selecting an alternative(s) to add the most value to the organization).

Chapter 2 also introduced decision analysis and the VFT process and explained why it was the most appropriate technique to use in this research effort. Additionally, the 10 steps to building a decision analysis framework were listed and described.

Chapter 3. Methodology

The Force Protection Battlelab (FPB) has the challenge of identifying innovative force protection ideas and assigning an action officer (AO) to lead a proof of concept to determine whether the identified idea advances Air Force capabilities via core competencies or joint warfighting. The problem for the FPB becomes one of selecting an appropriate idea from a pool of many while acknowledging their personnel, time, and money constraints. Additionally, the idea must have a reasonable chance of being proved within the 18-month time constraint imposed by AFI 10-1901 (Department of the Air Force, 1997:8). Perhaps more importantly, the idea must provide a positive force protection impact to the Air Force or joint community.

It is evident the FPB must consider multiple criteria in their selection of the myriad innovative force protection ideas (i.e., alternatives). Additionally, some ideas are "close, but slightly off target," as they do not precisely address a specific force protection need. These ideas require modification by the AOs before they are considered legitimate, innovative force protection ideas. In other words, the available alternatives may not completely satisfy the values of the FPB. Keeney (1992:198) suggests, "alternatives should be created that best achieve the values specified for the decision situation." Therefore, the FPB's situation indicates multi-criteria decision analysis with value-focused thinking (VFT) is the best-suited methodology to answer the research question. This chapter will detail the pre-analysis portion of the 10-Step process discussed in Section 2.7 (i.e., Steps 1 - 7).

3.1 Step 1 - Problem Identification

Through this thesis author's 3-year experience as an FPB AO and meetings with the FPB commander (i.e., the decision-maker (DM)) and members of the FPB, this research effort identified as the problem the fact that the FPB has no defensible, objective, and repeatable initiative selection process. The values of the FPB need to be incorporated in any decision assistance methodology to ensure the idea (i.e., alternative) selected meets the FPB's mission. The FPB's values may be classified as "strategic values;" they do not change from day to day and are considered foundational and stable for years (Keeney, 1992:27-28). The resulting problem for the FPB is clearly stated as: "Given many alternatives (i.e., innovative ideas and concepts), which ones should the FPB pursue in order to fulfill its warfighter support mission while acknowledging its personnel, time, and monetary constraints?"

3.2 Step 2 - Construct the Value Hierarchy

The FPB's value hierarchy addressing the problem identified in Step 1 was derived at the first working group meeting with FPB personnel (summaries of the working group meetings are contained in Appendix B). After the FPB AOs decided that the fundamental objective of the FPB was to fulfill their mission as stated in AFI 10-1901, the process of determining what values were appropriate to construct the different tiers of the value hierarchy began. The goal was to determine what the FPB personnel valued in their quest to achieve their fundamental objective and subsequently organize those values in hierarchical fashion from most general at the top to most specific at the bottom. A brainstorming session where the FPB AOs used Post-It™ notes identified the

values they deemed necessary to achieve their mission (i.e., the fundamental objective). After 20 minutes, they generated over 100 notes, which were collected, read aloud, and grouped by similarities; the ensuing discussion focused on how to subsequently structure the value hierarchy. More than one of the FPB AOs recognized that the groups of values seemed to be aligned along "programmatic" and "impact" themes. Constructing the hierarchy from a strictly "programmatic" and "impact" stance left the FPB AOs uneasy. They felt there was a disconnect between the values comprising the hierarchy and their fundamental objective.

Upon closer examination of AFI 10-1901, four fundamental governing principles were discovered that were intended to facilitate the execution of the battlelab mission statement. These principles were listed under the headings of "lean," "unique," "focused," and "innovative" (Department of the Air Force, 1997:2). Interestingly enough, all the values generated by the FPB AOs could be categorized under one of these headings. Additionally, it was noted that the battlelab mission statement was essentially comprised of two parts: a programmatic half and an impact half. Establishing the relationship between the mission statement (i.e., the fundamental objective), the four principles, and the values of the FPB AO's resulted in a mutually exclusive, collectively exhaustive value hierarchy.

As shown in Figure 12, the final hierarchy contains five tiers and is built with the battlelab mission statement as the fundamental objective. The first tier represents the two halves (i.e., programmatic and impact) of the mission statement. The second tier is comprised of the four battlelab fundamental governing principles, while the third tier contains more specific definitions of the four principles. The values of the fourth tier

highlight exactly what the FPB members find important from the values in the third tier. Finally, the fifth tier contains the measures (derived in Step 3) that depict the degree of attainment for each alternative with regard to the values in the fourth tier.

The sub-sections following Figure 12 describe the relationship between the stated mission of the battlelab and the four fundamental governing battlelab principles. The association between the AOs' values and statements from AFI 10-1901 were essential and instrumental in the FPB's approval of the value hierarchy. The fact that the mission statement and four governing principles (both directly from AFI 10-1901) were used in the construction of the value hierarchy lends credence to its structure. According to Chambal (2001), using AFI 10-1901 in the construction of the value hierarchy constitutes the "gold standard," which subsequently leads to a solid value model and ultimately a defensible ranking of alternatives.

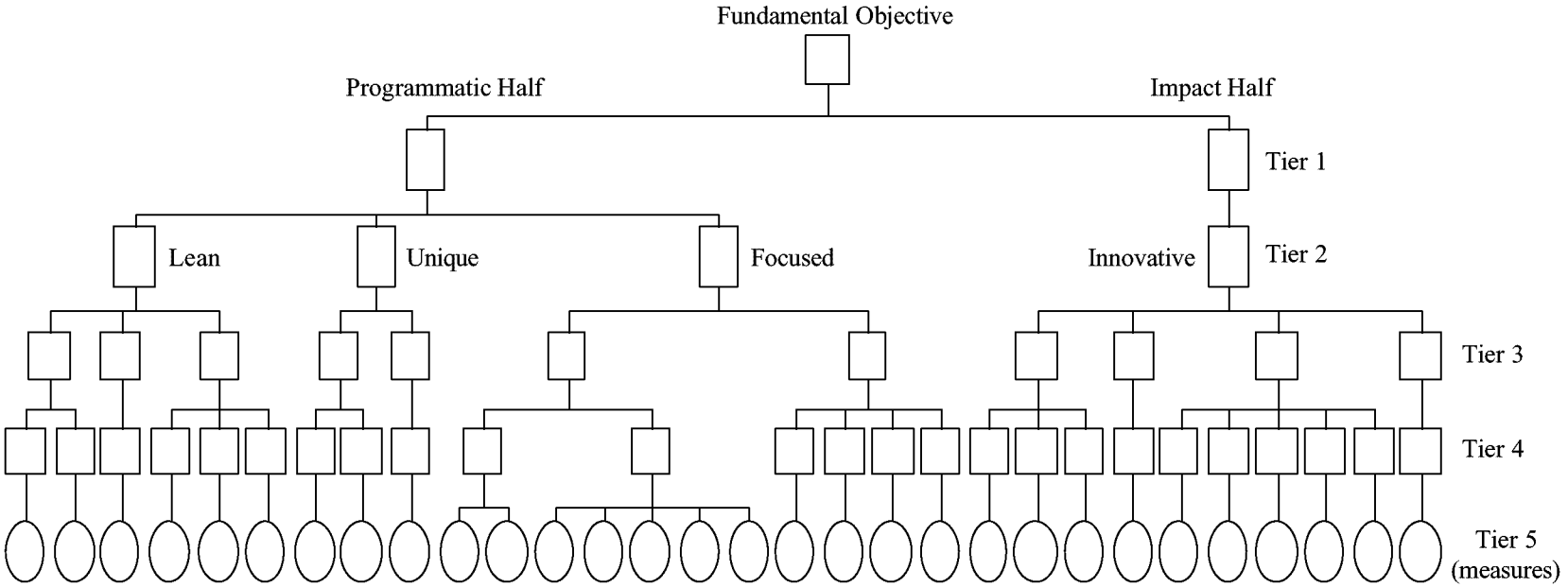

Figure 12. Final FPB Value Hierarchy

3.2.1 Decomposition of the Mission Statement

To describe the relationships between the tiers in the hierarchy, the mission of the FPB was broken into its two distinct elements: (1) "Rapidly identify and prove the worth of innovative ideas…" (programmatic half) and (2) "…improve the ability of the Air Force to execute its core competencies and Joint Warfighting" (impact half) (Department of the Air Force, 1997:2). In the final hierarchy, each half of the mission statement is addressed by at least one of the fundamental governing principles of battlelabs (i.e., "lean," "unique," "focused," and "innovative") as shown in Figure 13. While "innovative" is a fundamental principle, the FPB personnel felt "impact" was a more accurate heading of the principles addressing the second half of the mission statement (i.e., *Core Competencies and Joint Warfighting*). Note that the two first-tier values are analogous to the FPB fundamental objective; therefore, the first-tier values may be considered "place holders." The FPB personnel constructed the hierarchy in this manner to create a visually symmetric hierarchy that facilitates easy understanding.

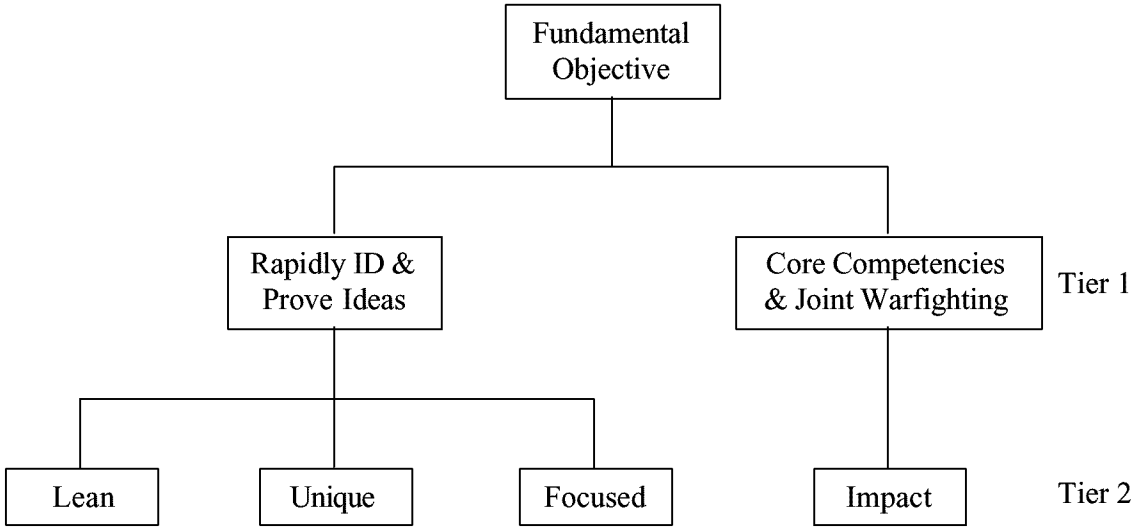

Figure 13. FPB Hierarchy Showing Tiers 1 and 2

3.2.2 Decomposing the Fundamental Principles

The four fundamental governing principles decompose into their respective definitions taken from AFI 10-1901. However, FPB personnel have incorporated their interpretation of the definitions in order to personalize the value hierarchy. Subsequently, the values that comprise the third and fourth tiers of the value hierarchy, while based on the definitions found in AFI 10-1901, are more precisely what the FPB members deemed important to achieve their fundamental objective (i.e., the mission statement). The subsequent paragraphs give the AFI definition of the governing principles along with the interpretations of those definitions by the FPB members. Included for each governing principle is a figure that illustrates the decomposition of the hierarchy through the values in the fourth tier.

3.2.2.1 Lean

Lean, as defined by AFI 10-1901, is "A permanent cadre of no more than 25 people, augmented by Temporary Duty experts and operating with a limited infrastructure, seeking to borrow or lease -- not buy" (Department of the Air Force, 1997:2). The FPB personnel interpret "A permanent cadre of no more than 25 people, augmented by Temporary Duty experts…" to mean that there is no cap on the number of personnel available but rather all personnel are used effectively and efficiently. It also means that personnel in appropriate Air Force Specialty Codes (AFSCs) are available to lead initiatives requiring specific expertise (e.g., an initiative to detect and rapidly identify a biological agent in a pre-release configuration is most appropriately lead by a an Air Force micro-biologist). Likewise, the FPB personnel interpret "…operating with a

limited infrastructure, seeking to borrow or lease -- not buy" to mean that they do not frivolously purchase equipment without a proof of concept plan in place. If the necessary equipment is available, they prefer to borrow or lease that equipment whenever possible to facilitate initiative proofs of concept. It also means they will be fiscally responsible and seek (1) "high pay-off initiatives with minimum cost and investment" (Department of the Air Force, 1997:2), (2) fiscal partnerships with other organizations, and (3) the ability to pay for equipment or services in multiple, equal disbursements versuss. single, large sum disbursements. Figure 14 highlights the values that comprise the *Lean* branch of the value hierarchy, and Table 7 provides a definition of those values.

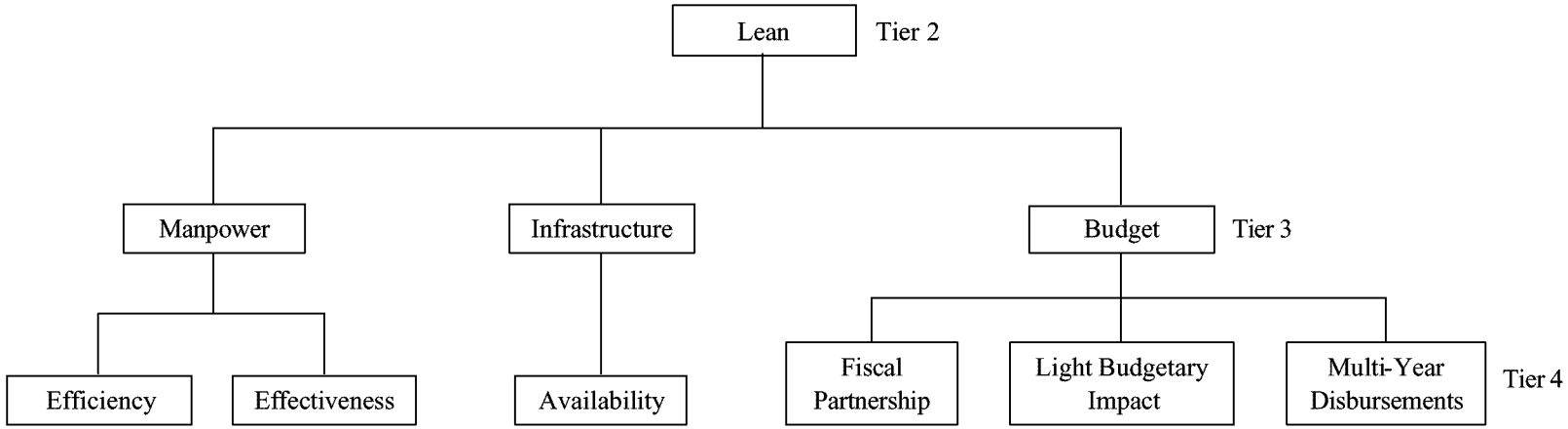

Figure 14. FPB Value Hierarchy (*Lean* Branch)

Table 7. Definitions of *Lean* Branch Values

Lean	Appropriate use of personnel, availability of infrastructure, and fiscal responsibility.
Manpower	Efficient and effective use of available personnel.
Efficiency	Whether a single AO is able to lead the evaluation of more than one initiative concurrently.
Effectiveness	Whether the specificity of the initiative requires a specialist or may be lead by an AO with any AFSC.
Infrastructure	Everything necessary to evaluate the military worth of an initiative aside from manpower and budget.
Availability	Whether the required infrastructure to evaluate an initiative is available within or external to the FPB.
Budget	Use of the available budget in a manner that maximizes evaluation capability of the FPB.
Fiscal Partnership	Whether external sources contribute to the cost of evaluating an initiative.
Light Budgetary Impact	Whether the cost of evaluating an initiative consumes a large portion of the FPB budget.
Multi-Year Disbursements	Whether the cost of evaluating an initiative is spread over more than one fiscal year and if so the proportionality of the spread.

3.2.2.2 Unique

Unique, as defined by AFI 10-1901, is "Evaluating ideas and concepts; differing from research labs or warfare centers which manage systems, programs, and projects" (Department of the Air Force, 1997:2). The FPB personnel interpret this definition to mean that they concentrate their evaluation efforts on innovative force protection ideas and that they are performing a one-time evaluation of a force protection idea vice managing a force protection system (analogous to the duties of an Air Force System Program Office (SPO)). They consider non-duplication of force protection efforts to be an important element of *Unique* and strive to eliminate or reduce duplicative efforts between offices or agencies. Figure 15 highlights the values that comprise the *Unique* branch of the value hierarchy, and Table 8 provides a brief definition of those values.

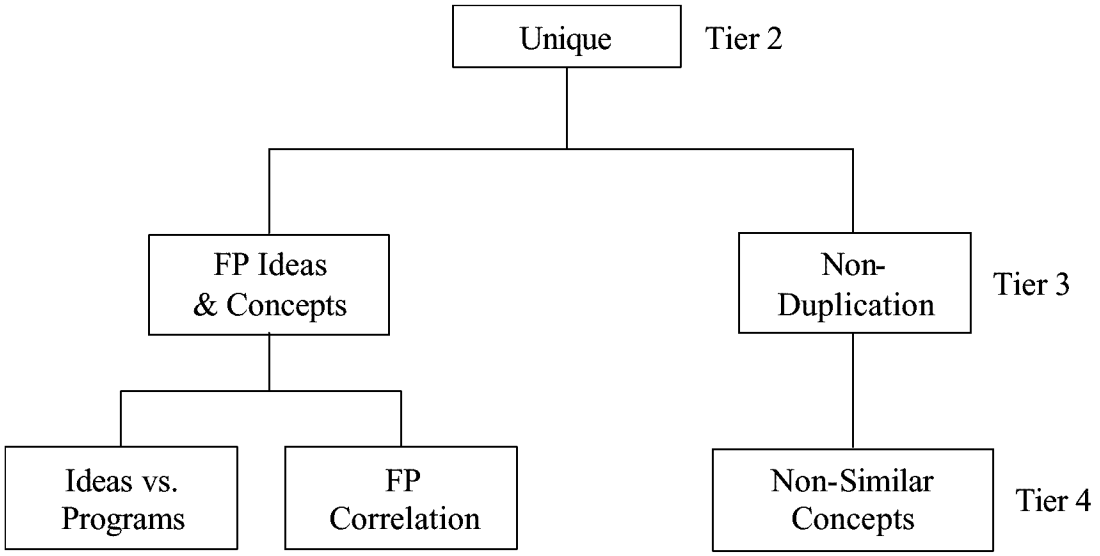

Figure 15. FPB Value Hierarchy (*Unique* Branch)

Table 8. Definitions of *Unique* Branch Values

Unique	Evaluation of concepts and ideas -- not management of systems or programs.
FP Ideas & Concepts	Evaluating only ideas and concepts that are related to force protection issues.
Ideas vs. Programs	Whether an initiative is a one-time evaluation of an innovative application of existing technology, equipment, or doctrine.
FP Correlation	Whether an initiative is strongly associated with an existing force protection issue.
Non-Duplication	Avoiding evaluation of initiatives that are already under study by other organizations.
Non-similar Concepts	Whether an FPB initiative is being evaluated for the identical purpose as an initiative at a different organization.

3.2.2.3 Focused

Focused, as defined by AFI 10-1901, is "Identifying, planning, and leading innovation [(initiatives)]; leveraging existing expertise, technology, and contracts" (Department of the Air Force, 1997:2). The FPB personnel interpret "innovation" as being analogous to battlelab initiatives. Initiatives by their nature are considered innovative and FPB AOs can more easily relate to leading the evaluation of "initiatives" vice "leading innovation." The FPB personnel interpret "Identifying, planning, and leading innovation (initiatives)…" as the application of their intrinsically lean manpower to formulate an evaluation strategy (in accordance with AFI 10-1901, Atch 3, Battlelab Initiative Format) to prove or disprove the military worth of innovative force protection

ideas. The second half of the definition, "…leveraging existing expertise, technology, and contracts," is interpreted by the FPB personnel to mean that they employ the capabilities of existing personnel before creating new sub-contracts. It also means they consider existing technology for any innovative force protection applications before seeking to create new technologies. Additionally, they couple their evaluation efforts with existing readiness exercise venues and contracts to facilitate an economical proof of concept. Figure 16 highlights the values that comprise the *Focused* branch of the value hierarchy, and Table 9 provides a brief definition of those values.

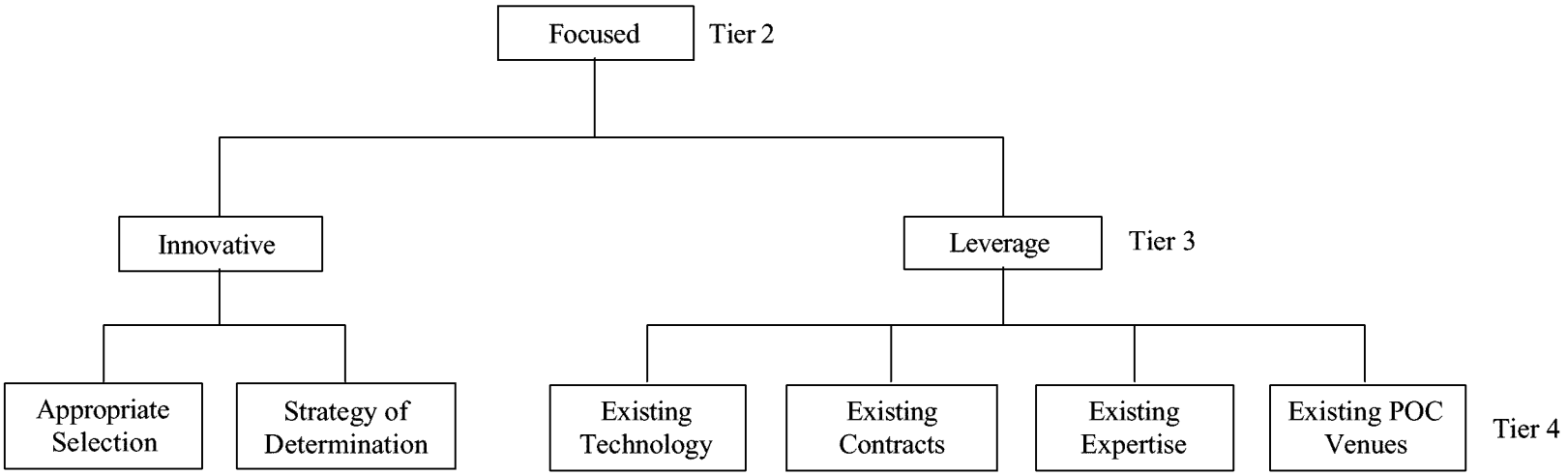

Figure 16. FPB Value Hierarchy (*Focused* Branch)

Table 9. Definitions of *Focused* Branch Values

Focused	Clearly defined initiative selection criteria and the ability to take advantage of existing assets.
Innovative	Selection of appropriate force protection ideas for evaluation and consideration of the relevant aspects of that evaluation.
Appropriate Selection	The level of advocacy from which an initiative is generated and its associated level of importance to the warfighter.
Strategy of Determination	The time required to evaluate an initiative, the cost, schedule, and performance risk associated with evaluating the initiative, and the sensibility of the initiative.
Leverage	Taking advantage of existing assets and cooperative efforts to achieve goals.
Existing Technology	Whether an initiative evaluation can take advantage of available technology.
Existing Contracts	Whether an initiative evaluation can take advantage of previously established contracts.
Existing Expertise	Whether an initiative evaluation can take advantage of readily available expertise.
Existing proof of concept (POC) Venues	Whether an initiative can be evaluated through the use of an established military exercise.

3.2.2.4 Innovative

Innovative, as defined by AFI 10-1901, is "Proving operations and logistics concepts which advance Air Force core competencies and drive revision to doctrine, organization, training, requirements, or acquisitions" (Department of the Air Force, 1997:2). Members of the FPB believe "impact" is a more appropriate descriptor of "innovative." Impact is used in the sense that the efforts of the battlelabs should have some positive effect, influence, or bearing on Air Force doctrine, organization, training, requirements, or acquisitions. Therefore, the fundamental principle *Innovative* will be replaced by *Impact* for the remainder of this thesis. The FPB personnel interpret the AFI definition to mean that the force protection concepts and ideas being pursued as initiatives must advance at least one of the six Air Force core competencies as listed in Air Force Doctrine Document 1: (1) Air and Space Superiority, (2) Precision Engagement, (3) Information Superiority, (4) Global Attack, (5) Rapid Global Mobility, or (6) Agile Combat Support (AFDC, 1997:28). In addition, it should enhance joint warfighting operations through furthering force protection. Finally, the force protection concept being evaluated should positively affect Air Force (or joint) doctrine, organization, training, requirements, or acquisitions. Figure 17 highlights the values that comprise the *Impact* branch of the value hierarchy, and Table 10 provides a brief definition of those values.

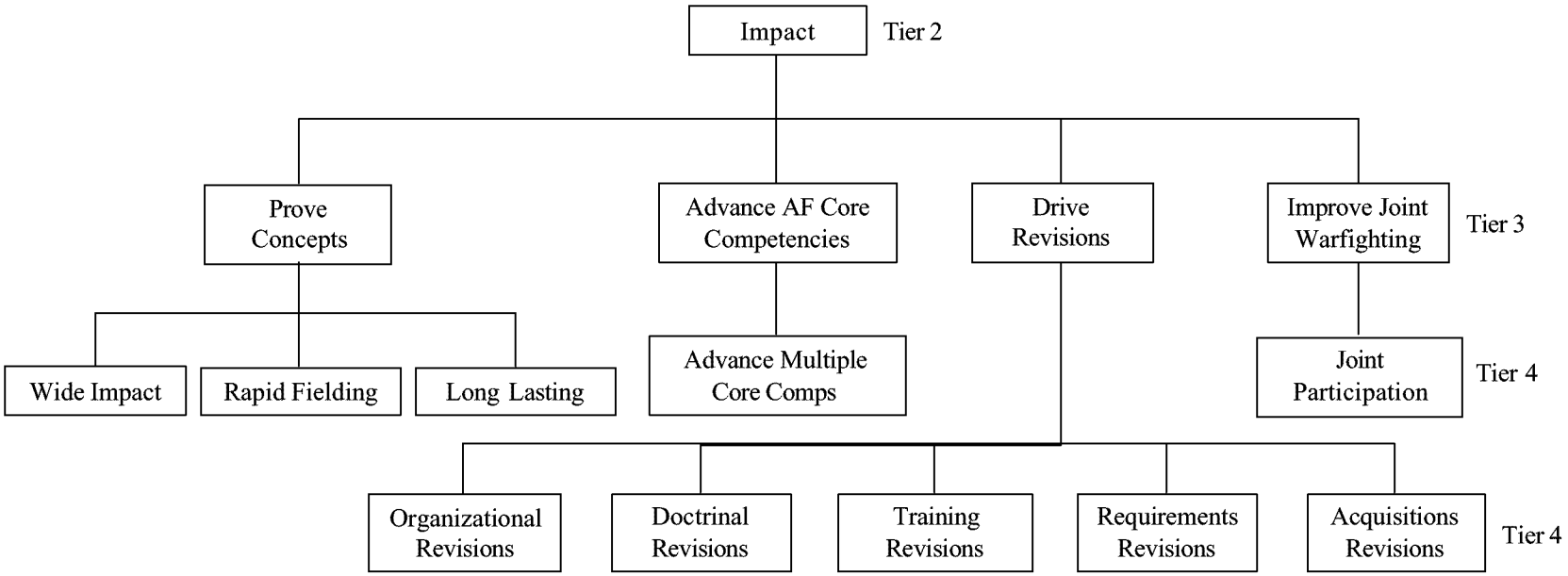

Figure 17. FPB Value Hierarchy (*Impact* Branch)

Table 10. Definitions of *Impact* Branch Values

Impact	Proving concepts that advance Air Force core competencies, drive revisions, and improve joint warfighting.
Prove Concepts	Evaluating initiatives that will have a widely felt positive impact, be quickly fielded, and provide a long-term solution to a force protection problem.
Wide Impact	Whether a proven initiative is applicable to a select, or large, group within the Department of Defense (DoD).
Rapid Fielding	Reflects an aspect of AFI 10-1901 "swift fielding of proven concepts" (Department of the Air Force, 1997:3).
Long Lasting	Whether a proven initiative will endure as a force protection solution or is simply a "band-aid."
Advance AF Core Competencies	Further any of the core competencies through successfully proven force protection initiatives.
Advance Multiple Core Competencies	Whether a proven initiative has potential to advance a single core competency or advance more than one.
Drive Revisions	Positively affecting how the Air Force organizes, trains, and equips its warfighters.
Organizational Revisions	Whether a proven initiative affects the way in which an Air Force unit is organized to achieve its mission.
Doctrinal Revisions	Whether a proven initiative affects Air Force doctrine.
Training Revisions	Whether a proven initiative affects the way in which Air Force units train to accomplish their missions.
Requirements Revisions	Whether a proven initiative affects existing or future Air Force requirements.
Acquisitions Revisions	Whether a proven initiative affects existing or future Air Force acquisitions.
Improve Joint Warfighting	Enhancing the ability of joint warfighting operations by providing reliable force protection.
Joint Participation	Joint service involvement throughout the execution of an initiative.

3.2.3 Decomposing the Overarching Objective

Like the mission statement, the overarching objective can also be distilled into the fundamental governing principles. Per AFI 10-1901, the battlelab's overarching objective is to "generate high pay-off initiatives with minimum cost and investment" (Department of the Air Force, 1997:2). The FPB personnel agree that "Generate high pay-off initiatives…" speaks to "unique," "focused," and "innovative" (i.e., impact), while "…with minimum cost and investment" speaks to the fundamental principles of "lean" and "focused." The ability to decompose the battlelab mission statement and overarching objective into the fundamental governing principles provided the foundation for the construction of the value hierarchy, while adding to the credibility of the final hierarchy. As a testimony to the exhaustiveness of the constructed value hierarchy, the acting deputy commander of the FPB presented a list of the FPB commander's concerns regarding the hierarchy and requested the list be addressed to his satisfaction. The list, and the associated value addressing each concern, is shown in Table 11.

Table 11. Values addressing specific FPB concerns

Concern / Desire	Addressed by Value(s)
External agency collaboration available for a potential initiative.	- Fiscal Partnership
Financial support and advocacy for a potential initiative.	- Fiscal Partnership (financial support) - Appropriate Selection (advocacy)
True mission need established for the potential initiative.	- Appropriate Selection - FP Correlation - Advance Multiple Core Competencies
Innovativeness of the potential initiative.	- Ideas vs. Programs
Risk associated with transitioning a successful initiative to the operational Air Force.	- Strategy of Determination

3.3 Step 3 - Develop Evaluation Measures

The next step in building the value model is development of the measures. FPB personnel created the measures during a two-day meeting (15 - 16 October 2001). The measures were derived by asking the FPB AOs what criteria they felt were important for assessing the degree of attainment for each potential initiative with respect to each fourth-tier value. The desirable properties of measures discussed in Section 2.8.3.4 were acknowledged in the development process and are evidenced in the resulting final measures. One important consideration common across all measures is the relative ease with which they are understood and correlated to their respective values by the DM and members of the FPB. Summaries of the measures and the definitions of each measure are

contained in Tables 12 through 19. Categorized by the second-tier values, the summary tables show (1) the value directly associated with each measure and (2) the lower and upper bounds of the x-axis. The measure definition tables show the definitions of each measure as preferred by the FPB personnel. Due to the general nature of the alternatives, (i.e., the lack of precision data available for the potential initiatives) all measures in this value model have categorical x-axes. Additionally, 29 of the 30 measures use constructed-proxy scales because there were no natural measures available to directly measure the attainment of the fourth-tier values. The one measure without a constructed-proxy scale is *Number of Core Competencies Advanced*. It is a numeric measure of how many core competencies are advanced by a potential initiative and thus has a natural-direct scale.

Although Kirkwood (1997:26) states, "Using several evaluation measure scales could give a misleading indication of the relative importance [of the lower-tier value]," FPB personnel required multiple measures for the values *Appropriate Selection* and *Strategy of Determination*. Kirkwood (1997:26) also notes, "subdividing [a particular measure] could require more effort than is warranted to obtain [the] scores…[and those] resulting scores could give an unwarranted indication of accuracy." The FPB personnel, however, insisted on the multiple measures for two reasons: (1) they knew they could obtain the data required by the measures and (2) they wanted to capture the different characteristics of the values regardless of any "unwarranted indication of accuracy."

3.3.1 Measures for *Lean*

Lean is the first fundamental principle in the second tier of the hierarchy. A summary of the measures for the *Lean* branch is displayed in Table 12, and the definitions are listed in Table 13.

Table 12. Summary of Measures for the *Lean* Branch

Fourth-Tier Hierarchy Value	Associated Measure	Lower Bound	Upper Bound
Efficiency	Full or Part-time	Full-time	Part-time
Effectiveness	Can Any AFSC Serve as AO	No	Yes
Availability	Infrastructure Location	External	Internal
Fiscal Partnership	% Initiative Cost Bore by Others	None	Very High
Light Budgetary Impact	Total Estimated Initiative Cost	Exorbitant	Low
Multi-Year Disbursement	Favorability of Disbursement	Unfavorably Disbursed	Favorably Disbursed

Table 13. Definitions of *Lean* Measures

Measure	Definition
Full or Part-time	Whether an initiative requires an AO's full attention or can be executed concurrently with others.
Can Any AFSC Serve as AO	Whether an initiative is general enough to be lead by an AO from any career field.
Infrastructure Location	Infrastructure: everything aside from manpower and money required to execute an initiative. Location: whether that infrastructure resides at the FPB or must be obtained externally.
% Initiative Cost Bore by Others	The cost of an initiative (including any required assets) that will be paid by external agencies.
Total Estimated Initiative Cost	Overall estimated cost to evaluate the military worth of an initiative.
Favorability of Disbursement	Integrated measure accounting for whether the cost of an initiative will be split over more than one fiscal year and, if so, the proportionality of the cost disbursement.

3.3.2 Measures for *Unique*

Unique is the second fundamental principle in the second tier of the hierarchy. A summary of the measures for the *Unique* branch is displayed in Table 14, and the definitions are listed in Table 15.

Table 14. Summary of Measures for the *Unique* Branch

Fourth-Tier Hierarchy Value	Associated Measure	Lower Bound	Upper Bound
Ideas vs. Programs	Innovativeness	Intended Purpose	Innovative Use
FP Correlation	FP Correlation	Real Stretch	Direct
Non-Similar Concepts	Degree of Similarity	Identical	Very Different

Table 15. Definitions of *Unique* Measures

Measure	Definition
Innovativeness	Degree of idea originality. Whether the force protection idea uses technology (or whatever enables the idea) in an innovative way or uses it for its originally intended purpose.
FP Correlation	The degree of association an initiative has with the theme of force protection.
Degree of Similarity	Considers the parallelism of FPB initiatives with those of external agencies.

3.3.3 Measures for *Focused*

Focused is the third fundamental principle in the second tier of the hierarchy. A summary of the measures for the *Focused* branch is displayed in Table 16, and the definitions are listed in Table 17.

Table 16. Summary of Measures for the *Focused* Branch

Fourth-Tier Hierarchy Value	Associated Measure	Lower Bound	Upper Bound
Appropriate Selection	Level of Request	Unit/Internal	HQ Air Force
	Urgency	Routine	Highest Priority
Strategy of Determination	Estimated Time to Complete Initiative	Very Slow	Quick
	Cost Risk	High	Low
	Schedule Risk	High	Low
	Performance Risk	High	Low
	Sensibility	Not at All	Very
Leverage Existing Technology	Degree of Leveraging	None	All
Leverage Existing Contracts	Degree of Leveraging	None	All
Leverage Existing Expertise	Degree of Leveraging	None	All
Leverage Existing POC Venues	Degree of Leveraging	None	All

Table 17. Definitions of *Focused* Measures

Measure	Definition
Level of Request	A measure of advocacy. The Air Force (or DoD) organizational level generating the initiative submittal.
Urgency	The priority of an initiative submittal. It is related to the need in the field for the proven force protection concept.
Estimated Time to Complete an Initiative	Time, baring extenuating circumstances, to accept an initiative submittal, execute a proof of concept plan, and brief the results and recommendations to the Air Force Requirements Oversight Council (AFROC).
Cost Risk	The probability of an initiative exceeding its total estimated cost.
Schedule Risk	The probability of an initiative exceeding its total estimated time to complete.
Performance Risk	The probability of initiative execution being hampered, the transition to the field being difficult, and the future potential for sponsorship which was not integral with the initiative submission.
Sensibility	Whether the initiative is far-fetched or conceivable with existing technology.
Degree of Leveraging Existing Technology	The degree to which existing technology is used in executing the initiative.
Degree of Leveraging Existing Contracts	The degree to which existing contracts are used in executing the initiative.
Degree of Leveraging Existing Expertise	The degree to which existing expertise (referring to expertise external to the FPB) is used in executing the initiative.
Degree of Leveraging Existing POC Venues	The degree to which existing proof of concept (POC) venues are used in executing the initiative.

3.3.4 Measures for *Impact*

Impact is the final fundamental principle in the second tier of the hierarchy. A summary of the measures for the *Impact* branch is displayed in Table 18, and the definitions are listed in Table 19.

Table 18. Summary of Measures for the *Impact* Branch

Fourth-Tier Hierarchy Value	Associated Measure	Lower Bound	Upper Bound
Wide Impact	Level of Impact	Localized	Global
Rapid Fielding	Estimated Time to Field	Long Time	Short Time
Long Lasting	Longevity	Temporary	Permanent
Advance Multiple Core Competencies	# of Core Competencies Advanced	0	6
Drive Revisions to Organization	Significant	Not	Very
Drive Revisions to Doctrine	Significant	Not	Very
Drive Revisions to Training	Significant	Not	Very
Drive Revisions to Requirements	Significant	Not	Very
Drive Revisions to Acquisitions	Significant	Not	Very
Joint Participation	Joint Involvement	No	Yes

Table 19. Definitions of *Impact* Measures

Measure	Definition
Level of Impact	Where the benefit of a successfully proven force protection concept will be recognized.
Estimated Time to Field	Upon successfully proving a force protection concept, what is a realistic time estimate before the benefit is recognized in the field?
Longevity	Whether the initiative is initially considered a genuine solution to a force protection problem or is recognized as a temporary fix.
Number of Core Competencies Advanced	The number of Air force Core Competencies advanced through a successfully proven initiative.
Significant Revisions to Organization	The potential a successfully proven initiative has to significantly affect Air Force organization.
Significant Revisions to Doctrine	The potential a successfully proven initiative has to significantly affect Air Force doctrine.
Significant Revisions to Training	The potential a successfully proven initiative has to significantly affect Air Force training.
Significant Revisions to Requirements	The potential a successfully proven initiative has to significantly affect Air Force requirements.
Significant Revisions to Acquisitions	The potential a successfully proven initiative has to significantly affect Air Force acquisitions.
Joint Involvement	Proxy measure that indicates the potential for future improvement of joint warfighting. It considers the probability of cooperation from other DoD services with the execution of the initiative.

3.4 Step 4 - Create Value Functions

Each measure requires an SDVF to convert its x-axis units to value units along the y-axis as discussed in Chapter 2. For standardization and ease of understanding, each SDVF was created in such a way that it is always monotonically increasing. This allows the DM to understand that more is always considered better. As with the measures, each SDVF was derived by FPB personnel during a two-day meeting (1 to 2 November 2001) at the FPB.

The technique used to construct the SDVFs relied on the experience and judgment of FPB personnel. They were asked to annotate the extreme scores (i.e., the worst and best) so they could be correlated to the category associated with values of zero and one, respectively. The intermediate values of the SDVFs were determined primarily by asking the DM and FPB personnel how much value (on the y-axis) they would assign each categorical increment along the x-axis, keeping in mind the monotonically increasing characteristic of each SDVF. To assist them in determining an appropriate value, the facilitator asked them if a category was closer in value to zero or to one and by how much. The resulting 30 SDVFs, one for each measure, were all discrete functions. The SDVFs created for the measures within each second-tier branch are discussed and shown in the following paragraphs and figures.

3.4.1 *Lean* Branch SDVFs

The *Lean* branch of the hierarchy contains six measures, which describe the degree to which the respective value in the fourth tier of the branch is achieved. The description of the SDVF associated with each *Lean* measure is given in the following paragraphs.

3.4.1.1 SDVF for Full or Part-time

The SDVF in Figure 18 translates the score a potential initiative receives for the measure *Full or Part-time* into a unit of value between zero and one. An initiative that can be run concurrently with other initiatives, by the same AO, is preferred over an initiative that will take a majority of an AO's time. Therefore, *part-time* is the most preferred category and *full-time* is the least preferred. The SDVF values are therefore 1 and 0 for *part-time* and *full-time*, respectively. The definitions for the categories are shown in Table 20.

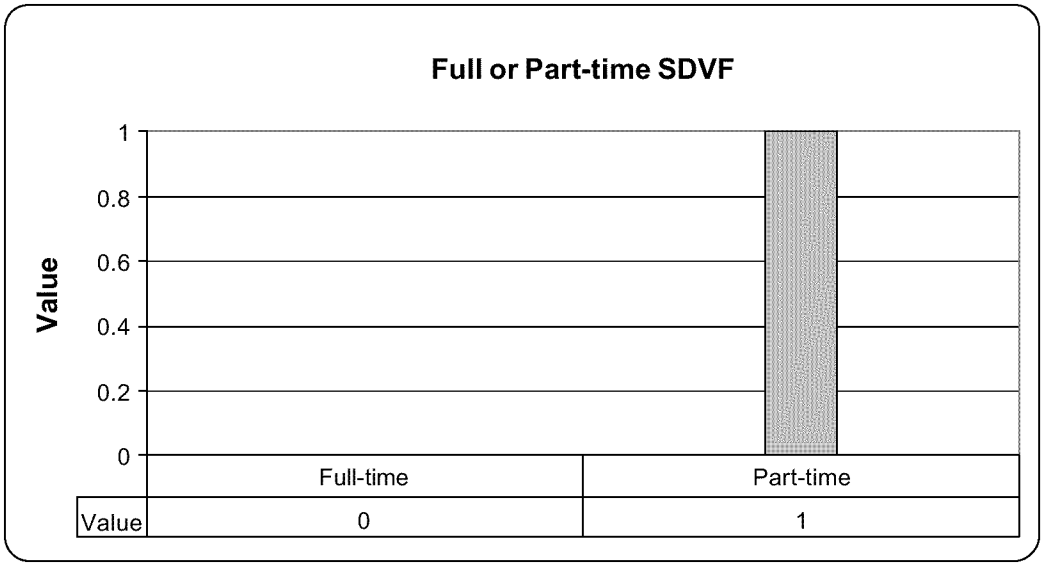

Figure 18. SDVF for *Full or Part-time* (*Lean* Branch)

Table 20. Definitions for *Full or Part-time* Categories

Category	Definition
Full-time	If undertaken, an AO will spend a majority of their time on this initiative.
Part-time	If undertaken, an AO will be able run this initiative concurrently with others.

3.4.1.2 SDVF for Can Any AFSC Serve as AO

The SDVF in Figure 19 translates the score a potential initiative receives for the measure *Can Any AFSC Serve as AO* into a unit of value between zero and one. Initiatives that are more general in nature are preferred by the FPB because they can be lead by any of the available AOs. Therefore, *yes* is the most preferred category and *no* is the least preferred. The SDVF values are therefore 1 and 0 for *yes* and *no*, respectively. The FPB personnel more closely associate the category of *potentially* with the category *no* because they do not value a potential initiative that is so complicated they cannot easily determine whether any AFSC can serve as the AO. The definitions for the categories are shown in Table 21.

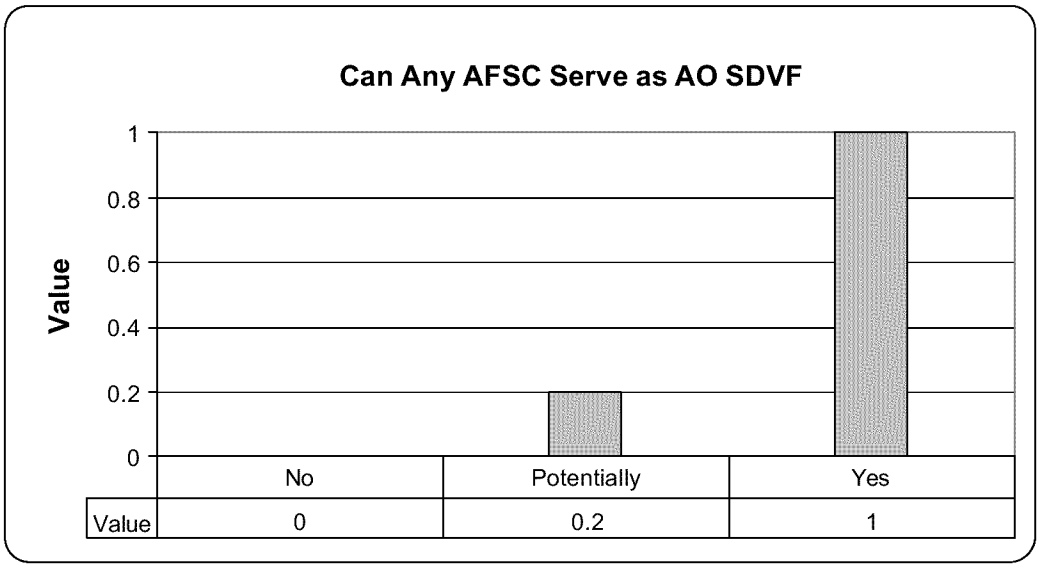

Figure 19. SDVF for *Can Any AFSC Serve as AO* (*Lean* Branch)

Table 21. Definitions for *Can Any AFSC Serve as AO* Categories

Category	Definition
No	Successful evaluation of this initiative requires a specific AFSC.
Potentially	It is not clear whether the initiative requires a specific AFSC.
Yes	Successful evaluation of this initiative definitely does not require a specific AFSC.

3.4.1.3 SDVF for Infrastructure Location

The SDVF in Figure 20 translates the score a potential initiative receives for the measure *Infrastructure Location* into a unit of value between zero and one. The FPB personnel confide that there is an unwanted degree of difficulty to proving the worth of a force protection initiative when it is necessary to obtain the required infrastructure from outside the confines of the FPB. In other words, FPB personnel prefer an initiative where the entire required infrastructure resides with them. Therefore, *internal* is the most preferred category and *external* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel place half as much value on having to use internally available infrastructure as well as externally available infrastructure as they do having all of the infrastructure available internally. This equates to a linear relationship between the three categories. The definitions for the categories are shown in Table 22.

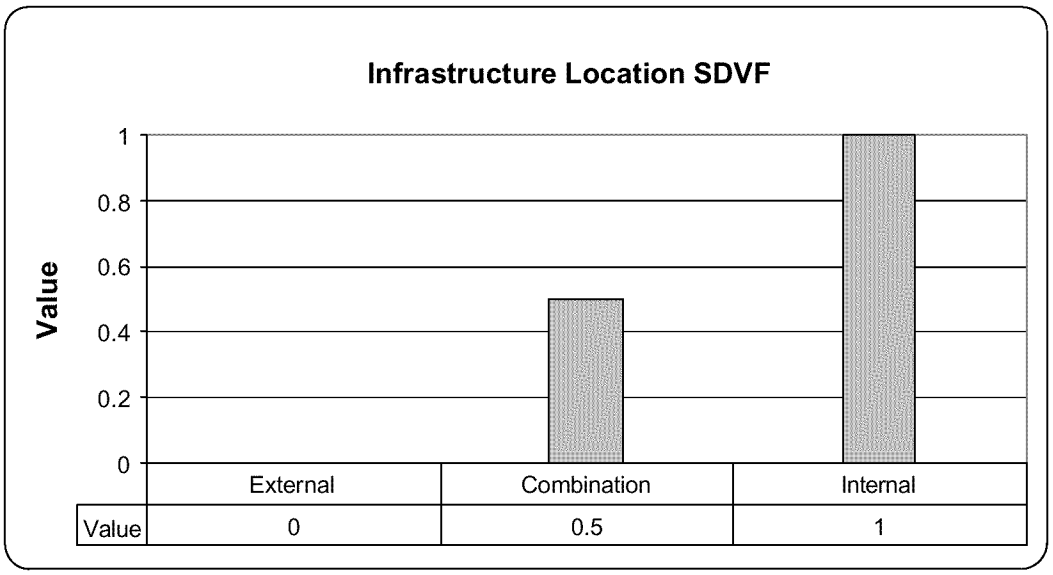

Figure 20. SDVF for *Infrastructure Location* (*Lean* Branch)

Table 22. Definitions for *Infrastructure Location* Categories

Category	Definition
External	All of the infrastructure required to evaluate this initiative resides outside the FPB.
Combination	Elements of the infrastructure required reside both at the FPB and outside the FPB (neither element can be excluded without jeopardizing the initiative evaluation).
Internal	All of the infrastructure required resides within the FPB.

3.4.1.4 SDVF for Percentage of Total Initiative Cost Bore by Others

The SDVF in Figure 21 translates the score a potential initiative receives for the measure *Percentage of Total Initiative Cost Bore by Others* into a unit of value between zero and one. To facilitate evaluating as many initiatives as possible with a fixed budget, FPB personnel value initiatives where a high percentage of the cost is bore by other agencies. Appropriately, *very high* is the most preferred category and *none* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel acknowledge a linear relationship between the categories defined in Table 23.

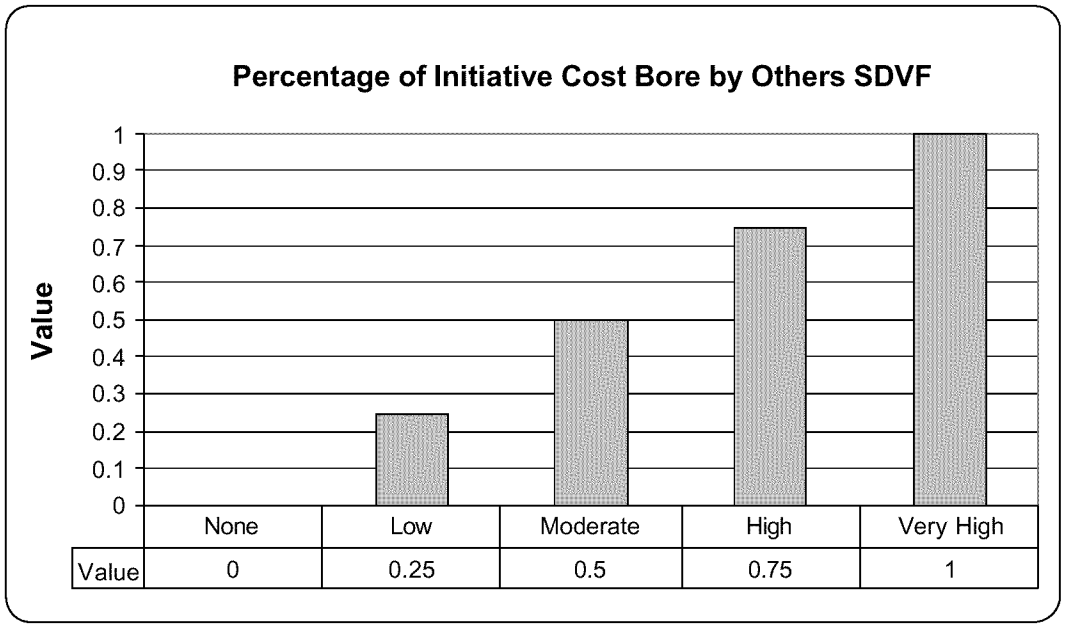

Figure 21. SDVF for *Percentage of Initiative Cost Bore by Others* (*Lean* Branch)

Table 23. Definitions for *Percentage of Initiative Cost Bore by Others* Categories

Category	Definition
None	Zero cost would be bore by others.
Low	The amount bore by others will be approximately > 0 and <= 30%.
Moderate	The amount bore by others will be approximately > 30 and <= 60%.
High	The amount bore by others will be approximately > 60 and <= 90%.
Very High	The amount bore by others will be approximately > 90%.

3.4.1.5 SDVF for Total Estimated Initiative Cost

The SDVF in Figure 22 translates the score a potential initiative receives for the measure *Total Estimated Initiative Cost* into a unit of value between zero and one. The FPB desires initiatives that have a low overall estimated program cost because it allows them to evaluate more force protection initiatives with a given budget. Subsequently, the category depicting *low* overall costs is the most preferred while *exorbitant* is the least preferred with SDVF values of 1 and 0, respectively. The substantial increase in value between *intermediate* and *reasonable* is due to the $250K ceiling that defines *reasonable*. Since the budget of the FPB must be distributed across multiple initiatives within a fiscal year, a potential initiative costing more than $250K is not highly valued. The definitions for the categories are shown in Table 24.

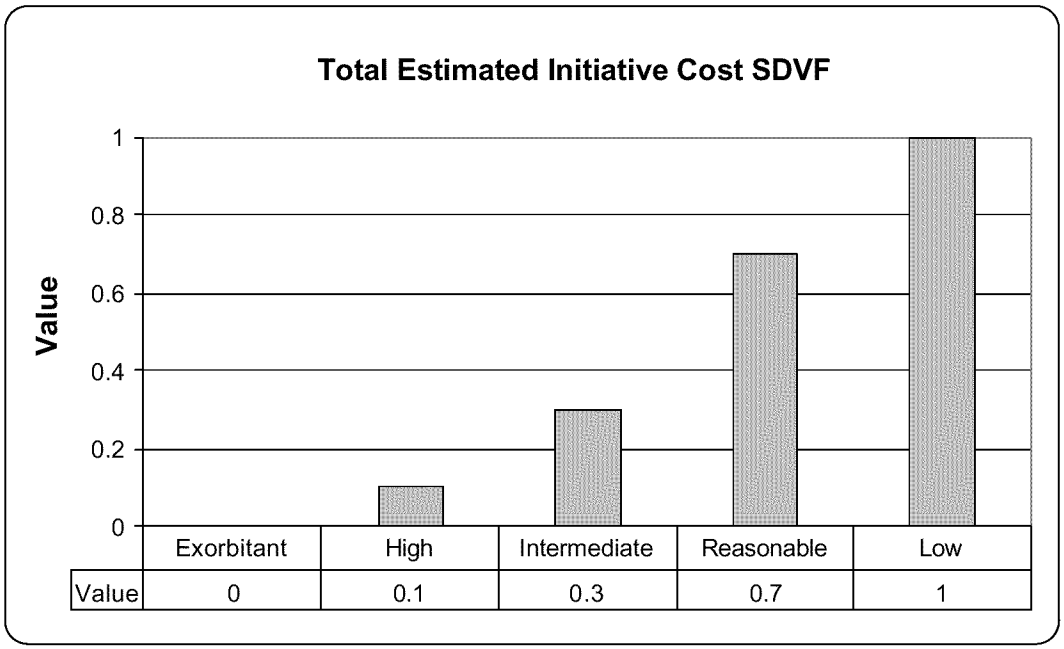

Figure 22. SDVF for *Total Estimated Initiative Cost* (*Lean* Branch)

Table 24. Definitions for *Total Estimated Initiative Cost* Categories

Category	Definition
Exorbitant	Any amount >= $1 million (inc amts > FPBs annual budget).
High	Any amount < $1 million but >= $750K.
Intermediate	Any amount < $750K but >= $250K.
Reasonable	Any amount < $250K but >= $100K.
Low	Any amount < $100K.

3.4.1.6 SDVF for Favorability of Disbursement

The SDVF in Figure 23 translates the score a potential initiative receives for the measure *Favorability of Disbursement* into a unit of value between zero and one. Members of the FPB prefer initiatives having an estimated cost that spans several fiscal years because cost distribution theoretically allows more initiatives to be undertaken in a particular year. As a caveat, they prefer initiatives having an equal distribution (e.g., 50 percent in the first year and 50 percent in the last year, recalling that proof of concept efforts can last up to 18 months) because of the general stability it provides in budgetary planning. However, they prefer non-disbursed initiatives to ones in which an unequal (e.g., between 90 and 99 percent of the cost is in one fiscal year) disbursement exists. Therefore, the category *favorably disbursed* is the most preferred and *unfavorably disbursed* is the least preferred with SDVF values of 1 and 0, respectively. The category *not disbursed* is preferred to *unfavorably disbursed* because of the complexity associated with funding initiatives that span more than one fiscal year. The definitions for the categories are shown in Table 25.

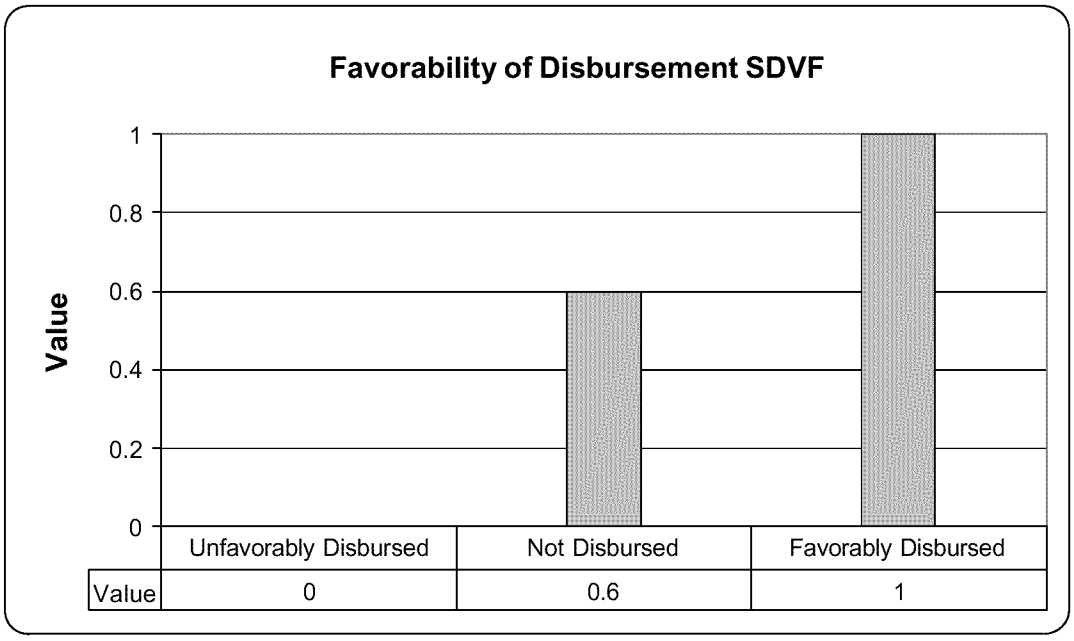

Figure 23. SDVF for *Favorability of Disbursement* (*Lean* Branch)

Table 25. Definitions for *Favorability of Disbursement* Categories

Category	Definition
Unfavorably Disbursed	There is a drastically unequal distribution of the initiatives cost that must be paid in one fiscal year versus another (e.g., 90 percent one FY and 10 percent the next FY).
Not Disbursed	No disbursement. The initiative will be paid for in one fiscal year.
Favorably Disbursed	There is an equitable distribution of the initiatives cost spanning fiscal years (e.g., 50 percent one FY and 50 percent the next FY).

3.4.2 *Unique* Branch SDVFs

The *Unique* branch of the hierarchy contains three measures which describe the degree to which the respective value in the fourth tier of the branch is achieved. The description of the SDVF associated with each *Unique* measure is given in the following paragraphs.

3.4.2.1 SDVF for Innovativeness

The SDVF in Figure 24 translates the score a potential initiative receives for the measure *Innovativeness* into a unit of value between zero and one. The FPB personnel prefer to evaluate initiatives that use existing technology, equipment, or doctrine for other than the originally intended purpose. The category *totally innovative purpose* is the most preferred and *intended purpose* is the least preferred with SDVF values of 1 and 0, respectively. However, since any amount of innovation is highly valued by FPB personnel, they place a commensurately high value on the middle category, *slightly modified purpose*. The definitions for the categories are shown in Table 26.

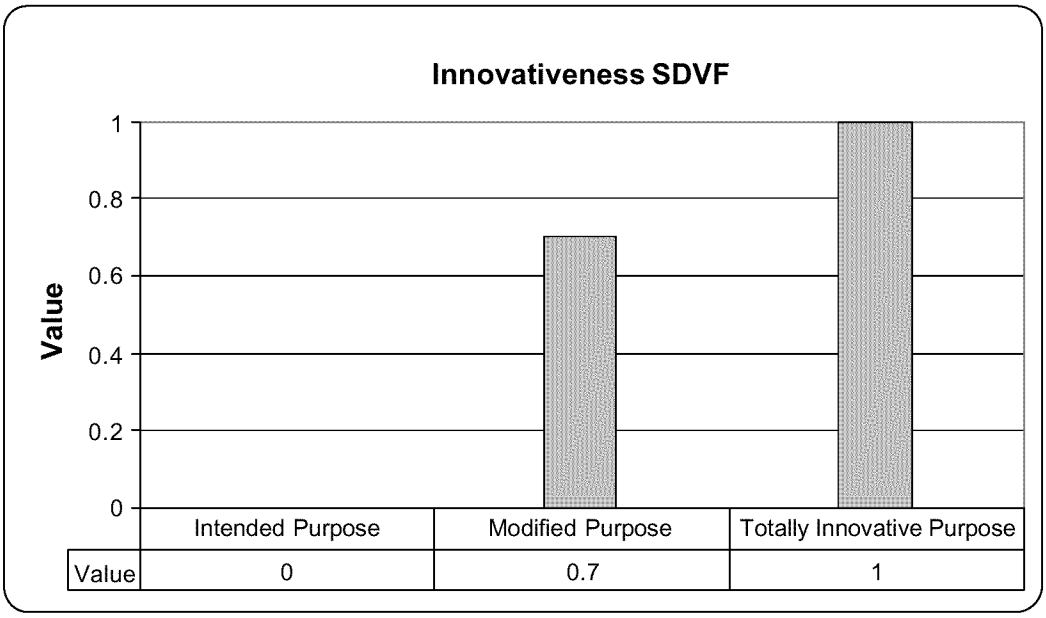

Figure 24. SDVF for *Innovativeness* (*Unique* Branch)

Table 26. Definitions for *Innovativeness* Categories

Category	Definition
Intended Purpose	Idea is in no way innovative and seems to be an acquisition request vs. an idea for evaluation.
Modified Purpose	Idea requires nonexistent or immature equipment or technology for use in an innovative fashion, or reflects only slight modification (not worthy of "innovative" notoriety).
Innovative Purpose	Idea suggests using COTS or GOTS equipment or technology in an innovative fashion.

3.4.2.2 SDVF for FP Correlation

The SDVF in Figure 25 translates the score a potential initiative receives for the measure *FP Correlation* into a unit of value between zero and one. The FPB personnel prefer to evaluate initiatives having a strong correlation to force protection problems. The category *direct* is the most preferred and *real stretch* is the least preferred with SDVF values of 1 and 0, respectively. The value associated with the *limited* category is low because FPB personnel recognize that their mission is to enhance the capabilities of the Air Force and joint warfighting community through pursuit of force protection related initiatives. The definitions for the categories are shown in Table 27.

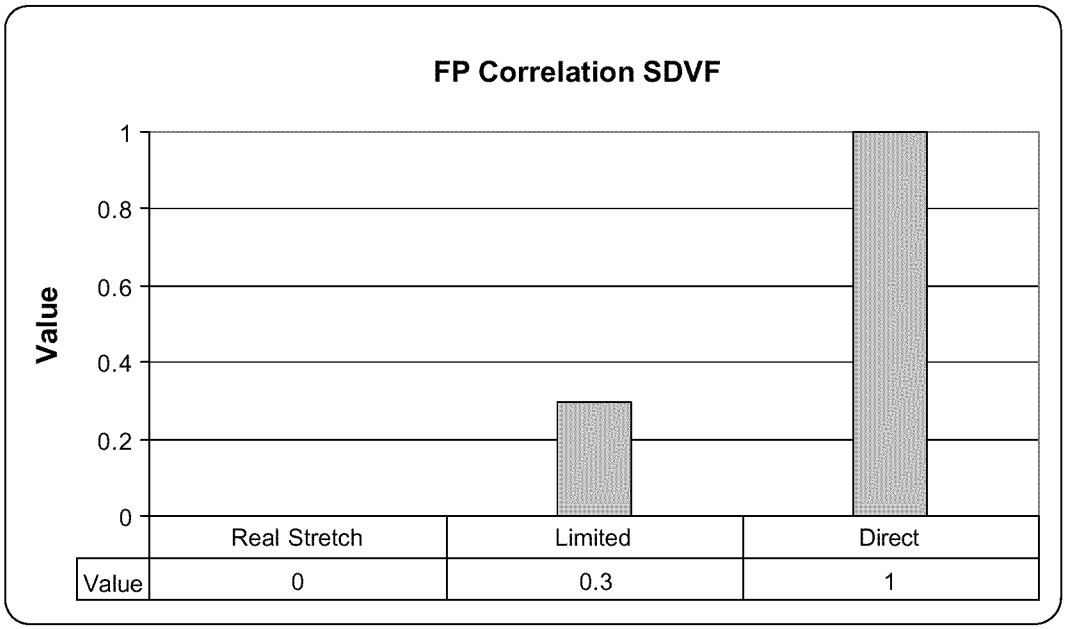

Figure 25. SDVF for *FP Correlation* (*Unique* Branch)

Table 27. Definitions for *FP Correlation* Categories

Category	Definition
Real Stretch	Associating the idea with the theme of force protection is not imaginable.
Limited	The idea has a limited, however valuable, association with the theme of force protection.
Direct	The idea has a direct, unequivocal association with the theme of force protection.

3.4.2.3 SDVF for Degree of Similarity

The SDVF in Figure 26 translates the score a potential initiative receives for the measure *Degree of Similarity* into a unit of value between zero and one. The FPB personnel prefer to evaluate initiatives that are not similar to other efforts at other agencies. They view duplication of efforts as wasteful of effort, time, and money. The category *very different* is thus most preferred and *identical* is the least preferred with SDVF values of 1 and 0, respectively. Since many initiatives may appear duplicative on the surface but are evaluated with the intention of achieving different end-states, the FPB personnel place almost as much value on those that are *different* as they do on those that are *very different*. Similarly, if a seemingly duplicative effort is found at another agency, the FPB does not place a high amount of value on it until they understand why it is being pursued. The definitions for the categories are shown in Table 28.

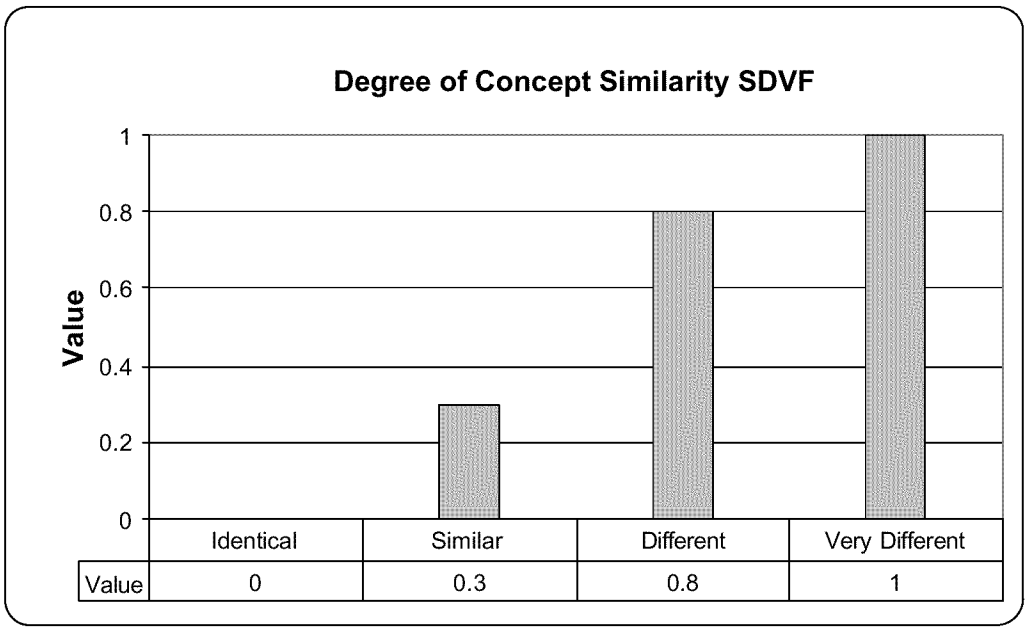

Figure 26. SDVF for *Degree of Similarity* (*Unique* Branch)

Table 28. Definitions for *Degree of Similarity* Categories

Category	Definition
Identical	Efforts are indistinguishable; outcomes will be identical.
Similar	Efforts are comparable and justify further exploration; outcomes may be closely related.
Different	Efforts are sparingly duplicative and justify full FPB engagement; outcomes will surely be different.
Very Different	No similar efforts exist whatsoever; the FPB initiative is one-of-a-kind.

3.4.3 *Focused* Branch SDVFs

The *Focused* branch of the hierarchy contains eleven measures, which describe the degree to which the respective value in the fourth tier of the branch is achieved. The description of the SDVF associated with each *Focused* measure is given in the following paragraphs.

3.4.3.1 SDVF for Level of Request

The SDVF in Figure 27 translates the score a potential initiative receives for the measure *Level of Request* into a unit of value between zero and one. The FPB personnel acknowledge the military structure of the Air Force by preferring to focus on initiative submittals that come from higher levels in the chain of command. For example, an initiative submittal from Headquarters Air Force receives more value than one from base level. If a submittal is received indicating advocacy from more than one level within the military organizational structure, only the highest level is considered when using the value model to score the potential initiative. The *Headquarters Air Force* category is the most preferred while *unit* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel closely associate *unit* with *base level* and subsequently their values are close on the lower end of the value scale. The FPB personnel indicate that an initiative submittal from a *numbered Air Force* is twice as important as one from the *base level*. Additionally, they feel there is a significant jump (a doubling of value) between an initiative submittal from a *numbered Air Force* and a *major command* because they have the impression that major commands have more power and influence over the warfighter than do the numbered Air Forces. As a testimony to the importance

the FPB personnel place on major commands, they closely associate an initiative submittal from a *major command* with one from *Headquarters Air Force.* The definitions for the categories are shown in Table 29.

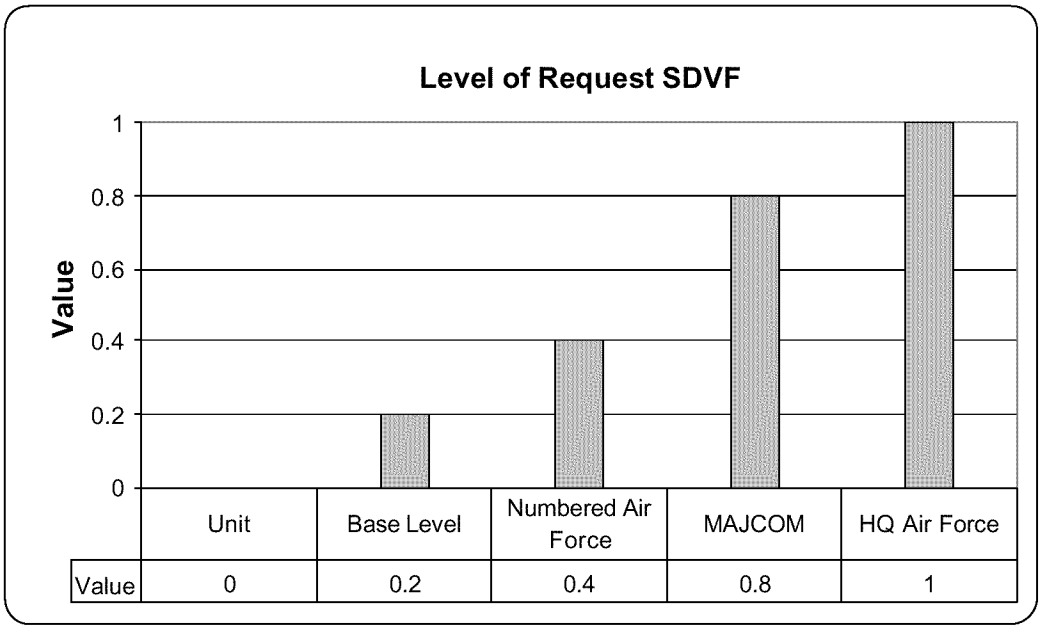

Figure 27. SDVF for *Level of Request* (*Focused* Branch)

Table 29. Definitions for *Level of Request* Categories

Category	Definition
Unit/Internal	Individual flights, squadrons, divisions, groups that have no evidence of advocacy from a wing or base commander.
Base Level	Wing or base commander endorsement.
Numbered Air Force	NAF commander endorsement.
MAJCOM	MAJCOM commander endorsement.
Headquarters Air Force	Endorsement or direction from leaders in HQ Air Force positions.

3.4.3.2 SDVF for Urgency

The SDVF in Figure 28 translates the score a potential initiative receives for the measure *Urgency* into a unit of value between zero and one. The FPB commander is sensitive to the concerns of the force protection "customers" in the field (Dillard, 2001). The value the FPB places on those concerns is influenced by the value the customer places on them. The FPB prefers initiatives that are submitted with a high priority because they know the submitting agency or office will provide a subsequent high degree of support throughout the initiative execution. Therefore, the category *highest priority* is the most preferred while *routine* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel do not differentiate much between the categories *routine* and *urgent* because in the eyes of the submitter each potential initiative is at least *urgent*. Determining which of the two categories is most appropriate is therefore left to

the subjective interpretation of the AOs. Likewise, the difference in value between *priority* and *highest priority* is small because each initiative that, in the eyes of the submitter, is higher in priority than the aforementioned *urgent* is elevated all the way to *highest priority* and skips the *priority* category. Again, it is left to the subjective interpretation of the AOs to determine which category is most appropriate. The definitions for the categories are shown in Table 30.

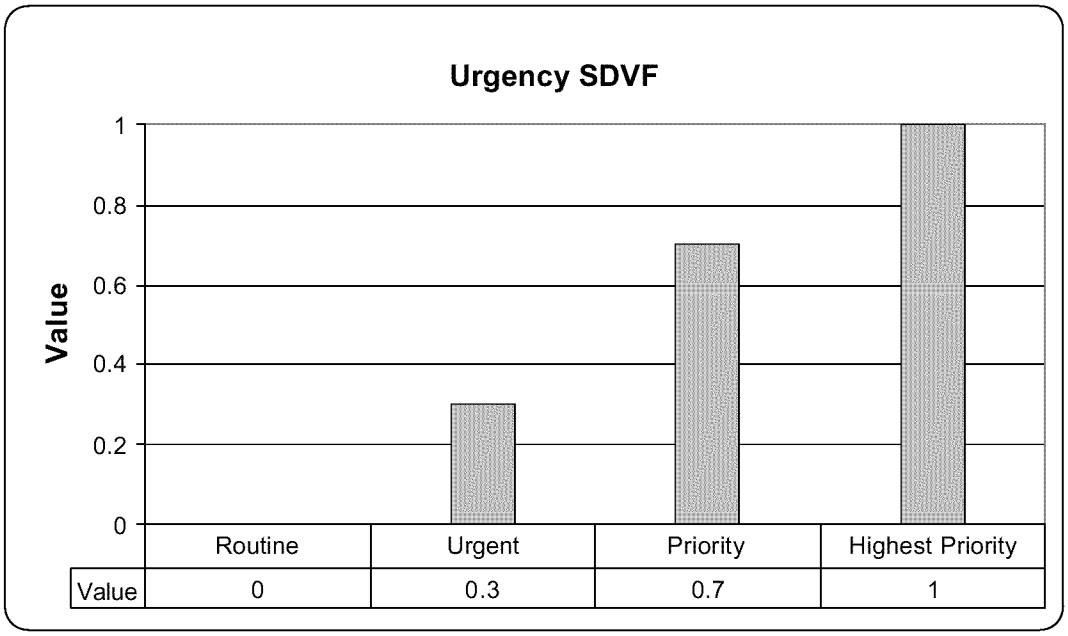

Figure 28. SDVF for *Urgency* (*Focused* Branch)

Table 30. Definitions for *Urgency* Categories

Category	Definition
Routine	No pressure to accomplish this initiative before any others.
Urgent	An initiative deemed important enough to be assigned an AO right away.
Priority	Aside from extraordinary circumstances, the initiative should take precedence.
Highest Priority	Maximum importance; all FPB resources should be redirected to accomplish.

3.4.3.3 SDVF for Estimated Time to Complete an Initiative

The SDVF in Figure 29 translates the score a potential initiative receives for the measure *Estimated Time to Complete an Initiative* into a unit of value between zero and one. According to AFI 10-1901, the battlelabs have 18 months to prove the military worth of an initiative (Department of the Air Force, 1997:8). If the 18-month time limit is removed in the future, the spirit of intent for the battlelabs will remain "…rapidly identifying and proving the worth of innovative and revolutionary operations and logistics concepts" (Department of the Air Force, 1997:2). Subsequently, FPB personnel will always value initiatives that can be proven quickly. Appropriately, the category *quick* is the most preferred and *very slow* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel indicated a significant decrease in value between *relatively quick* and *slow*. They wanted a value for *slow* that was near zero because support for the initiative from the submitting agency or office dramatically decreases if

that initiative takes longer than 12 months to complete. The definitions for the categories are shown in Table 31.

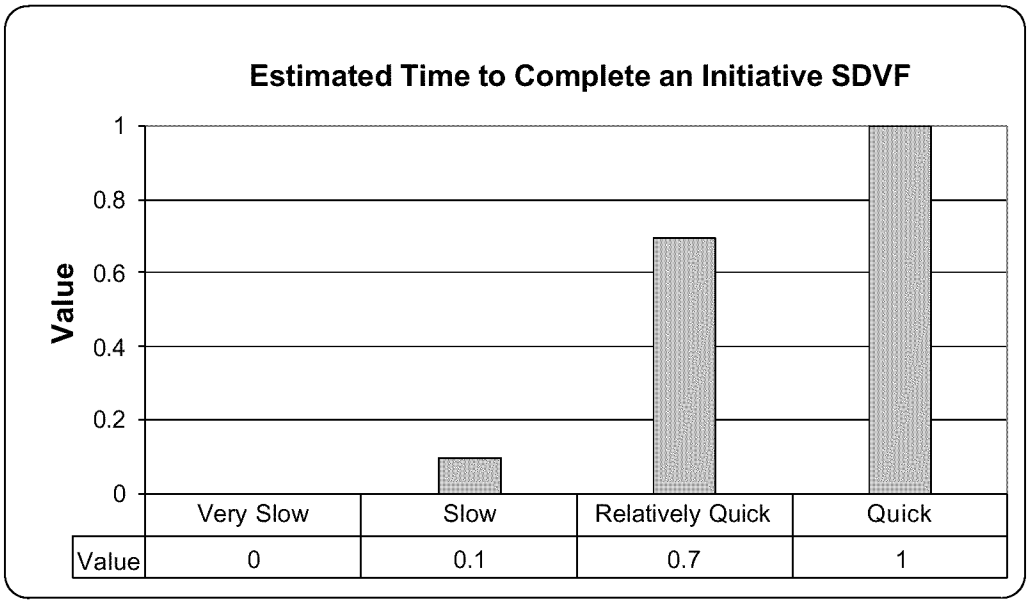

Figure 29. SDVF for *Estimated Time to Complete an Initiative* (*Focused* Branch)

Table 31. Definitions for *Estimated Time to Complete an Initiative* Categories

Category	Definitions
Very Slow	The time is > 18 months.
Slow	The time is >12 months and <= 18 months.
Relatively Quick	The time is > 6 months and <= 12 months.
Quick	The time is > 0 months or <= 6 months.

3.4.3.4 SDVF for Cost Risk

The SDVF in Figure 30 translates the score a potential initiative receives for the measure *Cost Risk* into a unit of value between zero and one. The FPB personnel will always prefer a potential initiative that has low cost risk because they execute multiple initiatives in a concurrent fashion throughout any particular fiscal year. Therefore, any initiative that exceeds its initial cost estimate negatively influences the FPB's ability to effectively execute the other initiatives. Consequently, the category *low* is the most preferred and *high* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel only slightly disvalue a potential initiative with a *medium* risk of exceeding its estimated cost. In other words, they are confident that an initiative exceeding its estimated cost will continue to be funded. The definitions for the categories are shown in Table 32.

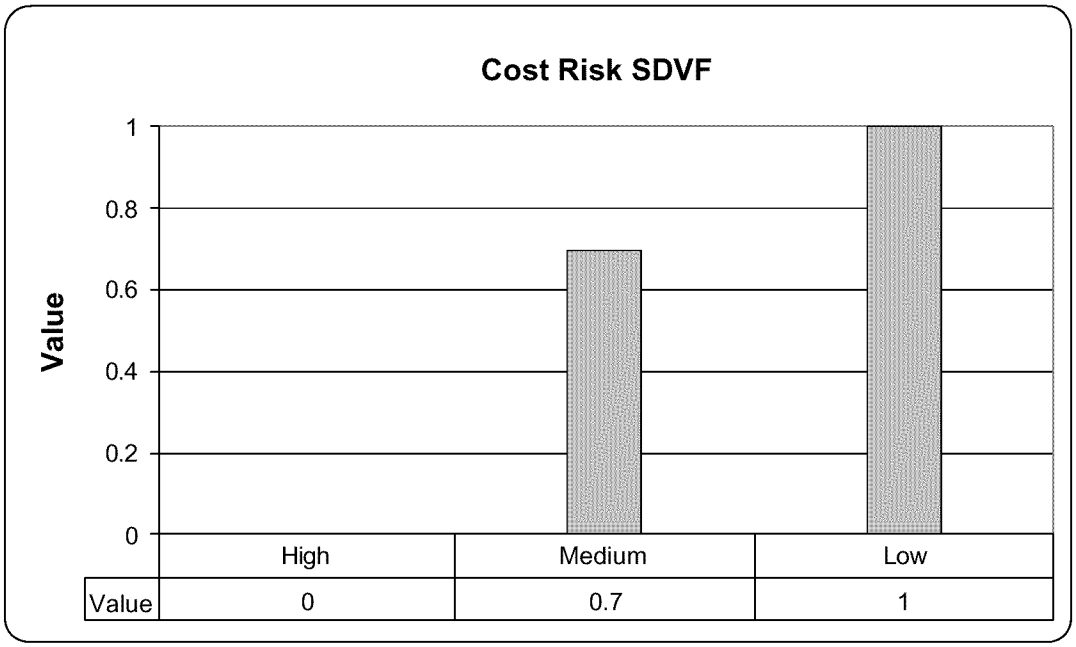

Figure 30. SDVF for *Cost Risk* (*Focused* Branch)

Table 32. Definitions for *Cost Risk* Categories

Category	Definitions
High	The probability is great to certain the initiative will exceed its initial cost estimate.
Medium	The probability is significant the initiative will exceed initial cost estimate.
Low	The probability is insignificant the initiative will exceed initial cost its estimate.

3.4.3.5 SDVF for Schedule Risk

The SDVF in Figure 31 translates the score a potential initiative receives for the measure *Schedule Risk* into a unit of value between zero and one. The FPB personnel will always prefer a potential initiative that has low schedule risk because they perceive a delay in proving the military worth of an initiative as a delay in providing force protection capabilities to the warfighter. Therefore, the category *low* is the most preferred and *high* is the least preferred with SDVF values of 1 and 0, respectively. The definitions for the categories are shown in Table 33.

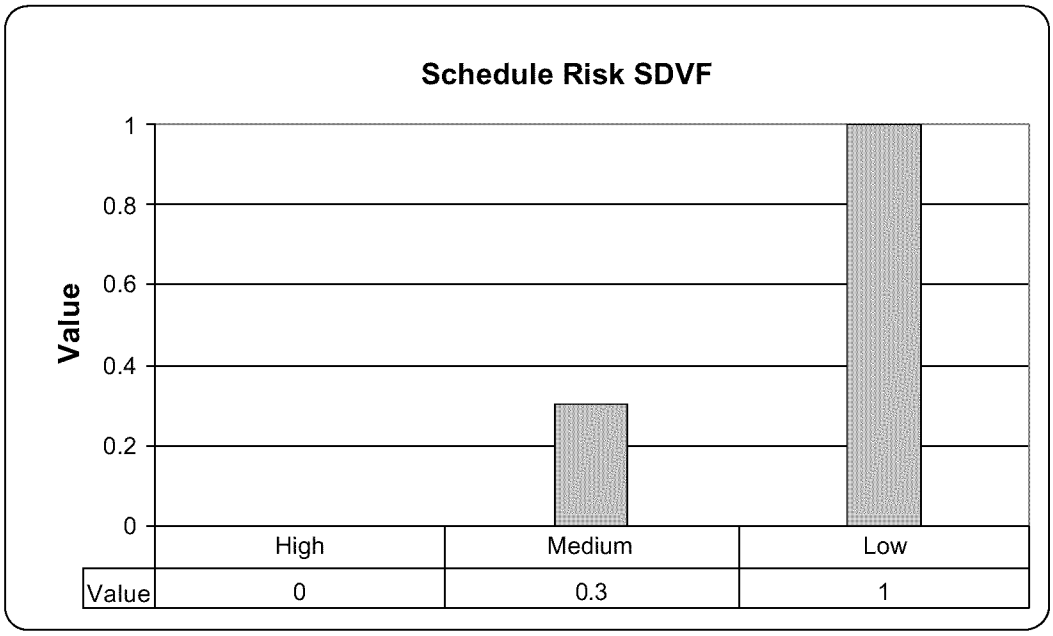

Figure 31. SDVF for *Schedule Risk* (*Focused* Branch)

Table 33. Definitions for *Schedule Risk* Categories

Category	Definition
High	The probability is great to certain the initiative will exceed its initial time estimate.
Medium	The probability is significant the initiative will exceed initial time estimate.
Low	The probability is insignificant the initiative will exceed initial time its estimate.

3.4.3.6 SDVF for Performance Risk

The SDVF in Figure 32 translates the score a potential initiative receives for the measure *Performance Risk* into a unit of value between zero and one. The FPB personnel will always prefer a potential initiative that has low performance risk. This is primarily due to the definition for the measure *Performance Risk*. The definition attempts to capture all aspects of risk that are not captured in the two previous risk categories (i.e., *cost* and *schedule*) and includes (but is not limited to) potential proof of concept difficulties as well as issues associated with transitioning an initiative proven to have military worth to the operational Air Force. Therefore, the category *low* is the most preferred and *high* is the least preferred with SDVF values of 1 and 0, respectively. The definitions for the categories are shown in Table 34.

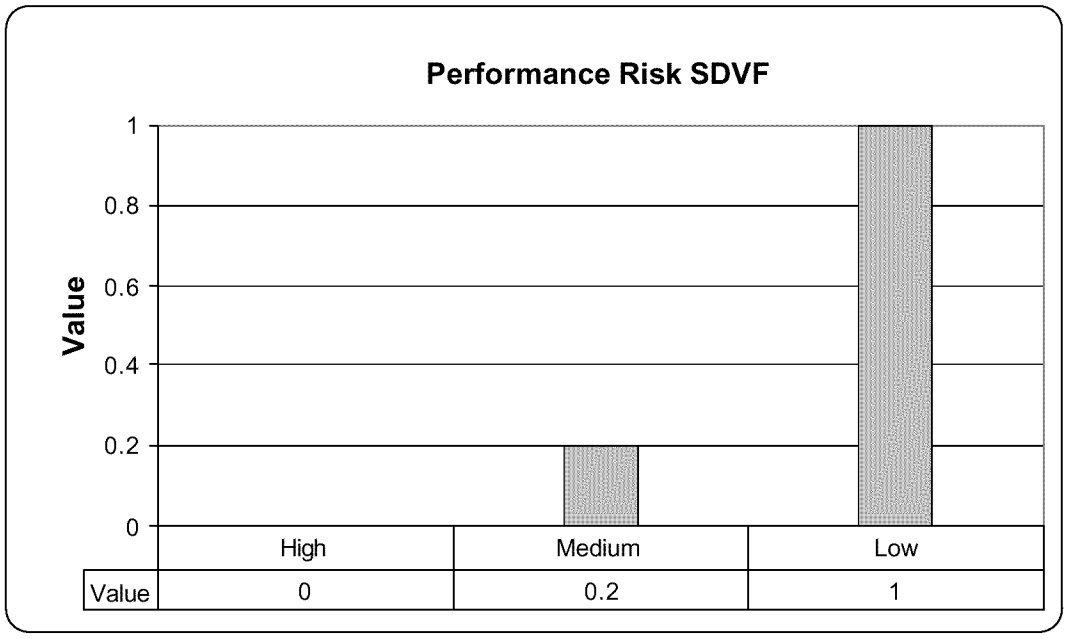

Figure 32. SDVF for *Performance Risk* (*Focused* Branch)

Table 34. Definitions for *Performance* Risk Categories

Category	Definition
High	The probability is great to certain there will be comp lications in the initiatives evaluation.
Medium	The probability is significant there will be complications in the initiatives evaluation.
Low	The probability is insignificant there will be complications in the initiatives evaluation.

3.4.3.7 SDVF for Sensibility

The SDVF in Figure 33 translates the score a potential initiative receives for the measure *Sensibility* into a unit of value between zero and one. While the FPB personnel value "imagination" and "out of the box" thinking, they do not value ludicrous force protection ideas (Department of the Air Force, 2001:7). The category *very* is subsequently the most preferred while *not at all* is the least preferred with SDVF values of 1 and 0, respectively. Because AFI 10-1901 implicates that the Air Force "take advantage of the rapid pace of technology by …expand[ing] boundaries and break[ing] old molds …chang[ing] paradigms and creat[ing] new ones," the FPB allows a significant amount of leniency when assigning value for the *Sensibility* of a potential initiative (Department of the Air Force, 1997:2). That leniency is evidenced in the linear relationship between the categories in the *Sensibility* SDVF. The definitions for the categories are shown in Table 35.

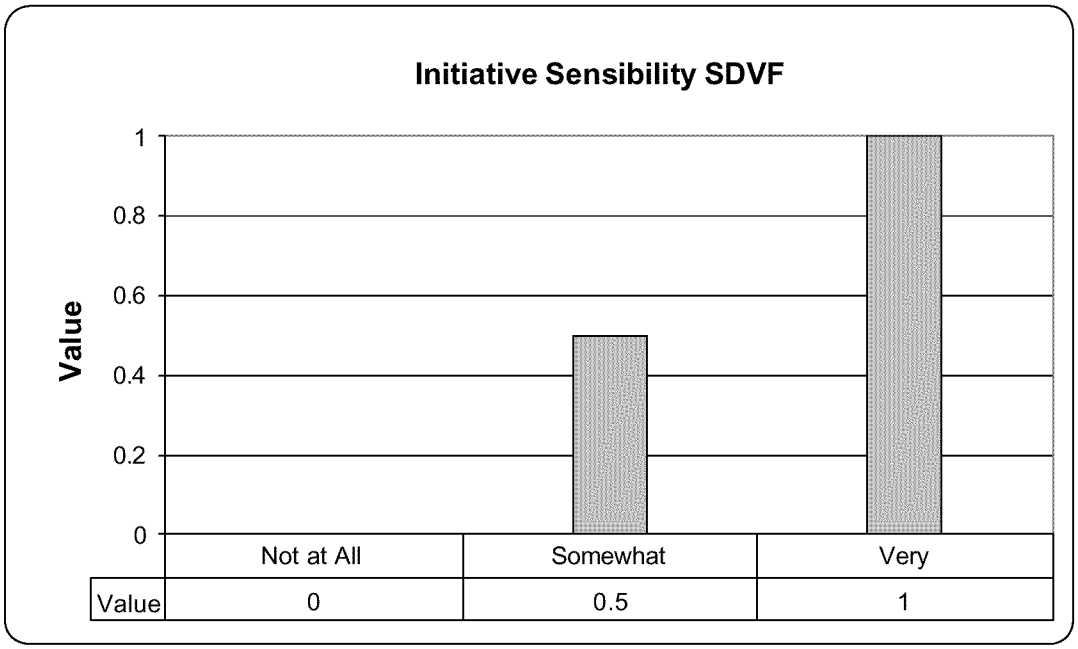

Figure 33. SDVF for *Sensibility* (*Focused* Branch)

Table 35. Definitions for *Sensibility* Categories

Category	Definition
Not at All	The idea is more appropriate for a science-fiction novel or totally outside the realm of possibility.
Somewhat	The idea is pushing the cutting edge of technology or revolutionary in thought.
Very	The idea is within grasp of existing technology or very conceivable in thought.

3.4.3.8 SDVF for Degree of Leveraging Existing Technology

The SDVF in Figure 34 translates the score a potential initiative receives for the measure *Degree of Leveraging Existing Technology* into a unit of value between zero and one. The FPB personnel value the ability to leverage existing technology in their quest to prove the military worth of an initiative. The category *all* is the most preferred while *none* is the least preferred with SDVF values of 1 and 0, respectively. The FPB members consider an initiative where only a portion of it leverages existing technology somewhat valuable because they know proofs of concept can still be successful when immature (i.e., prototype) technology is used. The definitions for the categories are shown in Table 36.

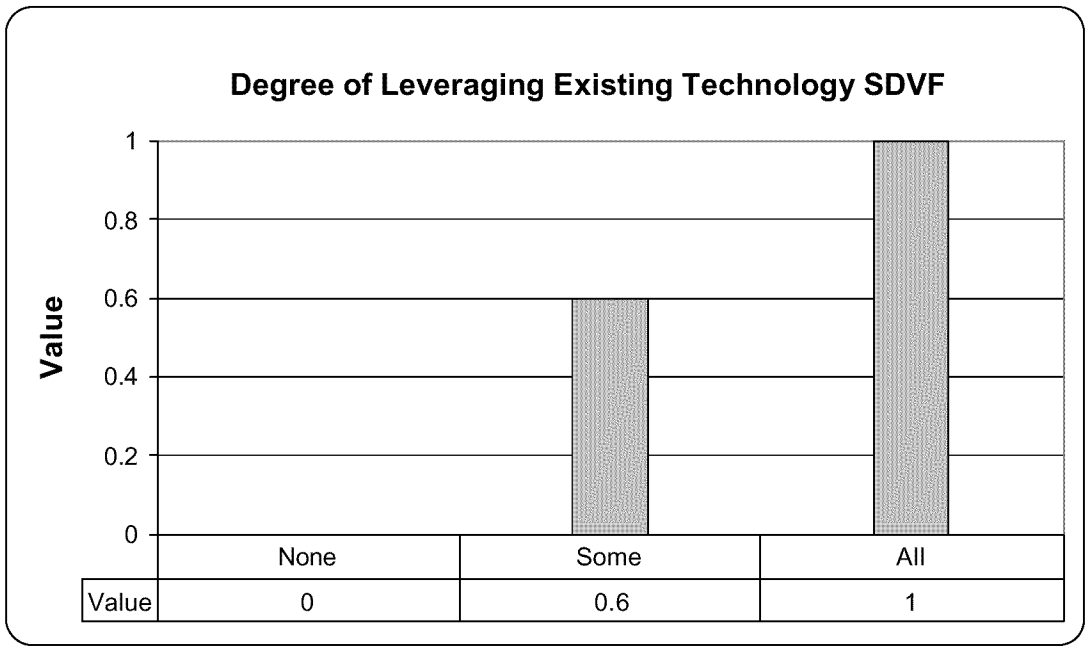

Figure 34. SDVF for *Degree Leveraging Existing Technology* (*Focused* Branch)

Table 36. Definitions for *Degree of Leveraging Existing Technology* Categories

Category	Definitions
None	No existing technology will be used in executing this initiative.
Some	A portion of the initiative will be executed using existing technology.
All	The entire initiative will be executed using existing technology.

3.4.3.9 SDVF for Degree of Leveraging Existing Contracts

The SDVF in Figure 35 translates the score a potential initiative receives for the measure *Degree of Leveraging Existing Contracts* into a unit of value between zero and one. The FPB personnel value the ability to leverage existing contracts in their quest to prove the military worth of an initiative. The category *all* is the most preferred while *none* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel indicate that they value the use of existing contracts, even in limited proportion, because the bureaucratic process to establish a contract takes a long time and negatively impacts the initiative execution schedule. The definitions for the categories are shown in Table 37.

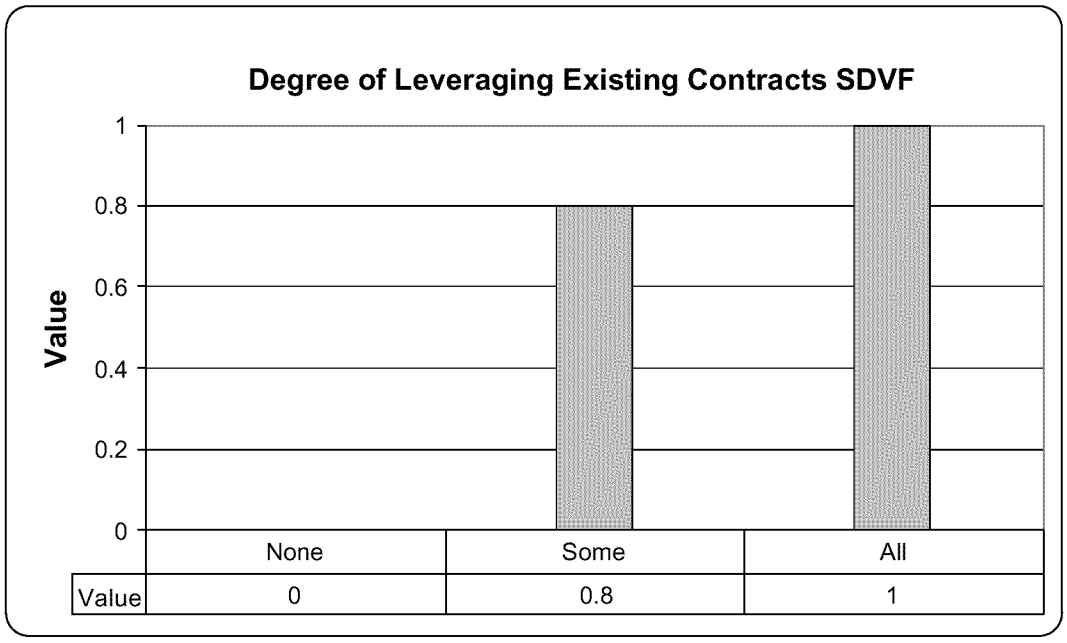

Figure 35. SDVF for *Degree Leveraging Existing Contracts* (*Focused* Branch)

Table 37. Definitions for *Degree of Leveraging Existing Contracts* Categories

Category	Definition
None	No existing contracts will be used in executing this initiative.
Some	A portion of the initiative will be executed using existing contracts.
All	The entire initiative will be executed using existing contracts.

3.4.3.10 SDVF for Degree of Leveraging Existing Expertise

The SDVF in Figure 36 translates the score a potential initiative receives for the measure *Degree of Leveraging Existing Expertise* into a unit of value between zero and one. The FPB personnel value the ability to leverage existing expertise in their quest to prove the military worth of an initiative. The category *all* is the most preferred while *none* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel indicate that they do not highly value the ability to execute only portions of an initiative with existing expertise. That is, regardless of whether there is *some* or *none* existing expertise available, the task of evaluating an initiative's military worth is still difficult. The definitions for the categories are shown in Table 38.

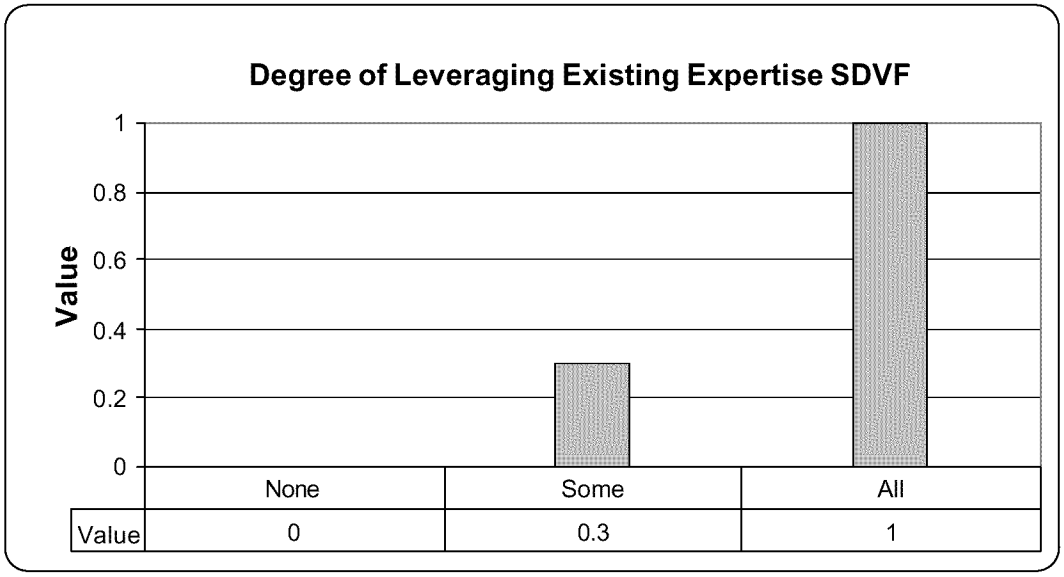

Figure 36. SDVF for *Degree Leveraging Existing Expertise* (*Focused* Branch)

Table 38. Definitions for *Degree of Leveraging Existing Expertise* Categories

Category	Definition
None	No existing expertise will be used in executing this initiative.
Some	A portion of the initiative will be executed using existing expertise.
All	The entire initiative will be executed using existing expertise.

3.4.3.11 SDVF for Degree of Leveraging Existing POC Venues

The SDVF in Figure 37 translates the score a potential initiative receives for the measure *Degree of Leveraging Existing POC Venues* (i.e., proof of concept venues) into a unit of value between zero and one. The category *all* is the most preferred while *none* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel value any ability to leverage existing POC venues because constructing "test-beds" from scratch is often the most difficult aspect of evaluating an initiative's military worth. The definitions for the categories are shown in Table 39.

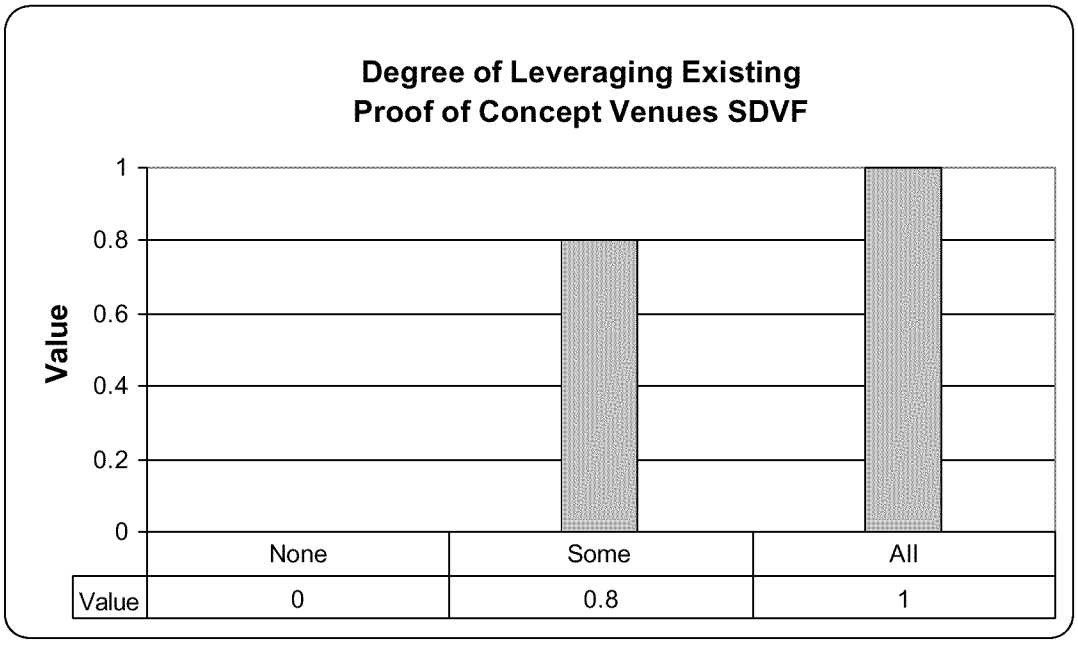

Figure 37. SDVF for *Degree Leveraging Existing POC Venues* (*Focused* Branch)

Table 39. Definitions for *Degree of Leveraging Existing POC Venues* Categories

Category	Definition
None	No existing POC venues will be used in executing this initiative.
Some	A portion of the initiative will be executed using existing POC venues.
All	The entire initiative will be executed using existing POC venues.

3.4.4 *Impact* Branch SDVFs

The *Impact* branch of the hierarchy contains ten measures which describe the degree to which the respective value in the fourth tier of the branch is achieved. The description of the SDVF associated with each *Impact* measure is given in the following paragraphs.

3.4.4.1 SDVF for Level of Impact

The SDVF in Figure 38 translates the score a potential initiative receives for the measure *Level of Impact* into a unit of value between zero and one. The FPB personnel desire the initiatives they execute to have a wide reaching positive impact on the Air Force. They do not value potential initiatives where the impact is only localized. Therefore, the category *global* is the most preferred and *localized* is the least preferred with SDVF values of 1 and 0, respectively. The definitions for the categories are shown in Table 40.

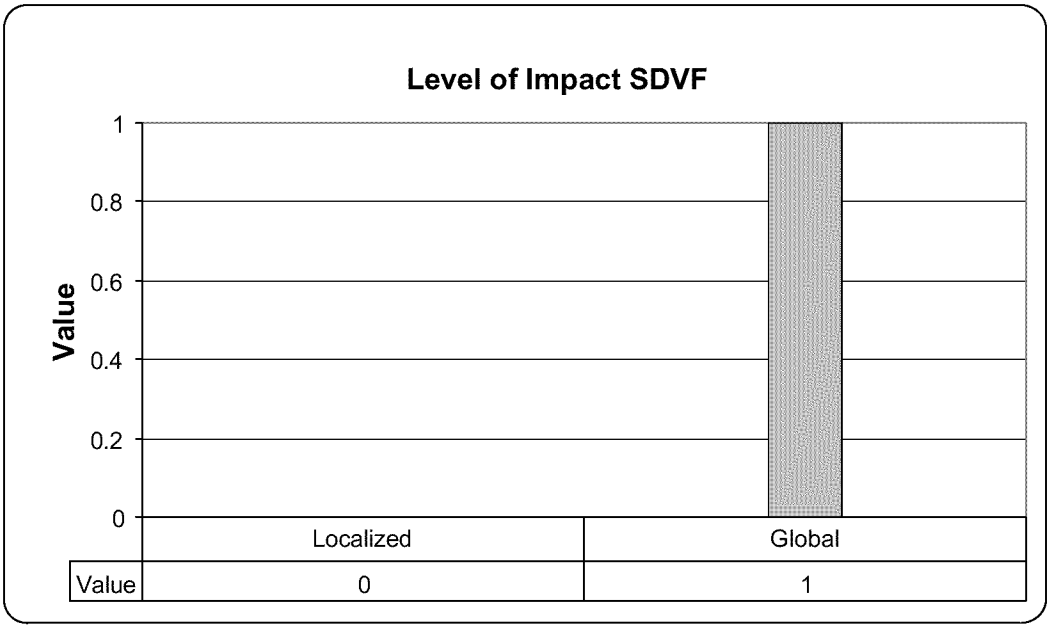

Figure 38. SDVF for *Level of Impact* (*Impact* Branch)

Table 40. Definitions for *Level of Impact* Categories

Category	Definition
Localized	The impact of the successful initiative is only felt within a specific area.
Global	The impact of the successful initiative is felt across a broad spectrum.

3.4.4.2 SDVF for Estimated Time to Field

The SDVF in Figure 39 translates the score a potential initiative receives for the measure *Estimated Time to Field* into a unit of value between zero and one. The FPB personnel value "…swift fielding of proven concepts" (Department of the Air Force, 1997:3). The category *short time* is the most preferred and *long time* is the least preferred with SDVF values of 1 and 0, respectively. To echo the requirement in AFI 10-1901 and fulfill the spirit of intent behind battlelabs, the FPB personnel acknowledge that if an initiative takes some intermediate time to field (i.e., between taking a long time and a short time) they want to more closely associate it with taking a long time to field and assign it a low value. The definitions for the categories are shown in Table 41.

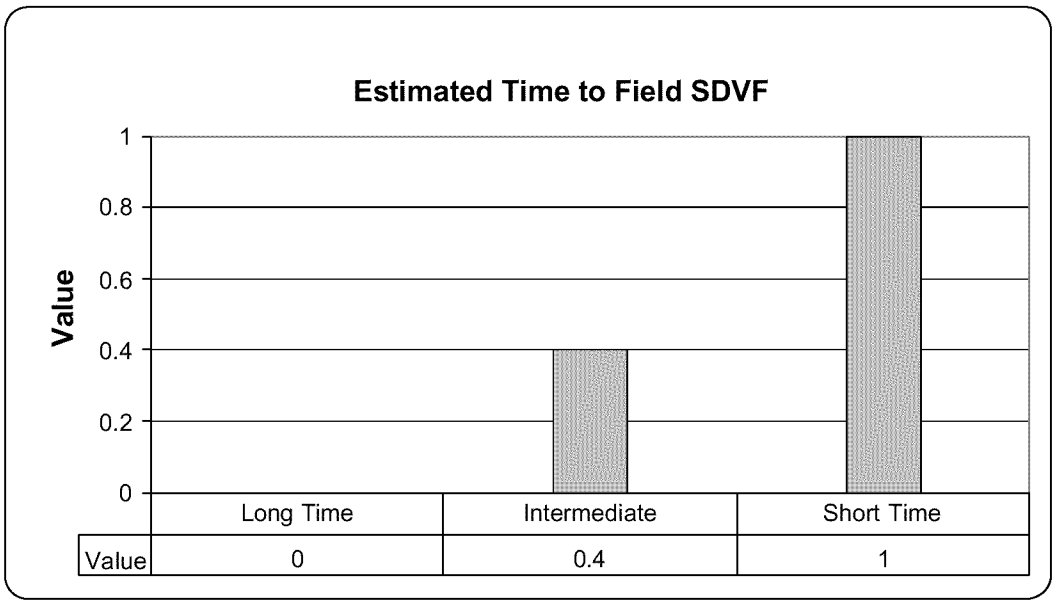

Figure 39. SDVF for *Estimated Time to Field* (*Impact* Branch)

Table 41. Definitions for *Estimated Time to Field* Categories

Category	Definition
Long Time	The impact of the successful initiative will not be recognized in the field for 5 + years.
Intermediate	The impact of the successful initiative will be recognized in the field between 2 and 5 years.
Short Time	The impact of the successful initiative will be recognized in the field before 2 years expire.

3.4.4.3 SDVF for Longevity

The SDVF in Figure 40 translates the score a potential initiative receives for the measure *Longevity* into a unit of value between zero and one. The FPB personnel value proving the worth of an initiative that will endure as a permanent solution to a force protection problem. The category *permanent* is the most preferred while *temporary* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel acknowledge that almost every potential force protection initiative is intended to be a permanent solution to a force protection problem. The permanence of an initiative is not truly known until tested by the element of time. Therefore, to fairly score the *Longevity* of a potential initiative, the default value it receives is one, unless known for certain and from inception that the initiative is only a temporary (i.e., "band-aid") solution. The definitions for the categories are shown in Table 42.

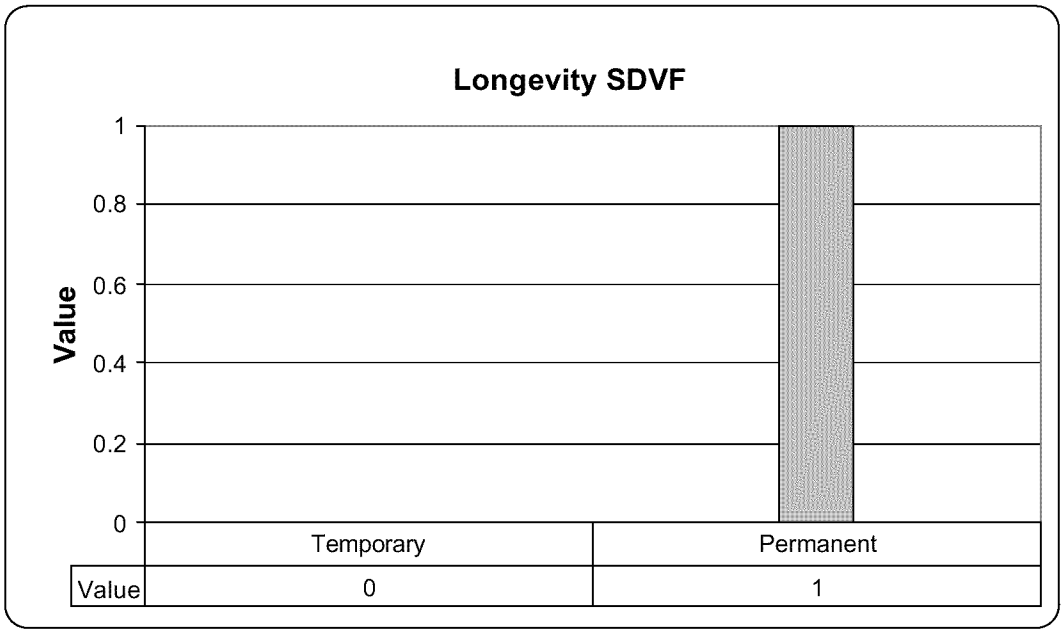

Figure 40. SDVF for *Longevity* (*Impact* Branch)

Table 42. Definitions for *Longevity* Categories

Category	Definition
Temporary	The initiative is known to be only an intermediate solution.
Permanent	The initiative is assumed to be an enduring solution.

3.4.4.4 SDVF for Number of Core Competencies Advanced

The SDVF in Figure 41 translates the score a potential initiative receives for the measure *Number of Core Competencies Advanced* into a unit of value between zero and one. The FPB personnel value initiatives that advance as many of the Air Force's six core competencies as possible. Therefore, the category *6* is the most preferred and *0* is the least preferred with SDVF values of 1 and 0, respectively. The definition of each core competency, shown in Table 43, is summarized from Air Force Doctrine Document 1. Table 43 is considered a worksheet; a value of 1 is given to a potential initiative if it will advance a specific core competency and a value of 0 if it will not. The resulting sum of zeros and ones is plotted on the SDVF to arrive at a value. Since the FPB personnel highly value advancing even one Air Force core competency, the value associated with category *1* is high and the value continues to increase with each additional core competency advanced. The FPB personnel also note there have been few initiatives that had the potential to advance more than three core competencies. Subsequently, while still desiring some separation between advancing four, five, or six core competencies, they judge the value associated with advancing that many to be nearly equal. The definitions for the categories are shown in Table 43.

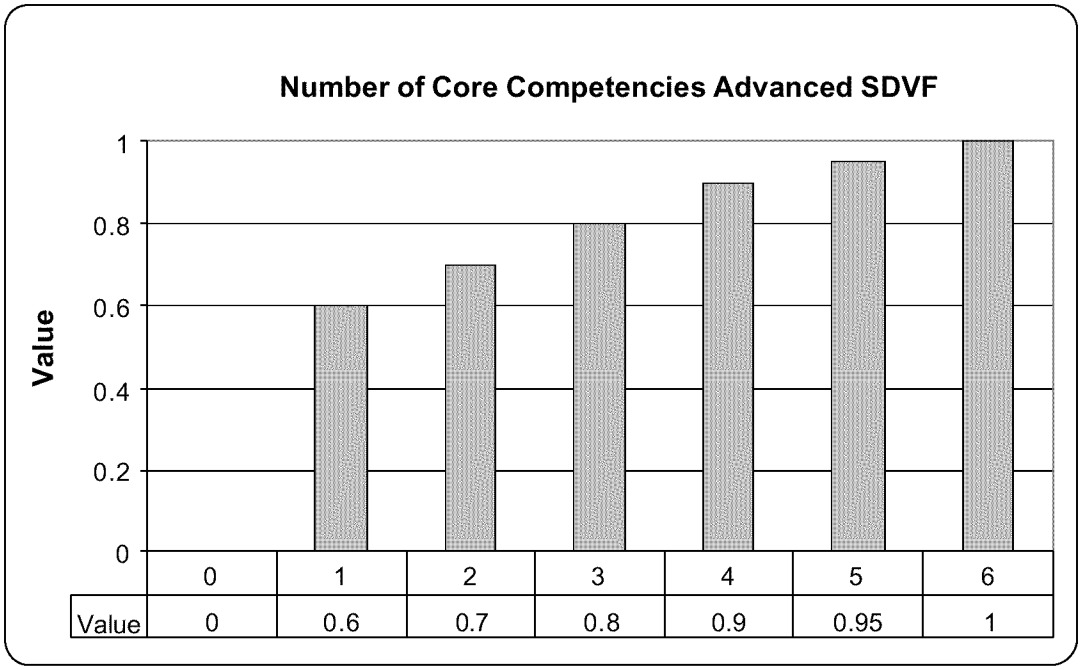

Figure 41. SDVF for *Number of Core Competencies Advanced* (*Impact* Branch)

Table 43. Definitions for *Number of Core Competencies Advanced* Categories

Category and Definition	1 = Advanced 0 = Not Advanced
Air and Space Superiority: Freedom to attack, freedom from attack; in air and space realms	
Precision Engagement: Ability to command, control, and employ forces to cause discriminate effects	
Information Superiority: Ability to collect, control, exploit, and defend information while denying an adversary the ability to do the same	
Global Attack: Ability to attack rapidly and persistently anywhere on the globe, at any time	
Rapid Global Mobility: Timely movement, positioning, and sustainment of military forces and capabilities across the range of military operations	
Agile Combat Support: Ability to support all elements US global forces (deployed and home-based forces) includes combat, as well as, quality of life facets	
Summation Total	

(AFDC, 1997:28-35)

3.4.4.5 SDVF for Significant Revisions to Organization

The SDVF in Figure 42 translates the score a potential initiative receives for the measure *Significant Revisions to Organization* into a unit of value between zero and one. Because AFI 10-1901 states that successful initiatives "…guide decisions across the spectrum of mission areas and impact organization…," FPB personnel value driving significant revisions to organizations within the Air Force (Department of the Air Force, 1997:2). In terms of significance of the revisions, the category *very* is the most preferred while *not* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel do not highly value a potential initiative that may only slightly influence the organization of Air Force units because they feel that small organizational changes cost more in effort than is yielded in benefits. Noteworthy is that the measure *Significant Revisions to Organization* does not include organization manpower adjustments. The definitions for the categories are shown in Table 44.

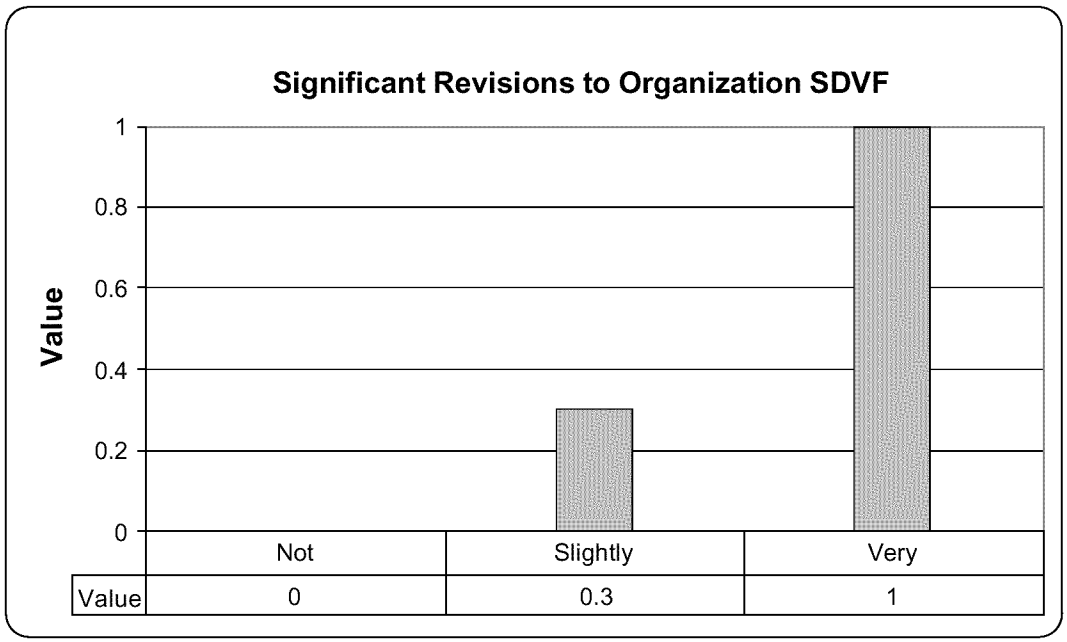

Figure 42. SDVF for *Significant Revisions to Organization* (*Impact* Branch)

Table 44. Definitions for *Significant Revisions to Organization* Categories

Category	Definition
Not	The successful initiative will in no way influence the organization of Air Force units.
Slightly	The successful initiative will have a small influence on the organization of Air Force units.
Very	The successful initiative will have a huge influence on the organization of Air Force units.

3.4.4.6 SDVF for Significant Revisions to Doctrine

The SDVF in Figure 43 translates the score a potential initiative receives for the measure *Significant Revisions to Doctrine* into a unit of value between zero and one. Because AFI 10-1901 states that successful initiatives "…guide decisions across the spectrum of mission areas and impact …doctrine…," FPB personnel value driving significant revisions to Air Force level doctrine (Department of the Air Force, 1997:2). In terms of significance of the revisions, the category *very* is the most preferred while *not* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel acknowledge that the way the Air Force trains, equips, and fights, cascades from Air Force doctrine. Subsequently, they highly value even small influences a successful initiative may have on Air Force doctrine. The definitions for the categories are shown in Table 45.

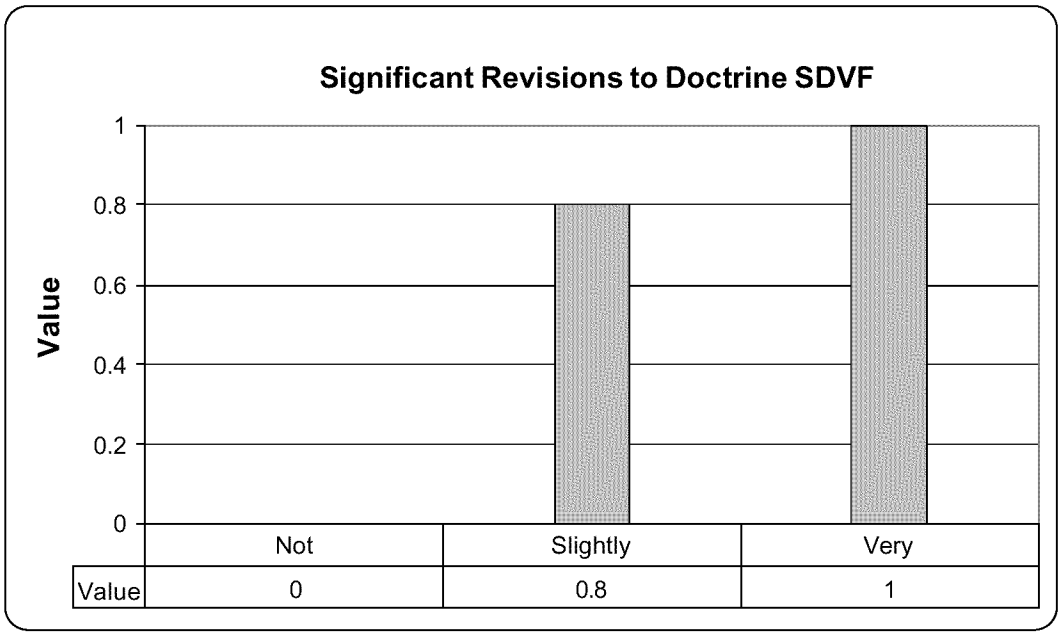

Figure 43. SDVF for *Significant Revisions to Doctrine* (*Impact* Branch)

Table 45. Definitions for *Significant Revisions to Doctrine* Categories

Category	Definitions
Not	The successful initiative will in no way influence Air Force doctrine.
Slightly	The successful initiative will have a small influence on Air Force doctrine.
Very	The successful initiative will have a huge influence on Air Force doctrine.

3.4.4.7 SDVF for Significant Revisions to Training

The SDVF in Figure 44 translates the score a potential initiative receives for the measure *Significant Revisions to Training* into a unit of value between zero and one. Because AFI 10-1901 states that successful initiatives "…guide decisions across the spectrum of mission areas and impact …training…," FPB personnel value driving significant revisions to Air Force training (Department of the Air Force, 1997:2). In terms of significance of the revisions, the category *very* is the most preferred while *not* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel acknowledge that while waiting for the official implementation of a successful initiative at the Air Staff level, base level training can be positively affected without requiring any doctrinal changes. Therefore, they highly value even slight positive influences on training generated by a successful initiative. The definitions for the categories are shown in Table 46.

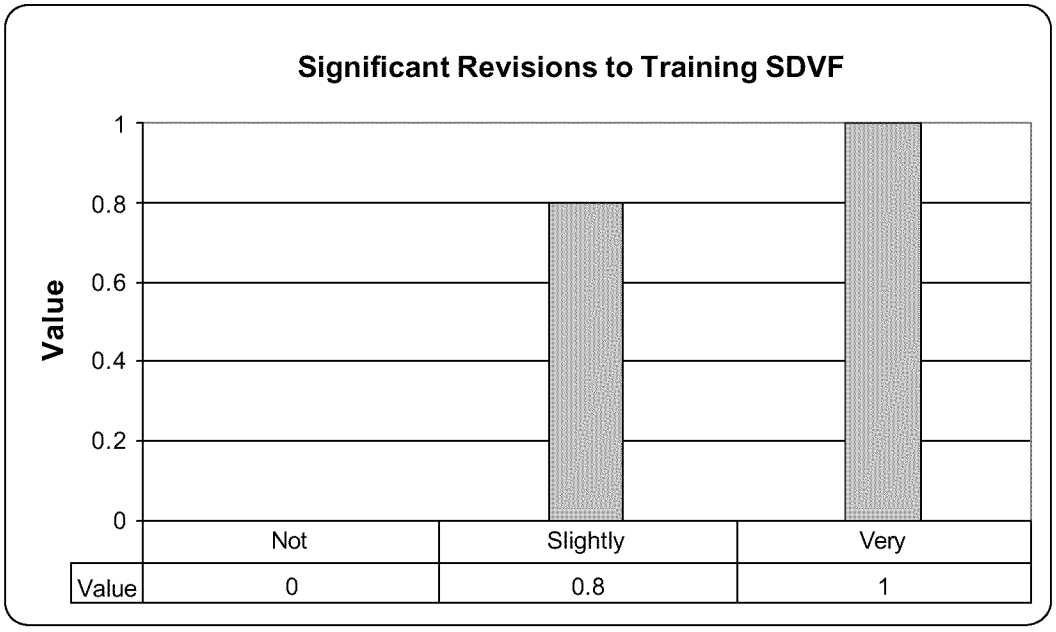

Figure 44. SDVF for *Significant Revisions to Training* (*Impact* Branch)

Table 46. Definitions for *Significant Revisions to Training* Categories

Category	Definition
Not	The successful initiative will in no way influence Air Force training.
Slightly	The successful initiative will have a small influence on Air Force training.
Very	The successful initiative will have a huge influence on Air Force training.

3.4.4.8 SDVF for Significant Revisions to Requirements

The SDVF in Figure 45 translates the score a potential initiative receives for the measure *Significant Revisions to Requirements* into a unit of value between zero and one. Because AFI 10-1901 states that successful initiatives "…guide decisions across the spectrum of mission areas and impact …requirements…," FPB personnel value driving significant revisions to Air Force requirements (Department of the Air Force, 1997:2). In terms of significance of the revisions, the category *very* is the most preferred while *not* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel do not place a high value on modifying existing requirements because they consider those requirements more easily influenced by other sources and are uncertain how much impact their successful initiative truly has in the end-state. The definitions for the categories are shown in Table 47.

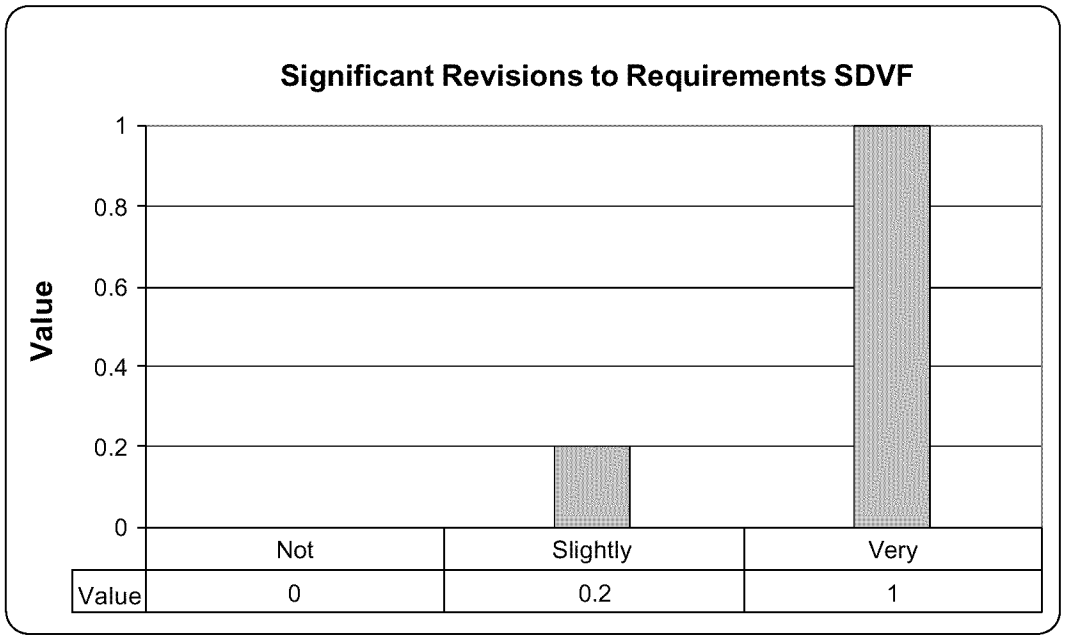

Figure 45. SDVF for *Significant Revisions to Requirements* (*Impact* Branch)

Table 47. Definitions for *Significant Revisions to Requirements* Categories

Category	Definition
Not	The successful initiative will in no way influence Air Force requirements.
Slightly	The successful initiative will modify existing Air Force requirements.
Very	The successful initiative will create new Air Force requirements.

3.4.4.9 SDVF for Significant Revisions to Acquisitions

The SDVF in Figure 46 translates the score a potential initiative receives for the measure *Significant Revisions to Acquisitions* into a unit of value between zero and one. Because AFI 10-1901 states that successful initiatives "…guide decisions across the spectrum of mission areas and impact …acquisitions," FPB personnel value driving significant revisions to Air Force acquisitions (Department of the Air Force, 1997:2). In terms of significance of the revisions, the category *very* is the most preferred while *not* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel do not place a high value on modifying existing acquisitions because they consider modifications to cost more in effort than is yielded in benefits. The definitions for the categories are shown in Table 48.

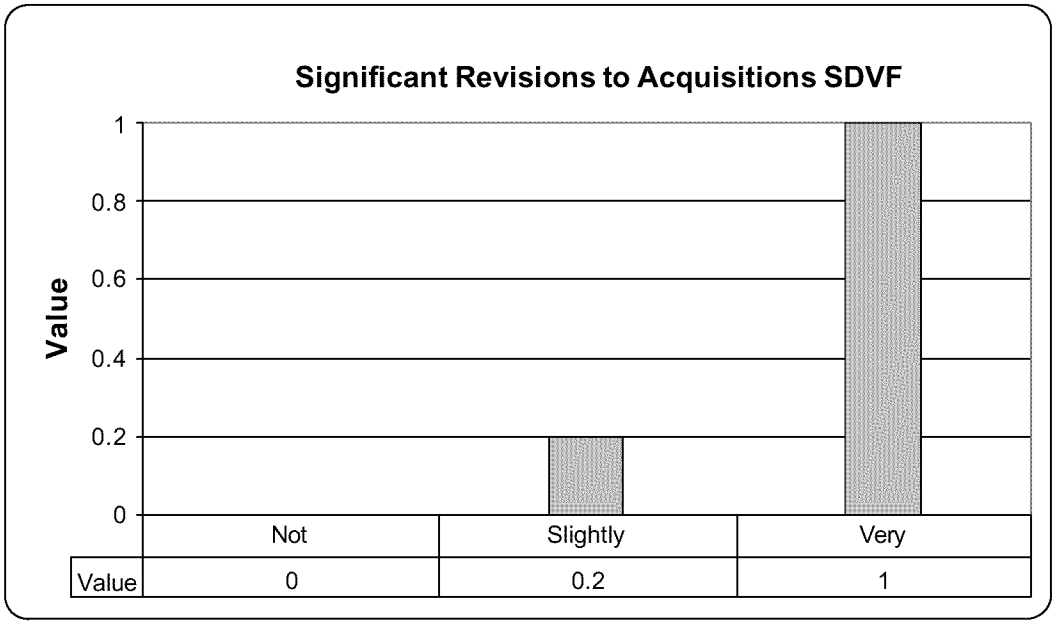

Figure 46. SDVF for *Significant Revisions to Acquisitions* (*Impact* Branch)

Table 48. Definitions for *Significant Revisions to Acquisitions* Categories

Category	Definition
Not	The successful initiative will in no way influence Air Force acquisitions.
Slightly	The successful initiative will modify existing Air Force acquisitions.
Very	The successful initiative will create new Air Force acquisitions.

3.4.4.10 SDVF for Joint Involvement

The SDVF in Figure 47 translates the score a potential initiative receives for the measure *Joint Involvement* into a unit of value between zero and one. Air Force Instruction 10-1901 states that the mission of battlelabs is not only to "…improve the ability of the Air Force to execute its core competencies…," but also to "improve…Joint Warfighting" (Department of the Air Force, 1997:2). Therefore, FPB personnel value initiatives with the potential to improve joint warfighting. Subsequently, the category of *yes* is the most preferred while *no* is the least preferred with SDVF values of 1 and 0, respectively. The FPB personnel have confidence that the slightest amount of joint involvement with the execution of an initiative will secure joint advocacy for the initiative and increase the probability of positively affecting joint warfighting. The definitions for the categories are shown in Table 49.

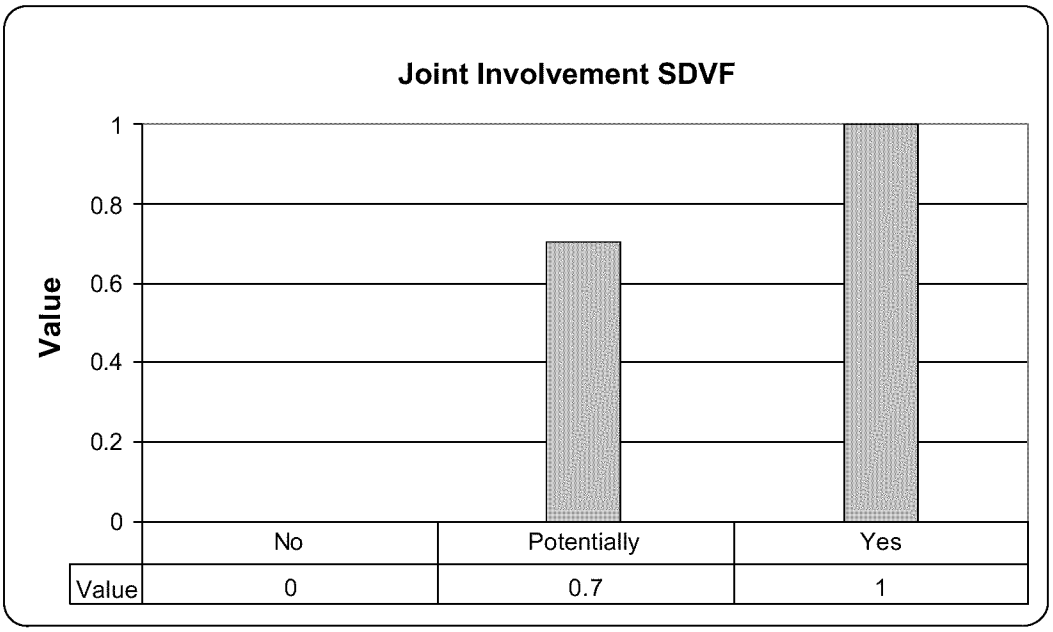

Figure 47. SDVF for *Joint Involvement* (*Impact* Branch)

Table 49. Definitions for *Joint Involvement* Categories

Category	Definition
No	There is absolutely no potential for joint involvement with this initiative.
Potentially	There is a reasonable chance there will be joint involvement with this initiative.
Yes	There is definitive joint involvement (known from the start) with this initiative.

3.5 Step 5 - Weight the Value Hierarchy

Each value in the hierarchy is not necessarily equal in importance. Weighting the hierarchy differentiates the values according to the level of importance placed on each one by the DM or other FPB members. The FPB commander, the individual most responsible for the leadership and policy decisions of the organization, concerned himself with the weights for the first-tier values (*Rapidly ID & Prove Ideas* and *Core Comps & Joint Warfighting*) and the second-tier values (*Lean*, *Unique*, *Focused*, and *Impact*). However, the commander delegated that duty to his deputy who, with a complete understanding of the commander's concerns and areas of emphasis, was at ease weighting the top two tiers of the hierarchy. The deputy conferred with the commander after weighting the top tiers and received concurrence on the weights of importance.

Weighting the lower-tier values required specific knowledge of initiative execution. Since the AOs were involved with the intricacies of the initiatives on a daily basis, they were considered the SMEs and asked to weight the third, fourth, and fifth tiers of the hierarchy. The local weights for each tier in each branch comprising the value hierarchy, appropriately summed to one. The direct weighting technique (i.e., "100 ball" technique) was used exclusively throughout the weighting process; it provided the FPB personnel the most understandable method of associating a level of importance with the values and measures. The resulting local and global weights for the FPB value hierarchy are described in the remainder of this section. The entire hierarchy is shown in Figure 48 as a reminder of its structure, with arrows indicating the direction of movement through the hierarchy as the weights for the values and measures are discussed.

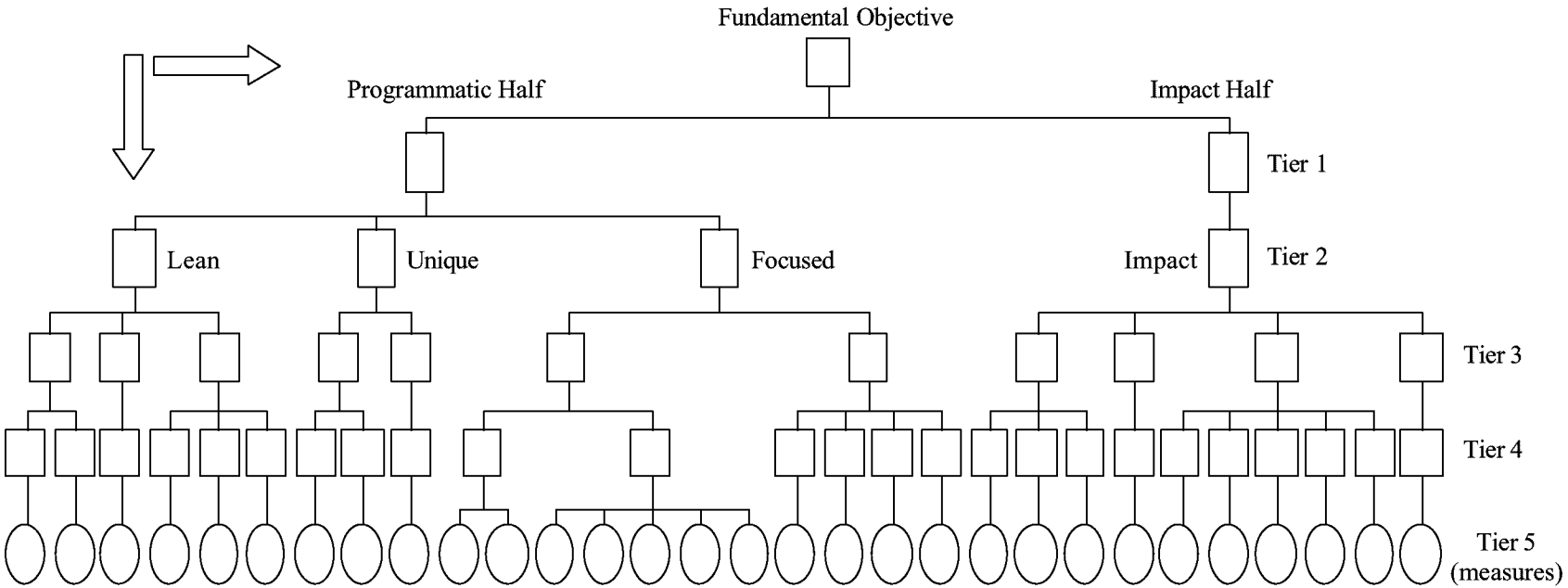

Figure 48. Final FPB Value Hierarchy (repeat)

3.5.1 Weights for the First-Tier Values

The values comprising the first tier of the hierarchy are the two halves of the mission statement, with the programmatic half being to *Rapidly ID and Prove Ideas* and the impact half being to *Advance Air Force Core Competencies and Improve Joint Warfighting*. In concurrence with the commander, the acting deputy placed a 70 percent emphasis (i.e., weight of importance = 0.7 out of 1.0) on the impact portion of the hierarchy and the remaining 30 percent on the programmatic portion. The commander acknowledged the mainstay of the FPB mission is to positively affect force protection throughout the Air Force. The high emphasis on the impact portion is subsequently justified. While the FPB leadership viewed the programmatic half somewhat important to accomplishing their fundamental objective, they considered it a means to an end (i.e., to achieving the impact portion of their mission statement) and subsequently worthy of less than one-half the weight given to the impact half of the hierarchy. The values of the first tier in the hierarchy and their associated local and global weights are shown in Figure 49.

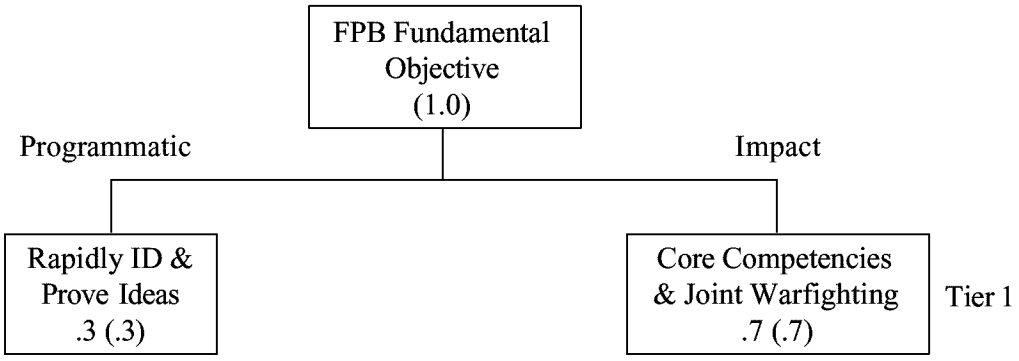

Figure 49. First-Tier Showing Local and Global Weights

3.5.2 Weights for the Second-Tier Values

The values comprising the second tier of the hierarchy are the four fundamental governing principles of battlelabs taken from AFI 10-1901 (recall the fundamental principle "innovative" was renamed by FPB personnel to "impact"). In concurrence with the commander, the acting deputy placed a 20 percent emphasis (i.e., weight of importance = 0.2 out of 1.0) on the value *Lean*, a 10 percent emphasis on the value *Unique*, and the remaining 70 percent emphasis on the value *Focused*. Since *Impact* is the only value under the *Advance Air Force Core Competencies and Improve Joint Warfighting* branch (i.e., the impact half of the mission statement) it receives 100 percent of the emphasis. Figure 50 shows the values in the first two tiers of the hierarchy and their associated local and global weights. The following sections will discuss the weights assigned to the values within each branch emanating from the second-tier values.

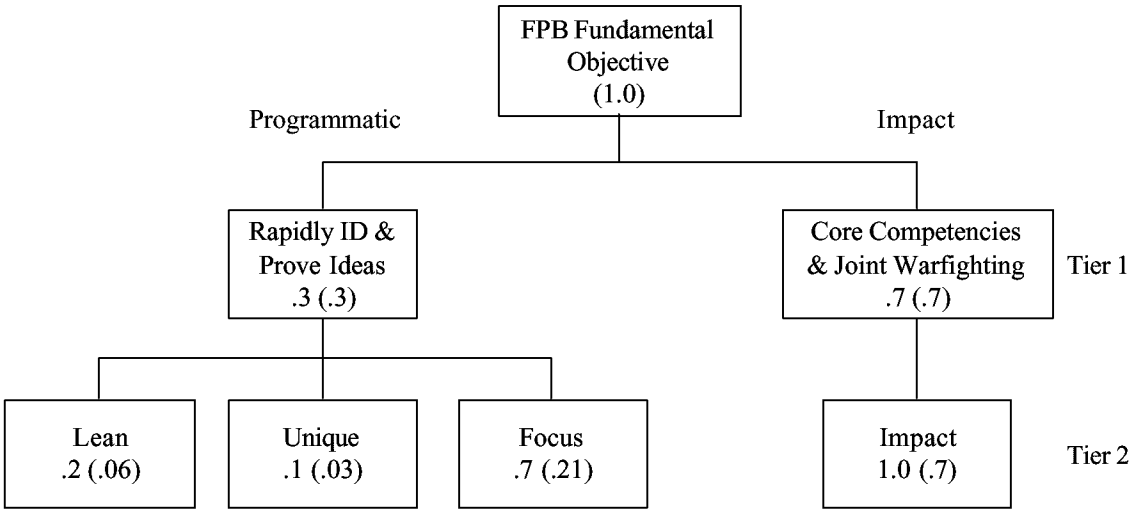

Figure 50. Top-Tiers of Hierarchy Showing Local and Global Weights

3.5.3 Weights for the Values Comprising the *Lean* Branch

The value *Lean* was assigned 20 percent of the total weight of importance (i.e., 100 percent) distributed between the three second-tier values under the first-tier value *Rapidly ID and Prove Ideas*. The global weight for *Lean* is 0.06. The small amount of local emphasis (i.e., 20 percent) given to *Lean* reflects the belief of the FPB commander that manpower, infrastructure, and money do not greatly influence the success of the battlelab in accomplishing their fundamental objective. The commander's belief is further reflected in the weights of importance assigned by the AOs to the third and fourth-tier values and the fifth-tier measures within the *Lean* branch.

The three values that comprise the third tier of the value *Lean* are *Manpower*, *Infrastructure*, and *Budget*, each having local weights of 0.6, 0.1, and 0.3, respectively. The global weights are 0.036, 0.006, and 0.018, respectively. The FPB personnel felt that *Manpower* deserved the highest weight of importance because without efficient and effective manpower they are unable to execute an initiative. The FPB personnel acknowledged that *Budget* should receive the second highest weight of importance due to their desire to be fiscally responsible with their annual budget allocation, thereby giving the Air Force the best product for the lowest cost. Finally, the FPB personnel placed the least emphasis on *Infrastructure* because they are confident that the infrastructure required will always be available and thus is not comparatively important. Figure 51 shows the values and measures with the associated local and global weights that comprise the *Lean* branch.

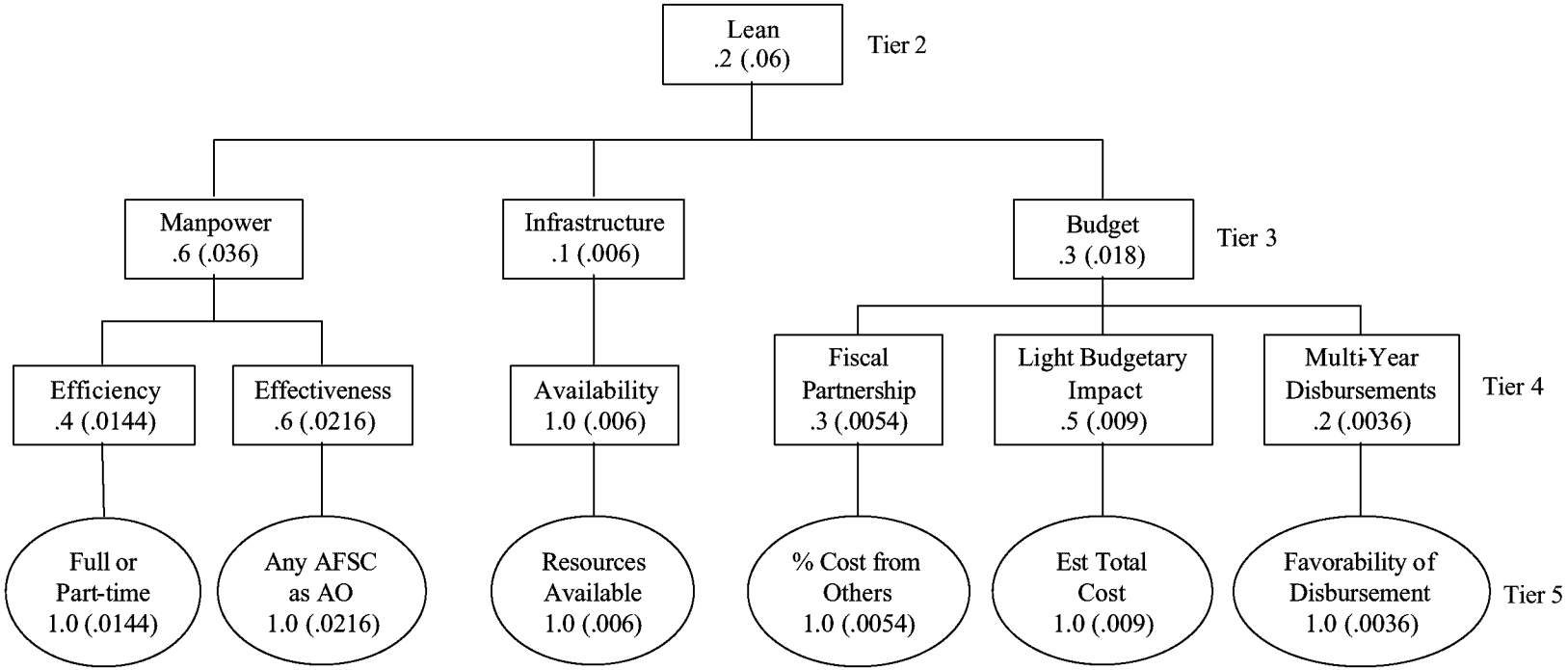

Figure 51. *Lean* Branch Showing Local and Global Weights

3.5.3.1 Weights for the Values Under Manpower

The FPB personnel felt *Efficiency* and *Effectiveness* were close in relative importance; therefore, the local weights are 0.4 and 0.6, respectively. The global weights are 0.0144 and 0.0216, respectively. They acknowledged the specificity of a potential initiative with regard to whether any AFSC could serve as the initiative lead (i.e., *Effectiveness*) is slightly more important than whether the potential initiative would require a majority of an AO's time. This is because the spectrum of potential initiatives is great and an AO's ability to be a generalist is more important than their career field specialty. This mindset ideally allows more initiatives to be undertaken by the FPB.

3.5.3.2 Weights for the Values Under Infrastructure

To achieve visual symmetry at the fifth tier and allow easy understanding of the hierarchical structure, the only value under *Infrastructure* is *Availability.* Therefore, it receives 100 percent of the emphasis, its local weight is 1.0, and its global weight is 0.006.

3.5.3.3 Weights for the Values Under Budget

The FPB personnel felt that of the values comprising *Budget* (*Fiscal Partnership*, *Light Budgetary Impact*, and *Multi-Year Disbursements*) should receive 0.3, 0.5, and 0.2 as local weights, respectively. The global weights are therefore, 0.0054, 0.009, and 0.0036, respectively. The overall estimated cost of the initiative (i.e., *Light Budgetary Impact*) was the most important to FPB personnel because they reasoned that there was always the chance a potential initiative would be selected that lacked cooperative

financing. In other words, they anticipate uncertainty associated with whether another agency will share the cost of executing the initiative. This highlights the reason the FPB personnel placed the second highest level of importance on the value of *Fiscal Partnership*. Finally, the least important value of *Budget* to FPB personnel is *Multi-Year Disbursement*. They consider spreading the cost of an initiative over multiple fiscal years as desirable more than necessary.

3.5.3.4 Weights for the Measures Under the Lean Branch

Each fourth-tier value within the *Lean* branch has only one measure associated with it. Therefore, each measure receives a local weight of 1.0. The global weight for each measure is shown in Table 50.

Table 50. Global Weights for *Lean* Branch Measures

***Lean* Branch Measures**	**Global Weight**
Full or Part-time	0.0144
Any AFSC as AO	0.0216
Infrastructure Location	0.0060
% Initiative Cost Bore by Others	0.0054
Total Estimated Initiative Cost	0.0090
Favorability of Disbursement	0.0036

3.5.4 Weights for the Values Comprising the *Unique* Branch

The value *Unique* was assigned 10 percent of the total weight of importance (i.e., 100 percent) distributed between the three second-tier values under the first-tier value *Rapidly ID and Prove Ideas*. The global weight for *Unique* is 0.03. The small amount of local emphasis (i.e., 10 percent) given to *Unique* reflects the belief of the FPB commander that while FP related concepts and non-duplication are considerations in the overall value of an initiative, most ideas submitted as potential initiatives will relate relatively strongly to force protection. Additionally, the commander acknowledged that there is typically enough variance between the FP ideas being evaluated by the multiple agencies now exploring force protection that non-duplication will be only slightly important to the successful achievement of the FPB mission statement. The commander's beliefs are further reflected in the weights of importance assigned by the AOs to the third and fourth-tier values and the fifth-tier measures within the *Unique* branch.

The two values that comprise the third tier of the value *Unique* are *FP Ideas & Concepts* and *Non-Duplication*, each having local weights of 0.7 and 0.3, respectively. The global weights are 0.021 and 0.009, respectively. The FPB personnel felt that *FP Ideas &Concepts* deserved the highest weight of importance simply due to their focus area (force protection) stipulated by AFPD 10-19 (Department of the Air Force, 1997:1). Figure 52 shows the values and measures with the associated local and global weights that comprise the *Unique* branch.

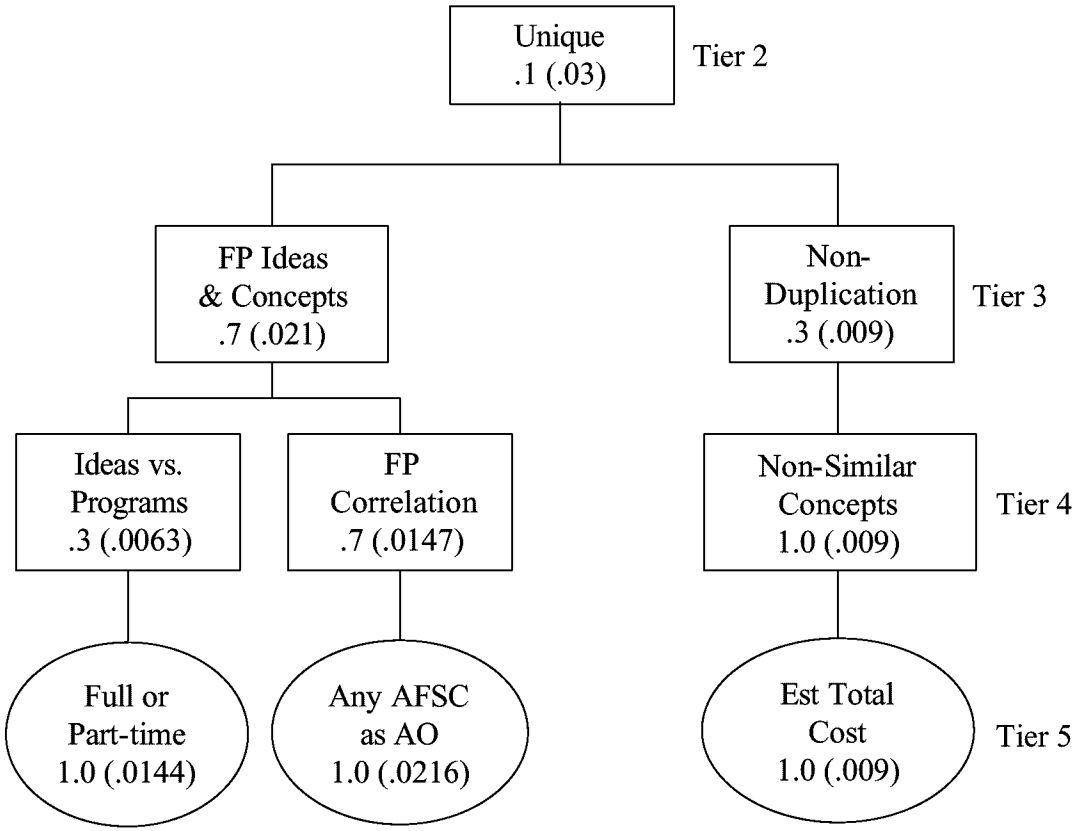

Figure 52. *Unique* Branch Showing Local and Global Weights

3.5.4.1 Weights for the Values Under FP Ideas & Concepts

The FPB personnel felt the value *FP Correlation* was more important than *Ideas vs. Programs*; therefore, the local weights are 0.7 and 0.3, respectively. The global weights are 0.0147 and 0.0063, respectively. Since the area of emphasis for the FPB is force protection, it is appropriate that they assign significantly more importance to the value *FP Correlation* than *Ideas vs. Programs.* Regarding *Ideas vs. Programs*, FPB members acknowledge that distinguishing between their job of performing a one-time evaluation of an innovative force protection concept and the job of managing a force protection system is often difficult. Since they have been successful at positively affecting Air Force force protection in the past, considering the lack of distinction between evaluating an idea and managing a system, they do not considered that ability critical to the achievement of their fundamental objective (i.e., mission statement).

3.5.4.2 Weights for the Values Under Non-Duplication

To achieve visual symmetry at the fifth tier and allow easy understanding of the hierarchical structure, the only value under *Non-Duplication* is *Non-Similar Concepts.* Therefore, it receives 100 percent of the emphasis, its local weight is 1.0, and its global weight is 0.009.

3.5.4.3 Weights for the Measures Under the Unique Branch

Each fourth-tier value within the *Unique* branch has only one measure associated with it. Therefore, each measure receives a local weight of 1.0. The global weight for each measure is shown in Table 51.

Table 51. Global Weights for *Unique* Branch Measures

***Unique* Branch Measures**	**Global Weight**
Ideas vs. Programs	0.0063
FP Correlation	0.0147
Non-Similar Concepts	0.0090

3.5.5 Weights for the Values Comprising the *Focused* Branch

The value *Focused* was assigned 70 percent of the total weight of importance (i.e., 100 percent) distributed between the three second-tier values under the first-tier value *Rapidly ID and Prove Ideas*. The global weight for *Focused* is 0.21. The large amount of local emphasis (i.e., 70 percent) given to *Focused* reflects the belief of the FPB commander that the proper selection and proof of concept execution, along with the ability to leverage existing resources (i.e., technology, contracts, expertise, and POC venues), is vitally important to the successful achievement of their mission statement. The commander's beliefs are further reflected in the weights of importance assigned by the AOs to the third and fourth-tier values and the fifth-tier measures within the *Focused* branch.

The two values that comprise the third tier of the value *Focused* are *Innovative* and *Leverage*, each having local weights of 0.7 and 0.3, respectively. The global weights are 0.147 and 0.063, respectively. While assigning some importance to a potential initiative's ability to leverage existing resources (i.e., technology, contracts, expertise, and POC venues), the FPB felt *Innovative* deserved their highest weight of importance. They base this decision on the first sentence in the opening paragraph of AFI 10-1901 (which is an excerpt from the Air Force *Global Engagement* document, page 9): "The key to ensuring today's Air Force core competencies will meet the challenge of tomorrow is Innovation" (Department of the Air Force, 1997:2). Figure 53 shows the values and measures with the associated local and global weights that comprise the *Focused* branch.

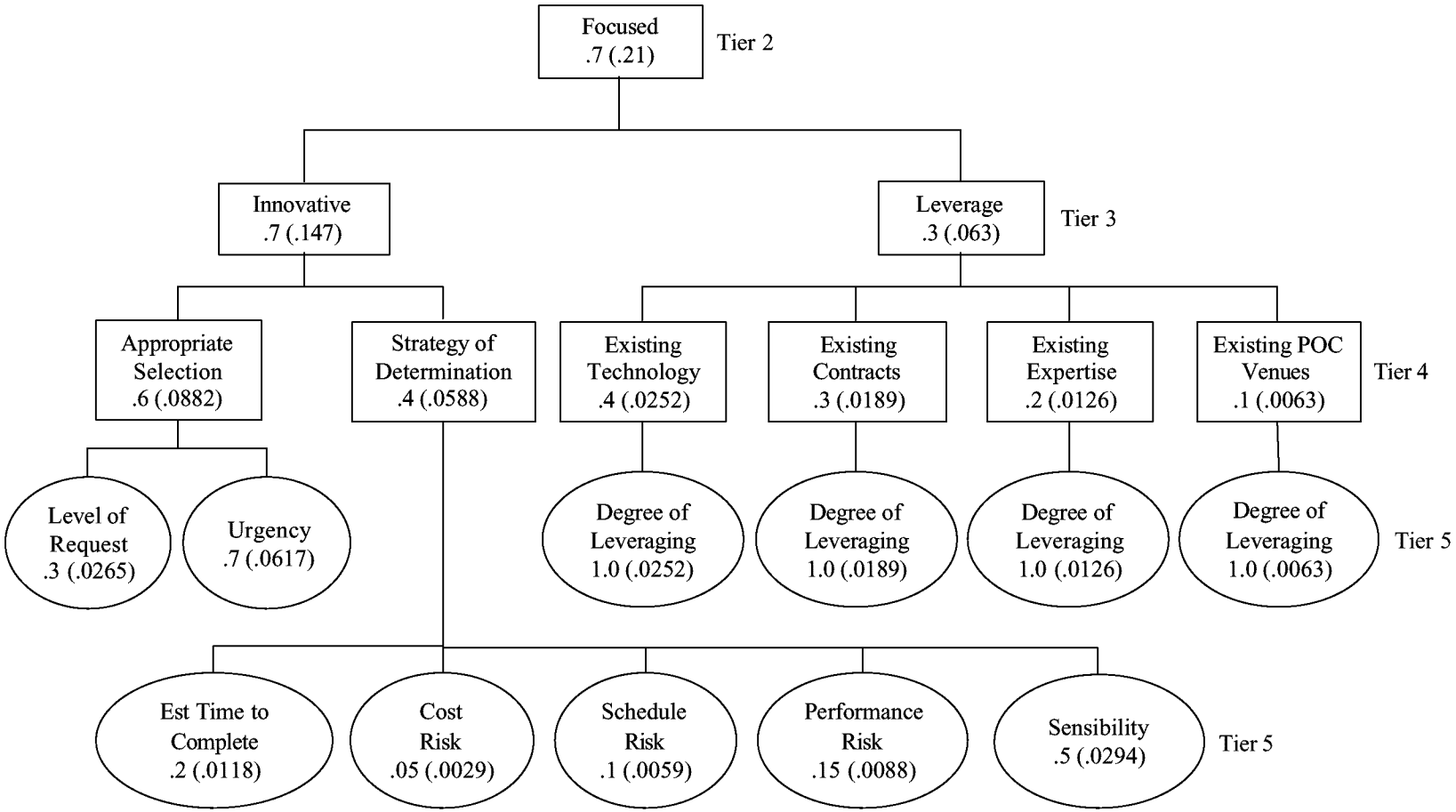

Figure 53. *Focused* Branch Showing Local and Global Weights

3.5.5.1 Weights for the Values Under Innovative

The FPB personnel place more importance on *Appropriate Selection* than *Strategy of Determination*; therefore, the local weights are 0.6 and 0.4, respectively. The global weights are 0.0882 and 0.0588, respectively. While the FPB personnel indicated similar local weights of importance for the two values, they acknowledged that they would rather have a promising potential initiative executed with a poor proof of concept strategy than a poor potential initiative executed with a great proof of concept strategy.

3.5.5.2 Weights for the Measures Under Appropriate Selection

The FPB personnel place more importance on the measure *Urgency* than *Level of Request*; therefore, the local weights are 0.7 and 0.3, respectively. The global weights are 0.0617 and 0.0265, respectively. The FPB personnel reason that the urgency of a force protection need should receive more weight than does the level of the submitter. For comparative purposes, the global weights for each measure comprising the *Focused* branch are shown in Table 52.

3.5.5.3 Weights for the Measures Under Strategy of Determination

The FPB personnel place the most importance on the measure *Sensibility* followed by *Estimated Time to Complete an Initiative*, *Performance Risk*, *Schedule Risk*, and *Cost Risk*. The local weights for each measure are 0.5, 0.2, 0.15, 0.1, and 0.05, respectively. Note that the global weights are displayed in Table 52. The measure *Sensibility* received the most local weight because the FPB personnel acknowledged that more reasonable potential initiatives had higher probabilities of success. While the local

weights of the remaining four measures are within 0.05 of one another, *Estimated Time to Complete an Initiative* is considered the second most important by FPB personnel because of their AFI mandate to "Rapidly identify and prove the worth of innovative ideas…" (Department of the Air Force, 1997:2). Regarding the three risk measures of *cost*, *schedule*, and *performance*, the FPB personnel place the least amount of importance on *cost risk* for two reasons. First, they feel it is the easiest risk of the three to mitigate. Second, if an initiative evaluation is going well (e.g., it looks as though the end-state of the initiative will provide significant force protection advancement), they feel costs in excess of the initial estimate will not be a limiting factor to the proof of concept. Conversely, they place the most importance on *Performance Risk*, which echoes their desire to avoid complications throughout the entire evaluation of a potential initiative. For comparative purposes, the global weights for each measure comprising the *Focused* branch are shown in Table 52.

3.5.5.4 Weights for the Values Under Leverage

The FPB personnel placed decreasing amounts of importance on *Existing Technology*, *Existing Contracts*, *Existing Expertise*, and *Existing POC Venues*. The local weights are 0.4, 0.3, 0.2, and 0.1, respectively. Note that the global weights are displayed in Table 52. To determine the appropriate local weights of importance for the four values under *Leverage*, the FPB personnel determined which value was the least important and compared the remaining values to it. In doing so, they indicated leveraging *Existing POC Venues* was the least important value because they felt a POC venue could either be created or simply was not a concern for a good initiative properly executed by the AO.

The value *Existing Expertise* was deemed twice as important as *Existing POC Venues*. While FPB personnel acknowledge expertise is necessary to affect a successful proof of concept, they also felt the expertise necessary for executing most potential initiatives is abundant. The FPB personnel felt leveraging *Existing Contracts* was three times as important as *Existing POC Venues* because of the time and effort required to establish a contract. Finally, the FPB personnel placed four times the importance on leveraging *Existing Technology* as they did on *Existing POC Venues*. The reason was that they understand AFI 10-1901 to encourage the innovative use of commercial and government off-the-shelf (COTS and GOTS) technology to address force protection problems.

3.5.5.5 Weights for the Measures Under Leverage

Each fourth-tier value under *Leverage* has only one measure associated with it. Therefore, each measure receives a local weight of 1.0. The global weight for each measure is shown in Table 52.

Table 52. Global Weights for *Focused* Branch Measures

***Focused* Branch Measures**	**Global Weight**
Level of Request	0.0265
Urgency	0.0617
Estimated Time to Complete an Initiative	0.0118
Cost Risk	0.0029
Schedule Risk	0.0059
Performance Risk	0.0088
Sensibility	0.0294
Degree of Leveraging Existing Technology	0.0252
Degree of Leveraging Existing Contracts	0.0189
Degree of Leveraging Existing Expertise	0.0126
Degree of Leveraging Existing POC Venues	0.0063

3.5.6 Weights for the Values Comprising the *Impact* Branch

The value *Impact* stands alone under the *Advance Air Force Core Competencies and Improve Joint Warfighting* branch. Therefore, while it is a second-tier value (like *Lean*, *Unique*, and *Focused*), it does not share its weight of importance with those values and receives 100 percent of the total local weight. The global weight for *Impact* is its local weight (1.0) multiplied by the local weight of the *Advance Air Force Core Competencies and Improve Joint Warfighting* value (0.7) to yield 0.7.

The four values that comprise the third tier of the value *Impact* are *Prove Concepts*, *Advance AF Core Competencies*, *Drive Revisions*, and *Improve Joint Warfighting*, each having local weights of 0.2, 0.4, 0.1, and 0.3, respectively. The global weights are 0.14, 0.28, 0.07, and 0.21, respectively. The FPB personnel assigned the highest weight of importance to *Advance AF Core Competencies* because their mission statement in AFI 10-1901 highlights the vital role Air Force core competencies play in furthering the entire nation's military capabilities (Department of the Air Force, 1997:2). Additionally, Air Force Doctrine Document 1 states "Core competencies are at the heart of the Air Force's strategic perspective and thereby at the heart of the Service's contribution to our nation's military capabilities" (AFDC, 1997:27). The FPB personnel assigned the second highest weight of importance to *Improve Joint Warfighting*. Again, their mission statement in AFI 10-1901 specifically calls on the battlelabs to advance core competencies and joint warfighting (Department of the Air Force, 1997:2). The FPB personnel acknowledge that if they are not proving innovative force protection concepts, they will not be able to advance Air Force core competencies, improve joint

warfighting, or even be able to drive revisions to Air Force organization, doctrine, training, requirements, and acquisitions. Therefore, they assign *Prove Concepts* a higher weight of importance than *Drive Revisions*. Figure 54 shows the values and measures with the associated local and global weights that comprise the *Impact* branch.

3.5.6.1 Weights for the Values Under Prove Concepts

The FPB personnel placed decreasing amounts of importance on *Wide Impact*, *Long Lasting*, and *Rapid Fielding*. The local weights are 0.5, 0.4, and 0.1, respectively. The global weights are 0.07, 0.056, and 0.014, respectively. The most emphasis was placed on the value *Wide Impact* because the FPB personnel felt compelled by their mission statement to positively affect as many Air Force personnel as possible with successful force protection initiatives. The FPB personnel subsequently acknowledged their desire for the aforementioned positive affect to be as permanent as possible and thus assigned the value *Long Lasting* the second highest importance. The value *Rapid Fielding* received the least weight of importance because, while the FPB personnel agreed a successful initiative is important, they acknowledged that upon completion of their proof of concept they have no control over how quickly it transitions to the field.

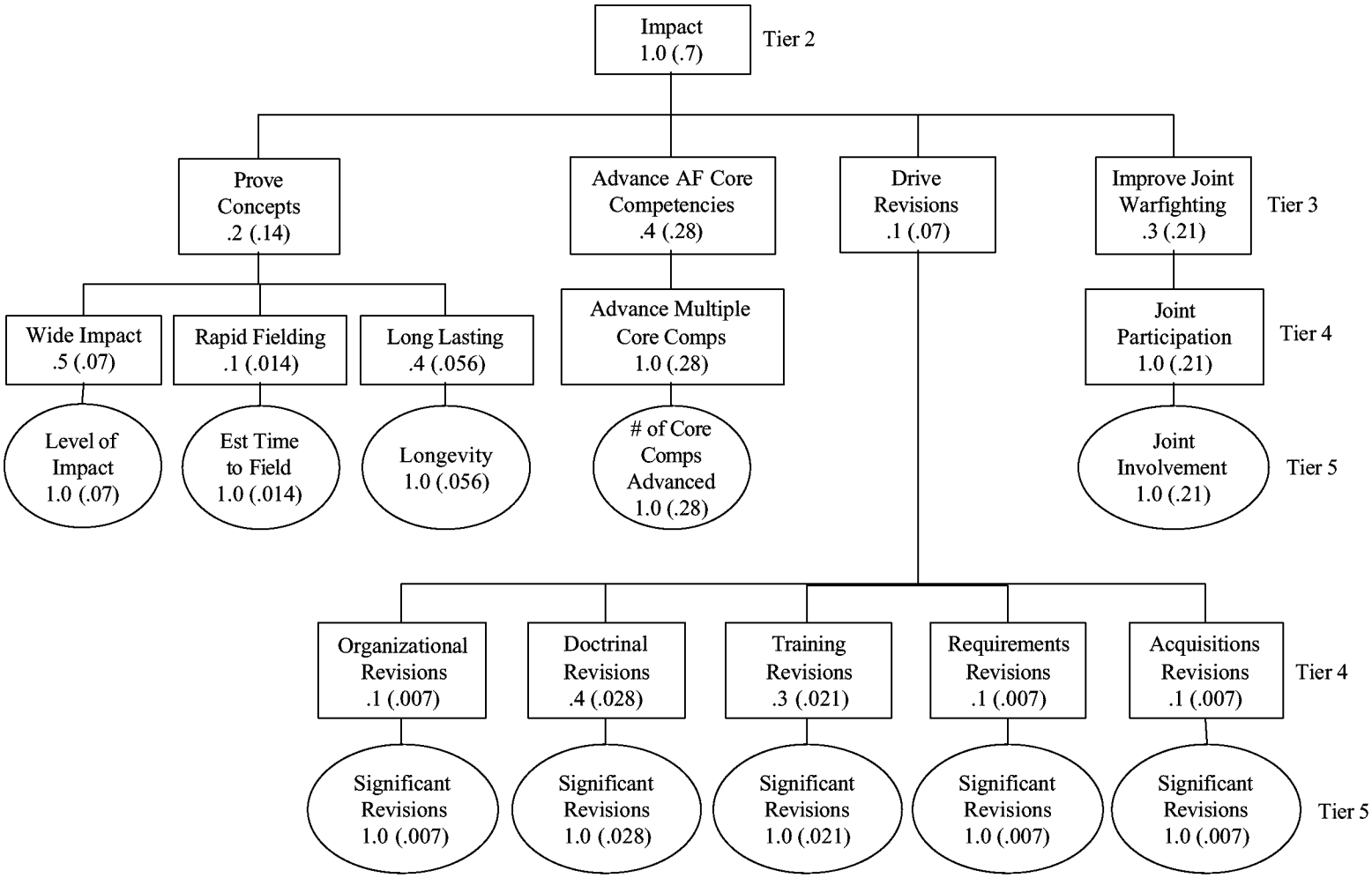

Figure 54. *Impact* Branch Showing Local and Global Weights

3.5.6.2 Weights for Values Under Advance AF Core Competencies

To achieve visual symmetry at the fifth tier and allow easy understanding of the hierarchical structure, the only value under *Advance AF Core Competencies* is *Advance Multiple Core Competencies*. Therefore, it receives 100 percent of the emphasis, its local weight is 1.0, and its global weight is 0.28.

3.5.6.3 Weights for the Values Under Drive Revisions

The FPB personnel weighted the importance of *Doctrinal Revisions* slightly higher than *Training Revisions*. The local weights are 0.4 and 0.3, respectively. The global weights are 0.028 and 0.021, respectively. They assigned equal weights of importance (i.e., 0.1) to the values *Organizational Revisions*, *Requirements Revisions*, and *Acquisition Revisions*. Realizing that Air Force Doctrine Document 1 states "…[AFDD 1] is the premier statement of US Air Force Doctrine and as such should form the basis from which air commanders plan and execute their assigned air and space missions and act as a component of a joint or multinational force" (AFDC, 1997:v), the FPB personnel place a high emphasis on positively affecting revisions to Air Force doctrine. The FPB personnel acknowledge training as a key enabler of the Air Force to accomplish its mission and therefore weight it only slightly less than *Doctrinal Revisions*. The FPB personnel placed equal weights of importance on the values *Organizational Revisions*, *Requirements Revisions*, and *Acquisition Revisions* because they felt the difference in importance between each value was insignificant in achieving their fundamental objective.

3.5.6.4 Weights for the Values Under Improve Joint Warfighting

To achieve visual symmetry at the fifth tier and allow easy understanding of the hierarchical structure, the only value under *Improve Joint Warfighting* is *Joint Participation*. Therefore, it receives 100 percent of the emphasis, its local weight is 1.0, and its global weight is 0.21.

3.5.6.5 Weights for the Measures Under the Impact Branch

Each fourth-tier value within the *Impact* branch has only one measure associated with it. Therefore, each measure receives a local weight of 1.0. The global weight for each measure is shown in Table 53.

Table 53. Global Weights for *Impact* Branch Measures

***Impact* Branch Measures**	**Global Weight**
Level of Impact	0.070
Estimated Time to Field	0.014
Longevity	0.056
Number of AF Core Competencies Advanced	0.280
Significant Organizational Revisions	0.007
Significant Doctrinal Revisions	0.028
Significant Training Revisions	0.021
Significant Requirements Revisions	0.007
Significant Acquisitions Revisions	0.007
Joint Involvement	0.210

3.6 Step 6 - Alternative Generation

This step of the value-focused thinking process is not applicable to the FPB. Their alternatives are in the form of force protection ideas and concepts submitted as potential initiatives. The only instance where the alternative generation step might be used in the FPB's value model is to conceive an initiative if none of those evaluated score adequately high in value.

3.7 Step 7 - Alternative Scoring

The FPB selected six of their ongoing initiatives to score using the weighted value hierarchy. There were no current initiatives nearing completion, thus there was no justification to score any recently submitted potential initiatives. The FPB's current operating timeline indicates an initiative selection meeting sometime before spring of 2002. The commander indicated his intentions to use the value model developed through this research effort to provide insight to their initiative selection process. In the mean time, the scoring of the six ongoing initiatives allowed the FPB members to practice the scoring technique and allowed refinement of definitions for the SDVFs and their associated categories. Six FPB members took part in the alternative scoring and are now competent to score potential initiatives in the future.

The procedure for scoring the six ongoing initiatives included listing each of the initiatives on a dry-erase board and considering each of them for a specific measure before advancing to the next measure. Scoring all six ongoing initiatives for a single measure, before advancing, allowed the AOs to maintain a firm understanding and knowledge of the definitions and promoted consistency in scoring. Each AO present had

at least rudimentary knowledge about the six ongoing initiatives and thus contributed to the scoring discussion on each measure. Noteworthy is the fact that the score for each measure, per ongoing initiative, was arrived at by consensus. During the scoring meeting, the AOs were only presented with the measure, the associated x-axis categories, and each category's definition. By not revealing / reminding them of the values associated with each SDVF category, they were hindered from mentally "gaming" the scoring to reflect their biases. The scores arrived at during the scoring session may be found in Appendix C.

3.8 Summary

This chapter is extensive in its explanation of how the values and measures comprising the FPB value hierarchy were derived. The definitions of the values and measures are very comprehensive. Their completeness contributes to the support and defense of the value hierarchy's mutual exclusivity and collective exhaustiveness. Upon completion of Steps 1 through 7, the deterministic and sensitivity analyses are conducted (i.e., Steps 8 and 9).

Chapter 4. Results and Analysis

This chapter contains the results of the deterministic and sensitivity analysis (Steps 8 and 9) performed on six ongoing Force Protection Battlelab (FPB) initiatives that were examined with the value model. Particular attention is paid to explaining why the highest-ranking initiative scored the best. Emphasis is also placed on the fact that the initiatives scored with the value model were already in progress and not truly available for the FPB commander to select. Additionally, the results of the sensitivity analysis using local and global weights are examined to determine how changes in assigned weights influence the overall ranking of the ongoing initiatives.

4.1 Step 8 - Deterministic Analysis

The deterministic analysis examines the initial results of the value model and provides insight to the FPB commander regarding the ranking of the ongoing initiatives. Specifically, the deterministic analysis highlights what values and measures contribute the most value to the FPB fundamental objective. The deterministic analysis also addresses the impact on the final rankings by measures having relatively high global weights.

4.1.1 Deterministic Analysis Results

Table 54 contains an alphabetically ordered description of the six initiatives (more expansive definitions are provided in Appendix D). The initial results of the value model are given in Table 55. Noteworthy is the fact that the base case scores are absolute. That is, if one initiative has a larger score, that initiative is recognized as contributing more value to the FPB's fundamental objective. If the selection were made based on that information alone, the initiative with the absolute largest score would be the most preferred alternative. The scores each ongoing initiative received for each measure may be found in Appendix C.

Table 54. FPB Initiative Definitions

Initiative	Definition
CBAWS -- (Chem, Bio, Aerosol Warning System)	Man-portable, tactical, chem./bio agent detection, providing rapid alerting for first responders.
CSC2 -- (Combat Support Command and Control)	Situational awareness enhancement for commanders; fuses myriad of information into a common tactical picture.
IBD 2020 -- (Integrated Base Defense 2020)	Investigating new methods, technologies, and ideas to protect bases at home and abroad through the year 2020.
K-9 BOSS -- (K-9 Bio-Organism Search Study)	Military working dogs detecting biological agents and the growth and transport mediums, before release of the agent.
MCI -- (Missile-field Communications Initiative)	Vehicle-based radio repeaters eliminating "dead spots" for security forces response personnel protecting AF missile fields.
RFT -- (Response Force Tracking)	Personal information transmitter to provide real-time vital statistics and location of security forces response personnel.

Table 55. Value Model Base Case Results

Ranking	Initiative	Final Score
1	**IBD 2020** -- (Integrated Base Defense 2020)	.700
2	**RFT** -- (Response Force Tracking)	.650
3	**CBAWS** -- (Chem, Bio, Aerosol Warning System)	.614
4	**CSC2** -- (Combat Support Command and Control)	.602
5	**K-9 BOSS** -- (K-9 Bio-Organism Search Study)	.487
6	**MCI** -- (Missile-field Communications Initiative)	.378

The cumulative bar graph, showing the amount of value each measure contributed to the final ranking of each initiative, is shown in Figure 55. Since there are 30 measures that could contribute to the final value score of an ongoing initiative, it is easier to understand the figure by highlighting the three primary contributing measures: (1) *Level of Impact*, (2) *# of Core Competencies Advanced*, and (3) *Joint Involvement*. The decimal numbers in the shaded blocks of Figure 55 indicate the amount of value contributed by a specific measure to the final value score. To lend further insight to the final ranking of the initiatives, Figure 56 shows the amount of value contributed by each second-tier value (i.e., *Lean*, *Unique*, *Focused*, and *Impact*).

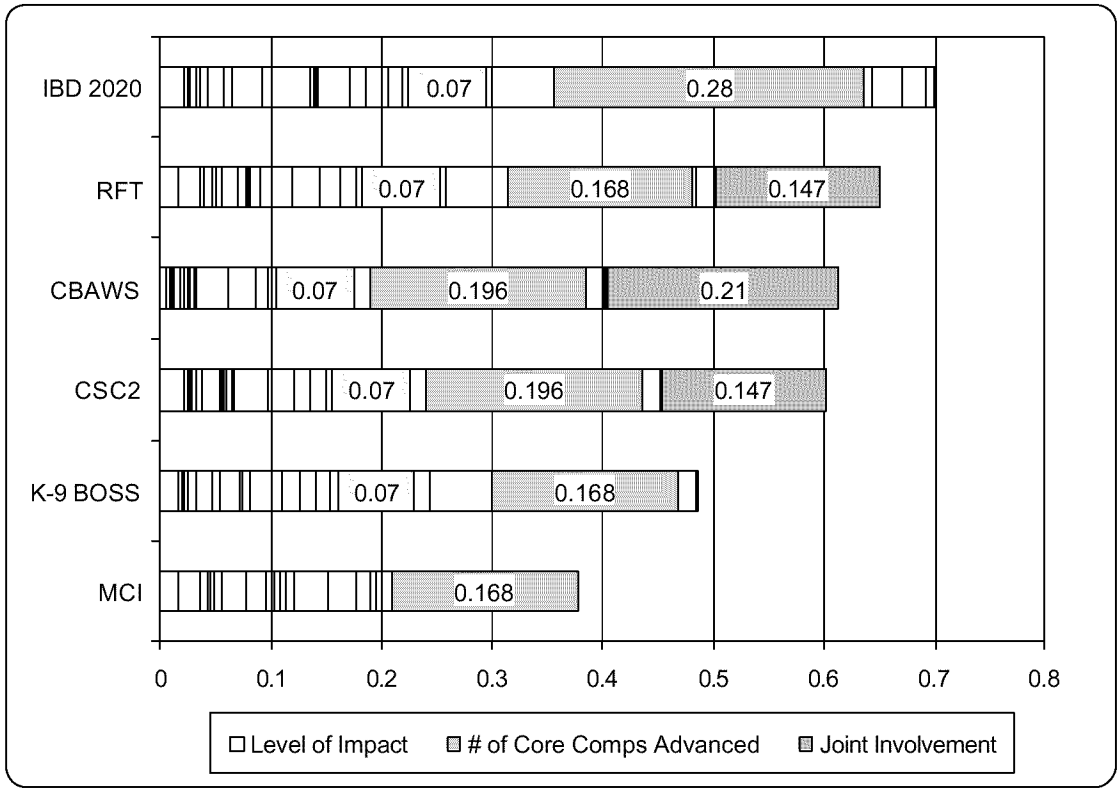

Figure 55. Contribution to the Base Case Scores by Measure

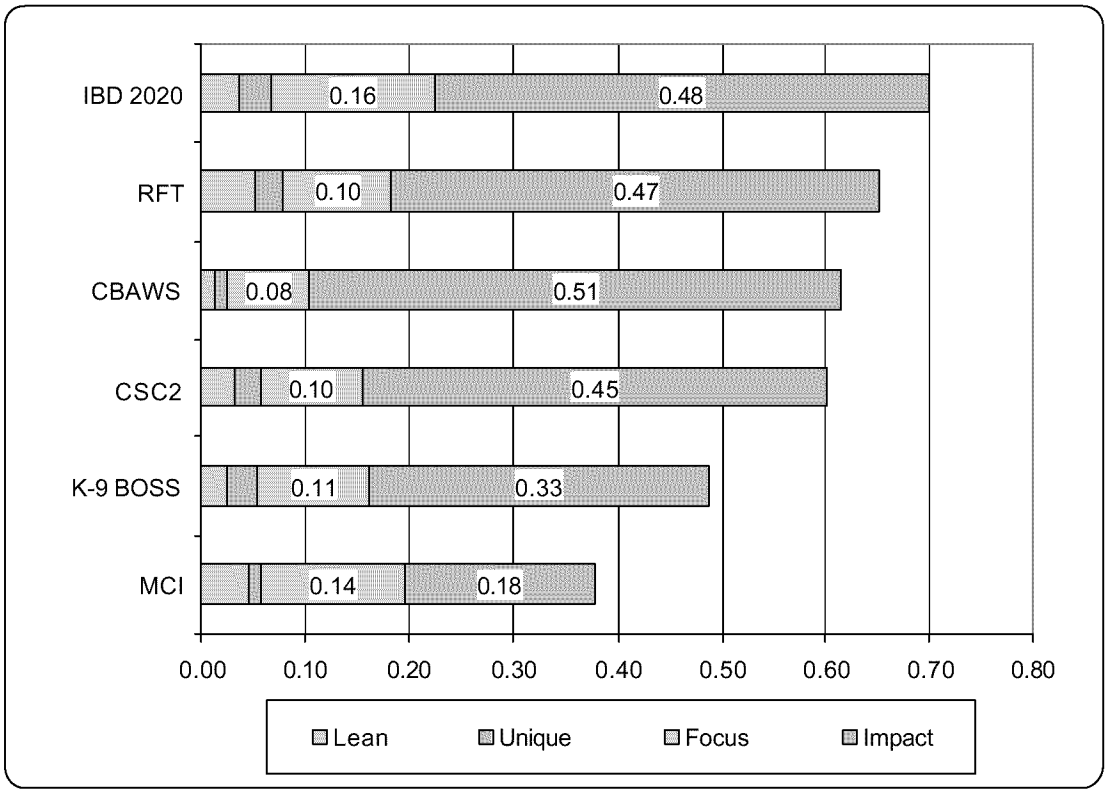

Figure 56. Contribution to the Base Case Scores by Second-Tier Values

As indicated in Figure 55, the ongoing initiative yielding the highest value to the FPB does so without contribution from the *Joint Involvement* measure. In other words, Integrated Base Defense (IBD) 2020 scored zero for the *Joint Involvement* measure. Yet, due to the weight placed on the value *Advance Air Force Core Competencies*, along with how well IBD 2020 scored for the measure *# of Core Competencies Advanced* (perfect score of "all six"), in addition to the compilation of the multiple smaller scores from the other measures, IBD 2020 still generated more value than any other ongoing initiative. Before providing more specific insight from Figure 55, it is important to reiterate that the definition of the *Joint Involvement* measure is that it is a "Proxy measure that indicates

the potential for future improvement of joint warfighting. It considers the probability of cooperation from other [Department of Defense] services with the execution of the initiative." Based on the name of the initiative, Integrated Base Defense (IBD) 2020, it seems counterintuitive that it scored zero for the *Joint Involvement* measure. However, since the IBD 2020 initiative is primarily a research study, it called upon the FPB to investigate doctrine, tactics, techniques, procedures, and technologies to protect US bases at home and abroad without any assistance from the joint community. Therefore the FPB may conclude that involving another service in the research would increase the probability of the initiative improving joint warfighting in the future. This conclusion is reasonable considering the probabilities associated with the continuing integration of Department of Defense (DoD) forces by the year 2020.

Further insight can be provided to the FPB commander by systematically searching for reasons that support the poor ranking of particular initiatives. For example, removing the affect of all the *Impact* measures reveals a different ranking of initiatives as shown in Figure 57. The IBD 2020 initiative is still ranked the highest. However, the previously lowest ranked initiative, Missile-field Communication Initiative (MCI), becomes the second highest ranked initiative. Examining the scores MCI received for each measure (shown in Appendix C) provides the necessary insight as to why this dramatic shift in rankings occurs. The resulting general observation would indicate that the MCI initiative is a relatively simple and straightforward initiative and therefore scored well when evaluated against the programmatic measures (i.e., those under the second-tier values of *Lean*, *Unique*, and *Focused*). For example, since the action officers (AOs) saw no risk in the MCI initiative it received perfect scores for *Cost*, *Schedule*, and

Performance Risk, confirming its simplistic nature. Additionally, it received perfect scores for *Leverage Technology*, *Leverage Expertise*, and *Leverage POC Venues*, which highlights the maturity of the technology, the availability of specific expertise, and the preparedness of a particular Air Force unit to provide a real-life evaluation location for the initiative. The MCI initiative also scored the highest of the six initiatives in the *Rapidness to Complete* measure because the AOs anticipated a quick proof of concept and subsequent forwarding of their after-initiative report to the Air Force Requirements Oversight Council (AFROC).

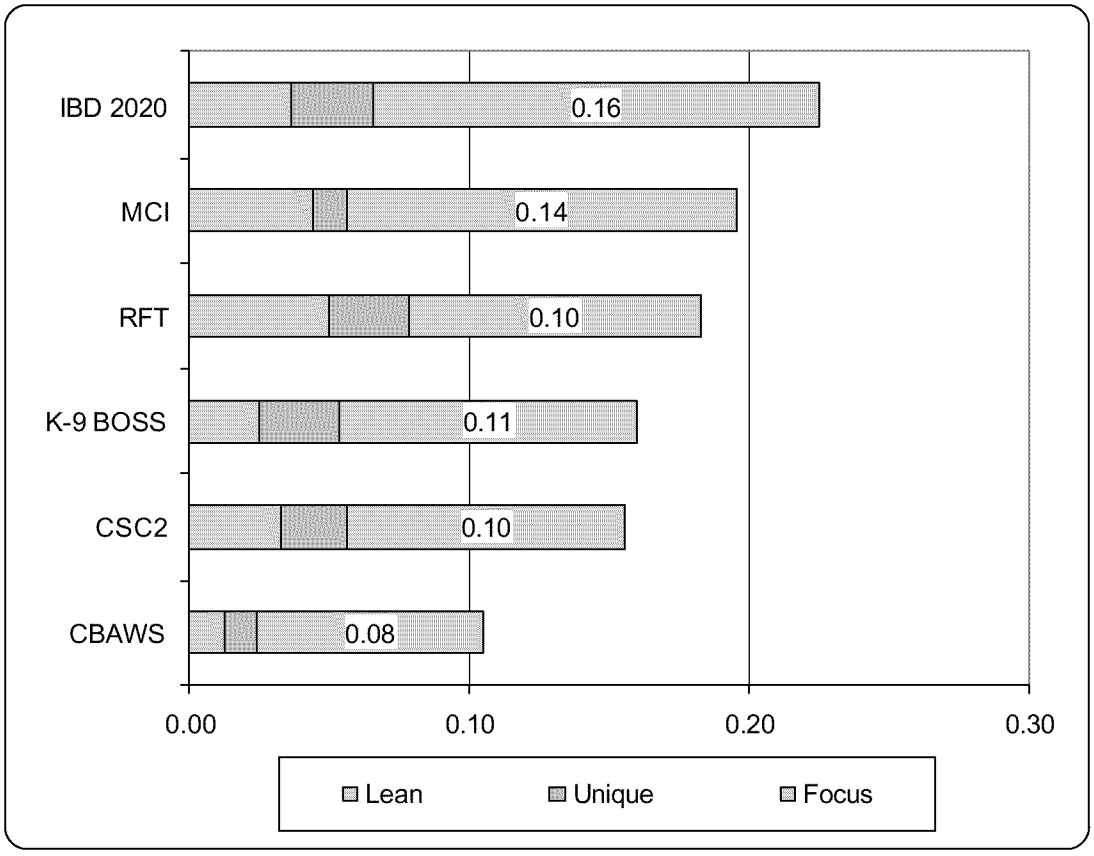

Figure 57. Contribution to the Base Case Scores by Programmatic Values

However, the MCI initiative scored poorly with regard to the *Impact* measures. Specifically, it scored zero for the measures: *Level of Impact* (meaning it represented only a local solution to a force protection problem), *Longevity* (meaning that when it was submitted as a potential initiative it was known to be only a temporary solution to a force protection problem), *Revisions to Organization, Doctrine, Training*, and *Requirements* (meaning it did not influence Air Force organization, doctrine, training, or requirements), and *Joint Involvement* (meaning there is no probability for cooperation from other DoD services with the execution of this initiative). Scrutinizing the poor scores reveals value gaps to the FPB personnel. In other words, by examining why MCI ranked poorly, the FPB personnel are able to address specific issues in an effort to correct its "deficiencies" (i.e., value gaps) if they desired the initiative to rank higher in the final results. For example, considering the global weight associated with the measure *Joint Involvement*, the FPB personnel could reasonably expect MCI to climb in the final rankings if they modified something about the initiative to entice members of other DoD services to cooperate in its execution.

As previously mentioned, the value model developed in this research is designed to help the decision maker determine which potential initiatives should be pursued. Unfortunately, a list of potential initiatives under consideration by the FPB was not available. Therefore, the alternatives scored by the value model were ongoing FPB initiatives. Even though the model cannot be used to select initiatives during this research, it still provides an example of the insight commanders can gain from using the model. Additionally, in this instance, the model highlights which ongoing initiatives contribute the least amount of value to the fundamental objective of the FPB (i.e., to

accomplish their stated mission) should it become necessary to curtail the number of initiatives they are currently pursuing due to lack of funds, sponsorship, or possibly the commander's prerogative.

4.1.2 Impact of Measures with High Global Weights

There are measures within the most heavily weighted branch, *Core Competencies and Joint Warfighting*, that exert a large influence on the final ranking of the alternatives. That is, how an alternative scores with respect to these measures has the ability to drive the final rankings. Table 56 ranks all of the measures in descending order by their global weights. The top-ranked measures, *# of Air Force Core Competencies Advanced* and *Joint Involvement*, have global weights of 0.28 and 0.21, respectively. These two measures carry such a large portion of the weight because they fall under the most heavily weighted branch, *Core Competencies and Joint Warfighting* (global weight = 0.70). Additionally, the assigned local weights for the appropriate third-tier values, *Advance Air Force Core Competencies* and *Improve Joint Warfighting*, are 0.40 and 0.30, respectively.

Understanding that 49 percent of the measures' global weight is represented by two measures, *# of Air Force Core Competencies Advanced* and *Joint Involvement*, is critical to correctly applying the value model. It highlights the area in which FPB personnel should spend most of their time. If the data is inaccurate or the scoring, especially for these two measures, is conducted in a capricious manner, the ranked results may not reflect the true value of a potential initiative and the true impact to the FPB's fundamental objective of completing their stated mission. Additionally, realization that

two measures bear a large portion of the global weight for the hierarchy lends credence to having well-honed measures and SDVF category definitions. Likewise, if supplementary or more appropriate measures can be determined, they should be added to the value model.

Table 56. Ranking of Measures by Global Weights

Measure Global Weights in Descending Order	
# of AF Core Competencies Advanced	0.28000
Joint Involvement	0.21000
Level of Impact	0.07000
Urgency	0.06174
Longevity	0.05600
Sensibility	0.02940
Significant Doc	0.02800
Level of Request	0.02646
Degree of Leveraging Technology	0.02520
Any AFSC as AO	0.02160
Significant Trg	0.02100
Degree of Leveraging Contracts	0.01890
Degree of FP Correlation	0.01470
Full or Part-time	0.01440
Est Time to Field	0.01400
Degree of Leveraging Expertise	0.01260
Est Time to Complete	0.01176
Total Est Initiative Cost	0.00900
Degree of Similarity	0.00900
Performance Risk	0.00882
Significant Org	0.00700
Significant Req	0.00700
Significant Acq	0.00700
Innovativeness	0.00630
Degree of Leveraging POC Venues	0.00630
Infrastructure Location	0.00600
Schedule Risk	0.00588
% Initiative Cost Bore by Others	0.00540
Favorability of Disbursement	0.00360
Cost Risk	0.00294
Sum of Measure Global Weights	1.00000

4.2 Step 9 - Sensitivity Analysis

The thrust of the sensitivity analysis examined how changes in the global weights for the second-tier values (*Lean*, *Unique*, *Focused*, and *Impact*) influenced the overall ranking of the ongoing initiatives. The analysis focused on the second-tier values because that is where the FPB leadership makes their value tradeoffs when selecting potential initiatives for future execution. While a myriad of reasons may exist to support tradeoffs of the weights of importance for the second-tier values, an example might be: due to changes in DoD funding priorities, the FPB commander determines that the values comprising the second-tier value *Lean* are collectively more important than those comprising *Unique* or *Focused*. Consequently, the commander assigns a higher weight to *Lean* while proportionally lowering the weights of the remaining two values (i.e., *Unique* and *Focused*).

Additionally, sensitivity analysis was performed on the local weights for the first-tier values (*Rapidly ID & Prove Ideas* and *Core Competencies and Joint Warfighting*) to test the reliability of the results from the sensitivity analysis on the second-tier values. This analysis concludes with a local sensitivity analysis performed on the highest globally weighted measure (where there were more than two measures associated with a fourth-tier value) under the second-tier valued *Focused* (i.e., *Sensibility*) to determine whether the ranking of alternatives was sensitive to changing the weights on the measures.

4.2.1 Sensitivity Analysis for the Second-Tier Values

The second-tier values are the four fundamental governing principles of the FPB. Figure 58 shows that three of the four values (*Lean*, *Unique*, and *Focused*) fall under the programmatic value of the first-tier (i.e., *Rapidly ID & Prove Ideas*) and the final value (i.e., *Impact*) falls under the impact value of the first-tier (*Core Competencies and Joint Warfighting*). Even though the values under examination are in different branches of the hierarchy, thus requiring the use of global weights for the sensitivity analysis, the independence characteristic of the hierarchy (discussed in Section 2.8.2.1 and referring to the concept that how an initiative scores on one measure should not affect its score for another measure) is not violated because the first-tier values (the two halves of the mission statement) are analogous with the fundamental objective. When viewed from that perspective, the four second-tier values are essentially first-tier values that fall directly under the fundamental objective.

Since this sensitivity analysis is conducted at the second tier, it may seem that the values comprising the first tier are not involved. However, the sensitivity analysis at the second tier is conducted using global weights. Since global weights are determined by multiplying a specific value's local weight by the local weights of its preceding values in the hierarchy, the first-tier values are integral in the sensitivity analysis performed on the global weights of the second-tier values. Figure 58 shows the local and global weights (in parentheses) for the fundamental objective and the first two tiers of the hierarchy. Since the local weight for *Impact* is one, its global weight is simply the local weight of the first-tier value above it (i.e., *Core Competencies and Joint Warfighting*). Note the global weights for the hierarchy must still sum to one across each tier. Additionally,

when doing a sensitivity analysis globally, the global weight of the value being examined varies from 0 to 1 and the weights on that entire tier maintain their original proportionality. Hence, the tier global weights still sum to one. The results of the sensitivity analysis for each second-tier value are discussed in the following sections. The actual scores the initiatives received for each measure may be found in Appendix C.

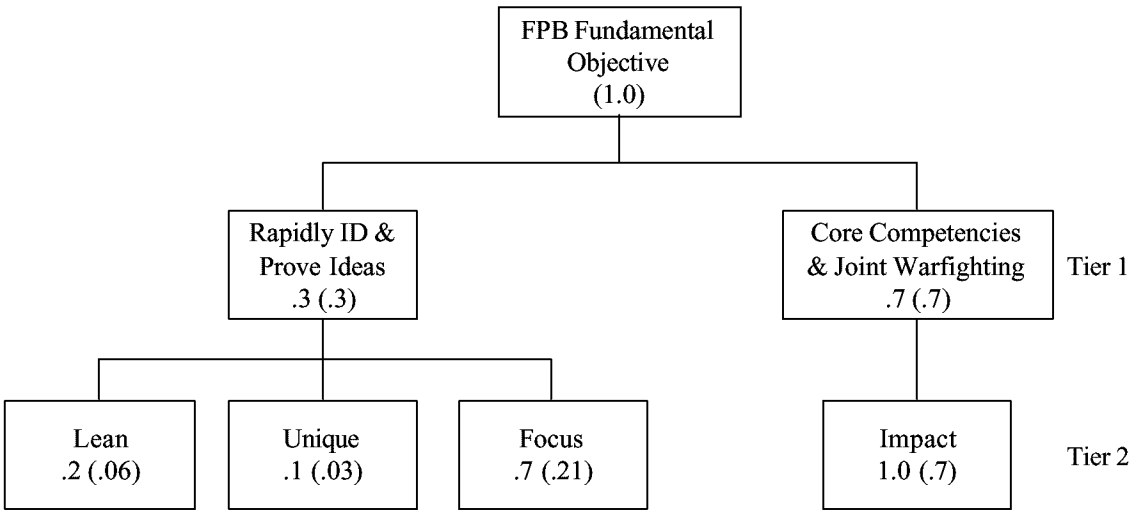

Figure 58. First Two Tiers Showing Local and Global Weights (in parentheses)

4.2.1.1 Global Sensitivity Analysis Results on Lean

Referring to Figure 59, notice that while IBD 2020 is recognized as the preferred alternative when the initial global weight on *Lean* is 0.06, its overall score steadily declines as the importance (i.e., the weight) placed on *Lean* is increased. Once the weight reaches 0.22, the Response Force Tracking (RFT) initiative becomes the preferred alternative. Once the weight reaches 0.71, the MCI initiative, which was originally the least preferred, becomes the second most preferred alternative. The Chem, Bio, Aerosol Warning System (CBAWS) initiative falls drastically from the third most preferred alternative at the initial weight to the least preferred.

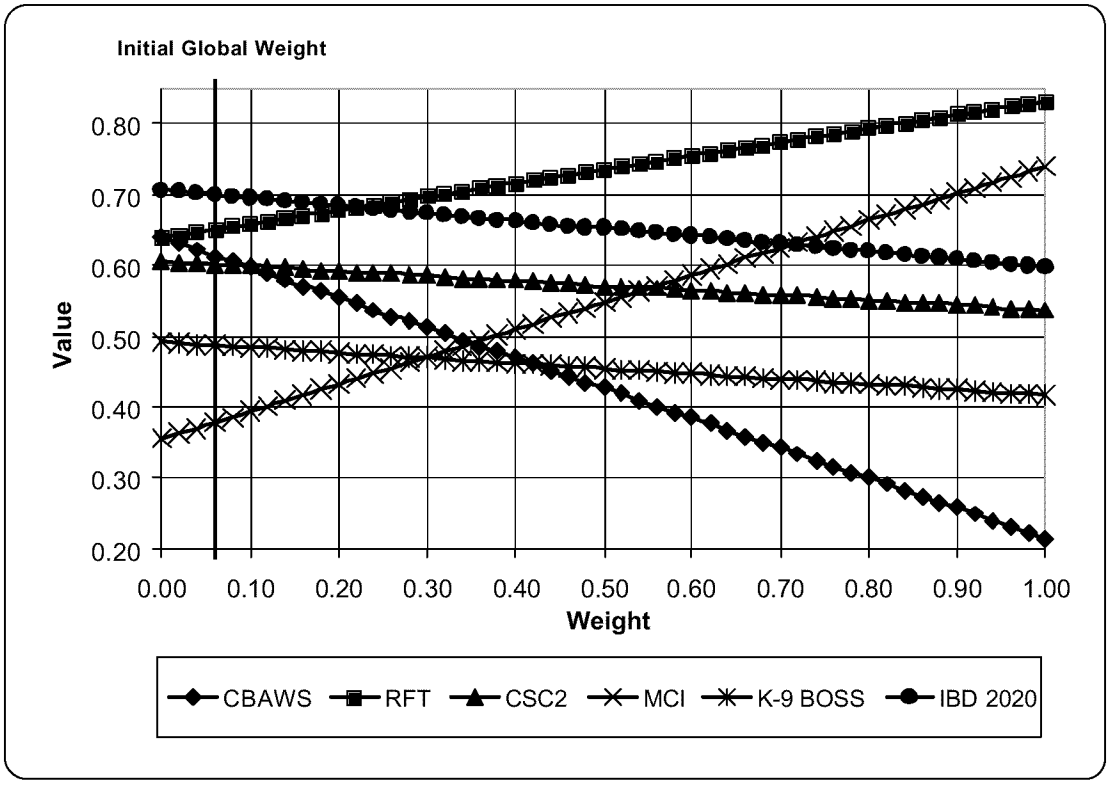

Figure 59. Sensitivity Analysis on *Lean*

Insight is gained as to why the initiatives changed position as the weight on *Lean* changed by examining the scores the initiatives received for the individual measures. Specifically examined are the reasons for the changes in position of the MCI (representing most dramatic increase) and CBAWS (representing most dramatic decrease) initiatives. The MCI initiative scored well for the *Lean* measures. Particularly noteworthy is the fact that it received perfect scores for the measures *Efficiency* and *Effectiveness* under the highest weighted value in the *Lean* branch's third-tier (i.e., *Manpower*). Addressing *Efficiency*, the AOs felt that the initiative was not very time intensive and could be executed by a single AO while that AO concurrently led the execution of other initiatives. Additionally, to address *Effectiveness*, the AOs acknowledged that MCI was a simplistic initiative that did not require specific expertise and thus could be led by an AO from any career field. The AOs also determined that the technology needed to prove the MCI concept was readily available on a "lend" basis from another DoD organization. Therefore, MCI scored as high as any initiative for the highest weighted value (i.e., *Light Budgetary Impact*) under the second highest weighted value in the *Lean* branch's third-tier (i.e., *Budget*). These scores reflect the simplistic nature of the MCI initiative and the availability of mature technology to prove it as a viable military force protection concept. In summary as increasing weight is placed on *Lean*, the MCI initiative's overall score dramatically improves.

The CBAWS initiative on the other hand scored poorly for the *Efficiency* and *Effectiveness* measures. The AOs determined that since CBAWS was a highly specialized and complicated initiative, it would require a chemical / biological specialist (i.e., it could only be executed by an AO with a particular career field specialty -- not

very efficient). The AOs additionally determined that the lead AO for the execution of CBAWS would have to devote their full attention to it (i.e., they could run no other initiative concurrently -- not very effective). The CBAWS initiative received the lowest score of the six initiatives for the highest weighted value (i.e., *Light Budgetary Impact*) under the second highest weighted value in the *Lean* branch's third-tier (i.e., *Budget*). This was because the technology to prove the CBAWS initiative was not readily available and that it required precise scientific experiments as part of its execution. Finally, CBAWS received a score of zero for the *Resources Availability* measure. The reason for this score of zero is that the entire conglomeration of infrastructure required to execute the initiative was only available external to the FPB. In summary, as increasing weight is placed on *Lean*, the CBAWS initiative's overall score dramatically declines.

4.2.1.2 Global Sensitivity Analysis on Unique

Figure 60 shows the sensitivity analysis performed on *Unique*. The IBD 2020 initiative is always the most preferred alternative. This is reasonable since IBD 2020 was the only initiative to receive the maximum score possible for all of the *Unique* measures. This occurred because the AOs felt the IBD 2020 initiative would make very innovative use of the existing technologies and concepts. They also acknowledged the direct force protection correlation of this initiative and felt there were currently no similar efforts being undertaken.

Figure 60 also shows the K-9 Bio-Organism Search Study (BOSS) initiative climbing from the "second to last" preferred to the second most preferred alternative. This is due to the K-9 BOSS scoring perfectly for the two *Unique* measures

(*Innovativeness* and *FP Correlation*) under the highest weighted value in the *Unique* branch's third-tier (*FP Ideas & Concepts*). The AOs gave K-9 BOSS the perfect score for *Innovativeness* because they felt using military working dogs to sniff out biological agents prior to weaponization and release was very innovative. Additionally, they scored it perfectly for *Degree of FP Correlation* because they knew a high association existed between using a military working dog to detect biological terrorist devices and force protection. The K-9 BOSS initiative also scored well for the *Degree of Similarity* measure because the AOs felt there were only minimal similarities between this initiative and others being conducted by other agencies.

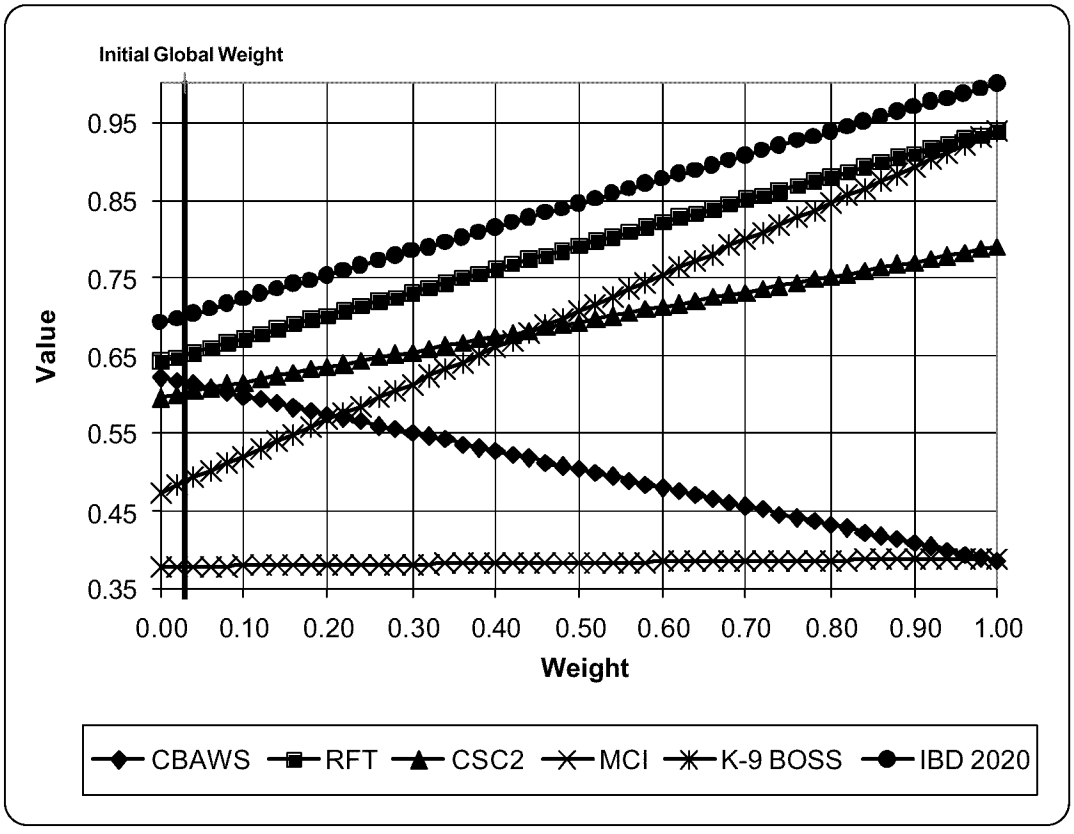

Figure 60. Sensitivity Analysis on *Unique*

Figure 60 also reveals that the CBAWS initiative is the only one that decreases in preference as the weight on *Unique* is increased. One reason for its decrease is the fact that it scored the lowest (along with MCI) for the measure *Degree of FP Correlation*. While the AOs acknowledged that CBAWS did have some inherent force protection correlation, they value more highly an initiative with an unequivocal force protection association.

4.2.1.3 Global Sensitivity Analysis on Focused

Figure 61 shows MCI increasing dramatically in preference as the weight on *Focused* increases. This is attributed to the perfect scores MCI received for all three risk measures (i.e., *Cost*, *Schedule*, and *Performance*) that fall under the *Focused* value's highest weighted third-tier value, *Innovative*; AOs felt MCI was a simple initiative that presented insignificant risk. Since MCI also leverages a high degree of existing technology, expertise, and proof of concept venues, it also scored perfectly for those three measures. The MCI initiative also had the second-highest score for the *Level of Request* measure, which reflects the fact that the FPB was asked to work on this initiative by Space Command. Finally, MCI had the highest score of the six ongoing initiatives for the *Estimated Time to Complete* measure because the AOs knew a mature technology was readily available for them to use in proving the concept and thus would facilitate a quick completion.

Figure 61 also highlights three initiatives (Response Force Tracking (RFT), Chem, Bio, Aerosol Warning System (CBAWS), and Combat Support Command and Control (CSC2)) that decrease in preference as the weight on *Focused* is increased.

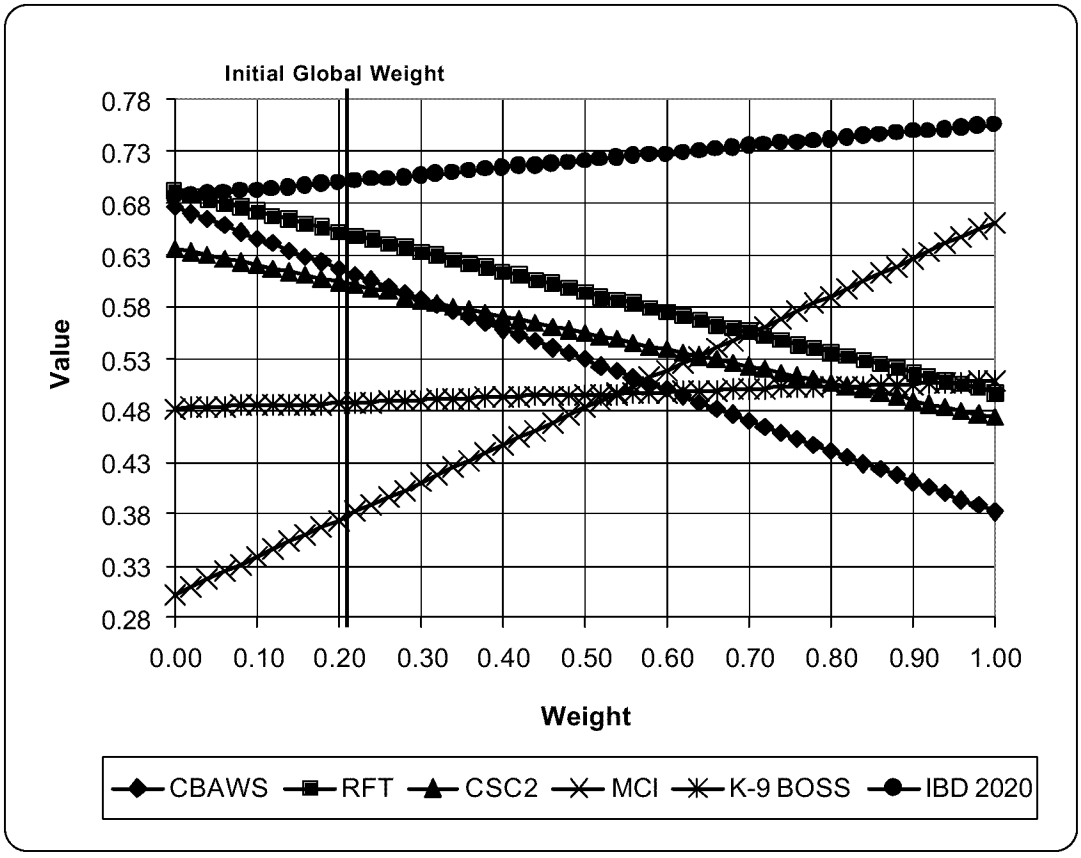

Figure 61. Sensitivity Analysis on *Focused*

These initiatives all scored zero for the first and third highest weighted measures in the *Focused* branch (i.e., *Urgency* and *Level of Request*). The low scores are attributable to the fact that (1) all the initiative requests either were generated internally at the FPB or came from the unit level and (2) all the initiatives only had a "routine" priority associated with them as determined by the initiative submitter. Also noteworthy is the fact that RFT, CBAWS, and CSC2 all scored low for the *Estimated Time to Complete* measure. In the case of RFT, the AOs felt it would take a long time to prove due to the high number

of field-condition scenarios necessary to evaluate it and the complicated information technology requirements. The CBAWS and CSC2 initiatives also required complicated information technology requirements and subsequently were estimated to take an extended amount of time to prove.

Aside from where the *Focused* value has a weight of zero, the IBD 2020 initiative is always the most preferred alternative according to Figure 61. At zero RFT has a value of 0.692 and IBD 2020 has a value of 0.686. Two primary reasons IBD 2020 is otherwise the most preferred alternative are (1) the perfect score it received for the *Level of Request* measure (the initiative was requested at the Headquarters Air Force level) and (2) the highest score of the six ongoing initiatives it received for the *Urgency* measure (it was submitted with an urgency level of "priority"). Those measures are the third and first highest weighted measures within the *Focused* branch, respectively. In addition, IBD 2020 scored perfectly for three of the four *Leverage Existing* measures (i.e., *Leverage Existing Contracts*, *Expertise*, and *POC Venues*). This was because the IBD 2020 initiative was being led by a civilian AO, with many years of base defense experience and already on contract with the FPB. Possible POC venues include deployed locations as well as bases within the United States that have requested force protection technology assistance. Finally, IBD 2020 received a perfect score for the second highest weighted measure within the *Focused* branch (i.e., *Sensibility*) because the scope of the initiative is limited to technologies that are readily available.

4.2.1.4 Global Sensitivity Analysis on Impact

At the original weight of 0.70 for *Impact*, the IBD 2020 initiative is the most preferred alternative. The CBAWS initiative is increasingly preferred, moving from the least preferred alternative at an *Impact* weight of zero to the most preferred alternative at a weight of approximately 0.90, as shown in Figure 62. The significant increase for CBAWS is primarily attributed to its high score for the measure *# of Core Competencies Advanced*, which is the highest weighted measure in the hierarchy. The AOs determined it advanced two of the six Air Force core competencies: (1) Agile Combat Support (because any successful force protection initiative will advance Agile Combat Support) and (2) Information Superiority (because CBAWS is envisioned as being capable of providing digital information feedback to the ground defense force commander). The second primary reason for the significant increase in value for the CBAWS initiative is the perfect score it received for the *Joint Involvement* measure, which is the second highest weighted measure in the hierarchy. The AOs acknowledged that CBAWS was the only alternative to have another DoD service involved in its execution.

Figure 62 also shows the MCI initiative moving from the second most preferred alternative to the least preferred alternative as the weight on *Impact* increases. This is due to MCI scoring zero for seven of the ten measures within the *Impact* branch of the hierarchy. Two measures for which it received at least a low score (*Estimated Time to Field* and *Acquisitions Revisions*) were two of the lowest weighted measures in the *Impact* branch. The AOs acknowledged that MCI was programmatically sound; recall it significantly increased in preference for *Lean* and *Focused* as the weight for those two

values increased. However, the AOs did not feel there would be any significant, positive impact realized as a result of proving the military worth of the MCI initiative.

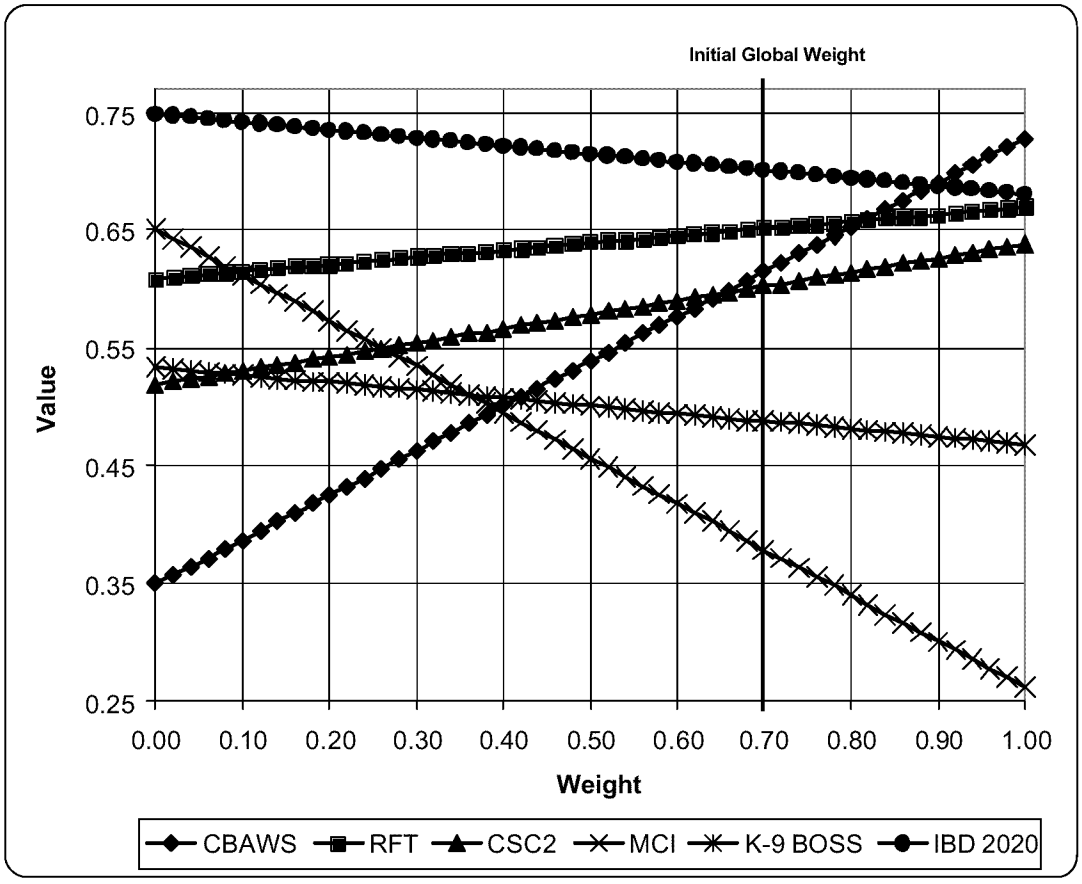

Figure 62. Sensitivity Analysis on *Impact*

4.2.2 Local Sensitivity Analysis on the First-Tier Values

A local sensitivity analysis was conducted on the *Rapidly ID and Prove Ideas* first-tier value of the hierarchy to help validate the previous sensitivity results. Since the

other first-tier value *Core Competencies and Joint Warfighting* is a "place holder," sensitivity analysis conducted on it would provide the same results obtained from a global sensitivity analysis on the second-tier value *Impact*. Figure 63 shows the results of the local weight sensitivity analysis on *Rapidly ID and Prove Ideas*. This figure is similar to Figure 61, which represents the results of the sensitivity analysis on the second-tier value *Focused*. This was expected since *Focused* represents 70 percent of the value associated with *Rapidly ID and Prove Ideas*. The similarity between the results of the two sensitivity analyses (i.e., global for the second-tier and local for the first-tier) lends confidence to the correct structuring of the overall value model.

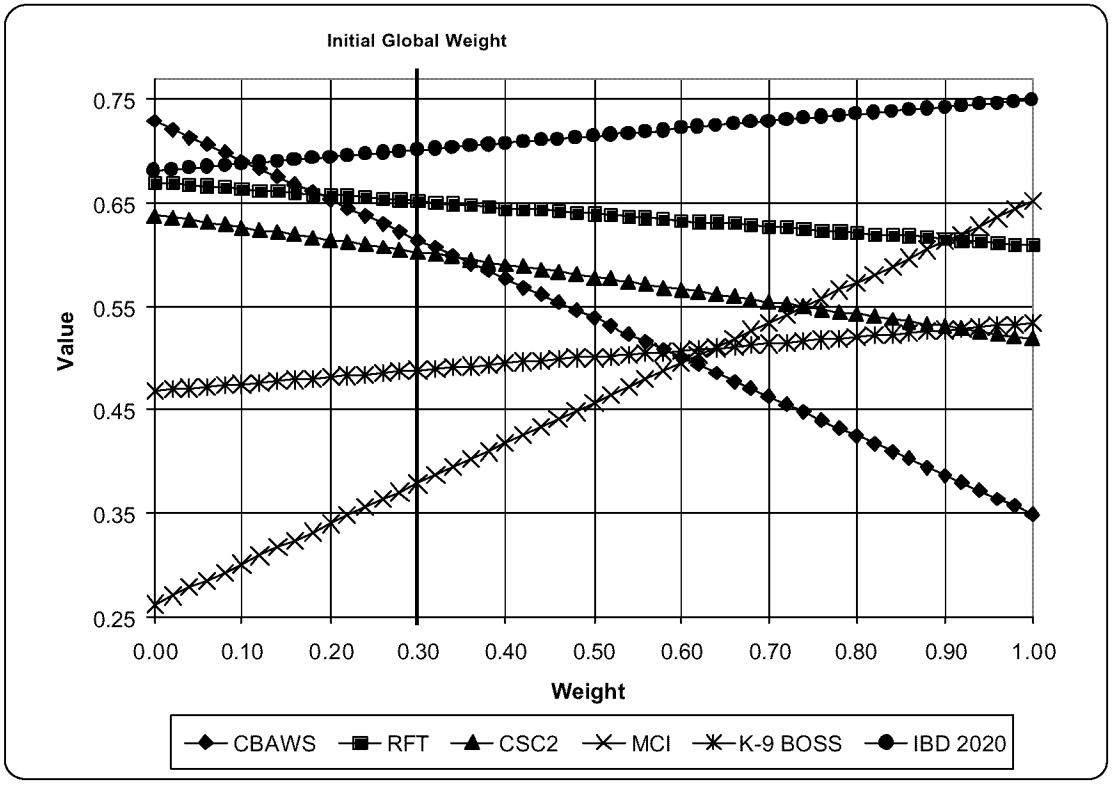

Figure 63. Sensitivity Analysis on *Rapidly ID & Prove Ideas*

4.2.3 Local Sensitivity Analysis Results on the Measure Level

To demonstrate the multiple objective nature of the value model, and to determine whether the ranking of alternatives was sensitive to changing the weights on the measures, a local sensitivity analysis was conducted on the measure *Sensibility*, which had a local weight of 0.50 and a global weight of 0.0294. If *Sensibility* demonstrates insensitivity the remaining measures are insensitive. This sensitivity analysis is shown in Figure 64. The measure *Sensibility* was selected for the sensitivity analysis by considering the fourth-tier value with the most measures (i.e., *Strategy of Determination*) and then selecting the measure with the highest global weight (i.e., *Sensibility*). The sensitivity analysis, where the local weight on *Sensibility* varies from 0 to 1 equates to the global weight for *Sensibility* varying from 0 to 0.0588. This demonstrates that even at the maximum local weight of one, the global weight is not getting too high. The assumption in performing this sensitivity analysis is that all of the alternatives will score differently for the *Sensibility* measure. If the alternatives were to score the same on all the measures, there would be no differentiation between them regardless of the weights. As indicated in Figure 64, the results revealed that *Sensibility* is insensitive to changes in weights (i.e., there were no weights between zero and one where the alternative ranking changed). This demonstrates that since the ranking of alternatives is not driven by a single measure the model is truly multi-objective.

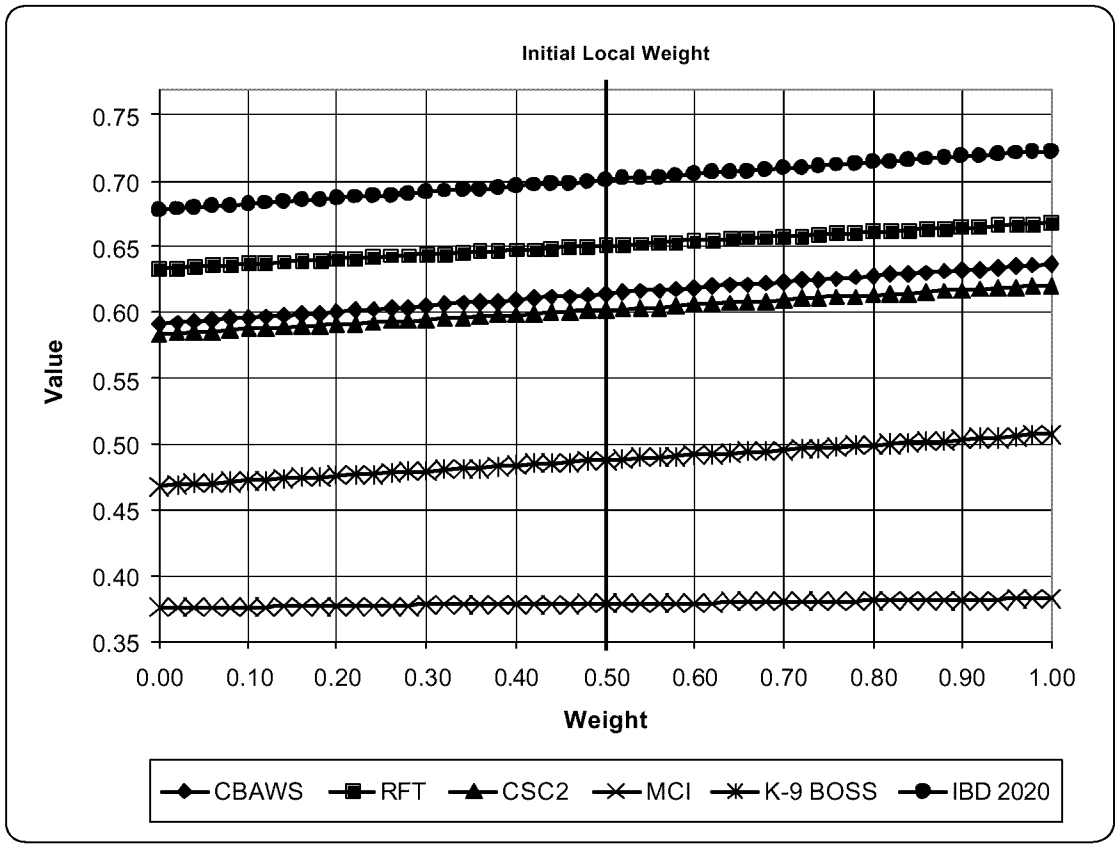

Figure 64. Local Sensitivity Analysis on the *Sensibility* Measure

4.3 Summary

Chapter 4 reviewed the results of using the value model with six ongoing FPB initiatives to determine the value each contributed to the FPB fundamental objective of accomplishing their stated mission. The deterministic results, summarized in Table 55, indicate the IBD 2020 initiative contributes the greatest value to the FPB. If the initiatives analyzed in this research were not ongoing ones, the FPB commander would be in a better position to choose which initiatives to pursue. However, the analysis still presents an example of the type of insight available and provides helpful information should it become necessary to discontinue one or more ongoing initiatives.

The sensitivity analysis performed using the global weights of the second-tier values indicated where the results were sensitive to changes in the global weights. For each second-tier value examined through sensitivity analysis, the most preferred alternatives for the widest range of weights were the IBD 2020 and RFT initiatives. The sensitivity analysis also highlighted the fact that the MCI initiative increases in preference as the weight is increased on the programmatic values of *Lean* and *Focused*. The MCI initiative remains at an almost constant value, as the least preferred alternative, as the weight is increased on *Unique*. The MCI initiative also decreases in preference as the weight is increased on the value *Impact*. Conversely, the CBAWS initiative decreases in preference as the weight is increased on the programmatic values *Lean*, *Unique*, and *Focused*, while it increases in preference as the weight is increased on the *Impact* value. The local sensitivity analysis performed on the first-tier value, *Rapidly ID & Prove Ideas*, demonstrates model confidence since it yielded results similar to those

obtained from the global sensitivity analysis on the second-tier value *Focused*. To confirm the multi-objective nature of the value model, a sensitivity analysis was also conducted using the local weight of the *Sensibility* measure within the *Focused* branch. The results indicated no decision change points (i.e., no sensitivity to changes in local weight); thus demonstrating the absence of a measure that singularly influences the final ranking of alternatives.

Chapter 5. Findings and Conclusions

Chapter 5 is the culmination of this thesis effort. It draws conclusions regarding the applicability of the value-focused thinking (VFT) process in force protection applications, describes the far reaching impacts of this work, addresses the value model's strengths and weaknesses, makes final recommendations for implementation of the VFT process in the force protection arena, and suggests possible future work.

5.1 VFT and Force Protection

This research effort is groundbreaking in that it proves personnel responsible for enhancing Department of Defense (DoD) force protection efforts have quantifiable values that can be arranged in hierarchical fashion to facilitate the measurement, scoring, analysis, and ranking (by value) of ideas and concepts related to force protection efforts. In other words, this thesis effort clearly demonstrates that the VFT process is a viable methodology for assisting decision makers in selecting appropriate force protection ideas and concepts for further evaluation that will ultimately enhance a warfighter's ability to accomplish missions in the field. Insight is gained by decision makers responsible for selecting ideas, concepts, technologies, and even doctrinal issues, for further development, exploration, and ultimate incorporation into a warfighter's toolkit. Therefore, by quantifying a normally subjective process, more informed decisions can be made. There are at least four advantages to using the value model and the VFT process in the force protection arena.

(1) Defendable confirmation of previous decisions: The process ranked the ongoing initiatives consistently with the subjective feelings of the action officers (AOs) at the Force Protection Battlelab (FPB). This is not meant to detract from the usefulness of the value model; in fact, it adds credibility. Through the use of the model, the AOs quantitatively confirmed the ranking of their initiatives and were in a position to defend their results.

(2) Promotes values-first critical thinking: The 10-Step VFT process required the FPB personnel to seriously discern, and for the first time document, what they valued in selecting potential initiatives to fulfill their mission. This focused their attention on the reason battlelabs were initially established and provided critical information to be used in the construction of an organizational strategic roadmap.

(3) Flexibility: The collectively exhaustive nature of the value hierarchy demonstrated the robustness of the value model; all possible values are accounted for and, if one becomes irrelevant, its weight of importance can simply be set equal to zero.

(4) Defendable, objective, and repeatable: The foundation of the model, which is its value hierarchy, was constructed using solicited values of FPB personnel with a subsequent connection made between those specific values and the generic battlelab AFI (i.e., AFI 10-1901). This demonstrates the irrefutability of, and confidence they can have in, the final rankings.

5.2 Impact

The impact of this research is recognized by the immediate capability the value model provides the FPB to rank their potential initiatives according to the values they

expressed as important in achieving their mission. In fact, prior to the completion of this thesis, the FPB commander requested that the value model be used to examine 29 potential initiatives in an effort to lend insight to his final initiative selection. The examination was accomplished; it provided defensible and objective reasons for the commander's final initiative selection decisions and will result in the FPB executing initiatives that have the largest impact on achieving their mission statement (i.e., their fundamental objective). The potential future impact is evidenced by senior Air Force leadership interest in the VFT process and its application in the force protection arena.

The success of this research effort will help the VFT process become more accepted within the military. As the Air Force, and other DoD agencies, begin to understand the potential of the VFT process in the force protection role, they will be able to apply it towards making more informed force protection decisions. Ultimately, the synergy generated through the cooperative use of the VFT process will result in improved joint warfighting, more efficient and effective operations, and saved lives.

5.3 Value Model Strengths

The primary strength of the value model is its "gold standard" foundational hierarchy. In other words, stated values of FPB personnel and written guidance on the battlelabs' responsibilities and processes coincide. This fact is the hinge-pin that lends defensibility to the model's final rankings. While the weights assigned to the values within the hierarchy are always open for debate, the sensitivity analysis adequately explores how weight changes affect the overall final ranking of alternatives. However,

the values comprising the hierarchy are not debatable since they directly reflect the values specified as important by the AFI.

Another strength of the value model is the use of Microsoft Excel in its construction. This strength is echoed through the familiarity and flexibility it provides decision makers. The familiarity of Excel adds to the decision maker's confidence in the model's results. Additionally, data entry and model execution are performed with ease on a desktop or laptop computer system. The decision maker is not forced to rely on "black box" software; the results of the existing model are simple to interpret and are definitive. Flexibility comes from the fact that values, measures, and weights can be modified; and the model continues to yield defensible results. Furthermore, constructing the model with a spreadsheet program like Excel provides the opportunity to competently evaluate and rank hundreds of alternatives if necessary.

Finally, the model's strength is enhanced by the fact that it remains general enough for implementation, with few adjustments, at the other Air Force battlelabs. This is based on the fact that the values expressed by FPB personnel can be linked to general battlelab guidance. The other battlelabs will undoubtedly make changes to the model; however, the model will still provide a defensible, objective, and repeatable process for evaluating ideas.

5.4 Value Model Weaknesses

The prominent weakness of the value model is that uncertainty is addressed only through the sensitivity analysis performed on the weights assigned to the values. However, it does not consider the uncertainty associated with the construction of the

single dimensional value functions (SDVFs) or the scores obtained for the evaluation measures of each alternative. For the FPB focus case, a team was responsible for determining the values of the SDVF categories; furthermore, scoring each alternative within the measures was accomplished via consensus. Other organizations may not have the luxury of an SDVF construction team or be able to reach consensus on the alternative scores.

Another weakness of the model is recognized by the fact that there are two measures accounting for almost 50 percent of the global weight within the hierarchy. Poor scoring procedures, which include reliance on inaccurate data for the alternatives, may subsequently influence the final ranking of the alternatives, thereby affecting the choices of the decision maker.

5.5 Conclusion

This research has provided a defensible, objective, and repeatable initiative selection process to aid the FPB commander in converting an existing pool of potential initiatives into a portfolio of executable force protection initiatives. Therefore, it is recommended the FPB adopt the value model to score and rank their pool of potential initiatives and base their selection for execution on the insight the model provides. This effort also demonstrated the value of the VFT process in helping decision makers address general force protection decisions in any service sector, military or civilian.

5.6 Recommendations for Future Work

Once the value model is adopted by the FPB, it is recommended that future work explore optimization routines that quantitatively incorporate financial, time, and

personnel constraints to develop a genuine portfolio of supportable initiatives. Appropriate routines may include integer programming and/or linear programming. Additionally, to account for the uncertainty associated with the SDVF construction and alternative scores, probabilistic techniques may be incorporated in the value model.

Another recommendation for future work involves a detailed review of the measures. Specific attention should be paid to those on the *Core Competencies and Joint Warfighting* half of the hierarchy, where two measures (*# of Air Force Core Competencies Advanced* and *Joint Involvement*) account for almost 50 percent of the hierarchy's global weight. Consideration should be given to ensuring those measures adequately capture all aspects of their associated values. Further decomposing the measures will improve scoring accuracy by removing generalities. For example, *# of Air Force Core Competencies Advanced* might be decomposed into the six core competencies in which separate SDVFs are constructed for each one.

The final recommendation is for the adoption and implementation of the VFT process in the DoD force protection arena. This will require backing by the Force Protection Battlelab and the Air Force Security Forces Center along with strong support from other organizations intimately involved in the protection of military personnel. Model demonstrations and briefings, the most efficient method to generate interest and build support for the VFT process, might provide valuable insight to others.

An interesting fact concerning the use of the VFT process in technology is the time value of technology. Winthrop (1999:114-115) comments that, as "time increases to complete a project, the value of technology will tend to decrease." This insight demonstrates that the importance originally placed on a force protection idea or concept

may be reduced or totally overcome by advances in other areas. Future work may examine how to account for this time value concept.

5.6 Summary

The VFT process is an appropriate and viable methodology to use in the DoD force protection arena. The results of this research have the potential to enhance not only Air Force force protection programs but also those across the DoD. The value model developed during this research has strengths and weakness. Strengths such as the model's flexibility and familiarity can be expanded, while weaknesses such as the uncertainty factor can be improved upon. Incorporating optimization routines can enhance the utility of the model and probabilistic techniques can dampen the effect of uncertainty. The most prominent recommendation from this research is that the VFT process should be adopted to improve the insight available to decision makers regarding pursuit of force protection ideas, concepts, or technologies within the DoD.

Appendix A: Value-Focused Thinking 10-Step Process

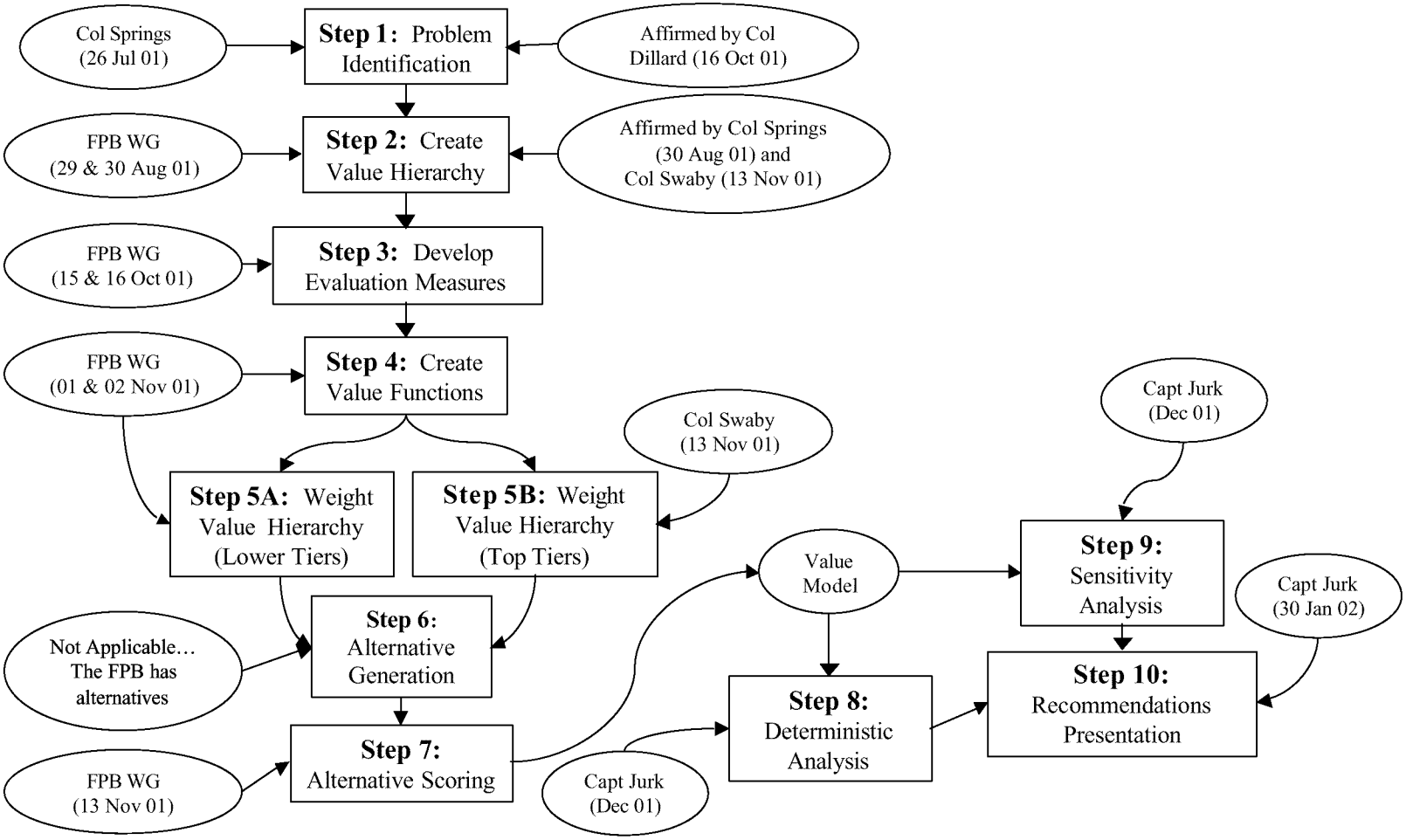

Figure 65. Value-Focused Thinking 10-Step Process

Appendix B: Documentation of Meetings with the Force Protection Battlelab

FPB AFIT Meeting 1: 26 July 2001

Location: FPB, Lackland AFB, TX

Present from FPB: Col Springs (FPB/CC), Lt Col Addison (FPB/CD), Capt Luke Cropsey (FPB/FPC)

Present from AFIT: Capt Stephen Chambal, Capt David Jurk

Meeting Purpose:

Present the idea of using decision analysis, specifically, the value-focused thinking process, to assist the FPB in determining their values, ultimately providing insight for their selection of force protection ideas to become funded battlelab initiatives.

Meeting Highlights:

1. Capts Chambal and Jurk provided a brief description of DA/VFT and its applicability to the FPB situation.

2. Capt Cropsey was in full agreement that the VFT process was appropriate and very much needed.

3. Lt Col Addison noted, that if anything, the exercise of going through the VFT process may highlight some deficiencies and provide a framework for a repeatable initiative selection procedure as well as, potentially assist them in the development of a strategic roadmap.

4. Col Springs wanted to know what the deliverable was going to be.

    a. Capts Chambal and Jurk indicated the deliverable would be a draft value model through which the FPB can score initiatives according to the overall value they add to the FPB.

    b. "Draft" was indicated because; as this would be the first VFT work done for the FPB, the thesis process would result in a value model that may be "rough around the edges" requiring future adjustment.

FPB AFIT Meeting 2: 29 - 30 August 2001

Location: FPB, Lackland AFB, TX

Present from FPB: Lt Col Addison, Maj Mark Koch, Maj Kevin McFadden, Capt Mark Archuleta, Capt Luke Cropsey, CMSgt Earl Jones, Mr. Jay Flaherty, Mr. John Shackell, Mr. Don Lowe

Present from AFIT: Capt Stephen Chambal, Capt David Jurk

Meeting Purpose:

1. Introduce decision analysis and the value-focused thinking process to as many FPB personnel as possible. The introduction would allow FPB personnel to understand the VFT process and contribute to the construction of their value hierarchy.

2. Construct their value hierarchy, with no measures.

3. Detail Capt Jurk's timeline for this effort.

4. Establish next meeting date.

Meeting Highlights:

1. "Buy the Best Truck" example was used to introduce DA/VFT.

    a. Discussed the 10-Step process for building a decision analysis framework.

2. FPB personnel brainstormed their values via Post-it™ notes (over 100 notes).

    a. Avoided overpowering personalities dominating the values discussion and allowed all ideas to be read before discussing them.

    b. Read all notes and consolidated similar ideas.

    c. Majority of results were "measures."

    d. Lessons Learned:

        1) Use one color of Post-it™ note.
        2) State and clarify what they should consider as the objective statement.

3. Discussed the "Gold Standard" and its importance to the defensibility of the final value hierarchy.
4. Highlighted the four battlelab fundamental "governing" principles from AFI 10-1901. They are lean, unique, focused, and innovative.

5. Significant discussion about fitting each "value" from the Post-it™ notes under one of the four fundamental "governing" principles.

6. Subsequently, began hierarchy construction with the four fundamental "governing" principles as the first-tier values.

    a. Received buy-in from: Col Springs, Lt Col Addison, Maj McFadden, Mr. Flaherty.

7. FPB personnel wanted to see the connection between their mission statement, per AFI 10-1901, and the four fundamental "governing" principles.

    a. Capt Jurk accomplished that via the "Connection Document" which was forwarded to the FPB for their concurrence, on 05 Oct 01.

    b. The mission statement thus comprised the first-tier of the hierarchy and the four fundamental principles became the second-tier.

8. FPB personnel assisted in the hierarchy construction.

    a. Three of the four fundamental "governing" principles (i.e., second- tier values) were completed by FPB personnel (Capts Chambal and Jurk facilitating).

    b. Remaining portion of the hierarchy was completed by Capt Jurk and included in the "Connection Document" which was forwarded to the FPB for their concurrence, on 05 Oct 01.

9. Capt Jurk's timeline considerations:

    a. Sep 01: Hierarchy constructed.

    b. Oct 01:
        1) Conceive all measures.
        2) Construct associated SDVFs.
        3) Assign lower-tier weights (FPB Personnel).
        4) Receive sample set of alternatives from FPB.

    c. Nov 01:
        1) Assign upper-tier weights (Col Dillard).

2) Score sample set of alternatives.

d. Dec 01:
   1) Perform deterministic analysis.
   2) Sensitivity analysis.
   3) Document efforts.

e. Jan 02: Thesis defense.

f. Jan 02: Brief results to FPB.

10. Established next meeting date for 17 - 18 Sep 01.

    a. OBE (11 Sep 01 terrorist attacks).

    b. Rescheduled for 15 - 16 Oct 01.

FPB AFIT Meeting 3: 15 - 16 October 2001

Location: FPB, Lackland AFB, TX

Present from FPB: Capt Luke Cropsey, CMSgt Earl Jones, MSgt Rob Mills, Mr. Jay Flaherty, Mr. John Shackell

Present from AFIT: Capt Stephen Chambal, Capt David Jurk

Meeting Purpose:

1. Review the value hierarchy constructed during the last meeting. Explain the connection between the stated mission of the FPB and the four governing principles defined in AFI 10-1901.

2. Develop the evaluation measures (and their associated x-axes) for each bottom-tier value, in order to show the degree of attainability of those values.

3. Develop the single dimensional value function (SDVF) for each measure.

4. Establish next meeting date to weight the hierarchy.

Meeting Highlights:

1. Reviewed and received concurrence on the value hierarchy and the connections drawn between the FPB mission and the four governing battlelab principles listed in AFI 10-1901.

2. Capt Chambal and Capt Jurk explained to the FPB members the characteristics of appropriate measures and x-axes scales. Since the data available for the potential initiatives would be general in nature (most potential initiatives are innovative ideas and concepts with no hard data) it was noted that the majority of the measures would probably be categorical.

3. Measure construction began with the left-most measure in the hierarchy (Full or Part-time) and continued across to the right-most.

    a. Lessons Learned:

        1) Too much time had elapsed between this meeting and the previous meeting. To facilitate the review and concurrence of the hierarchy a very in-depth explanation was required to refocus the FPB members.
        2) To lessen the potential of having to revisit measures, request as specific definitions as possible for the x-axis categories.

4. The characteristics of SDVFs were explained to the FPB members. It was determined that monotonically increasing SDVFs would be easiest to work with when scoring the alternatives. Monotonically increasing SDVFs lend themselves to knowing that more is always better.

5. All SDVFs were constructed.

    a. While the majority were discrete, some were continuous (negating a categorical measure).

    b. Lessons Learned: If possible, construct the SDVF for a particular measure immediately following the development of the measure to prevent spending time readdressing each measures definition.

6. The next meeting date was established as 01 - 02 Nov 02 to weight the lower-tiers of the hierarchy (i.e., the measures, the fourth-tier, and the third-tier).

FPB AFIT Meeting 4: 01 - 02 Nov 2001

Location: FPB, Lackland AFB, TX

Present from FPB: Capt Aeneas Gooding, Capt David Skiba, Mr. Jay Flaherty, Mr. John Shackell

Present from AFIT: Capt David Jurk, Capt Dee Jay Katzer

Meeting Purpose:

1. Weight the lower-tiers of the value hierarchy.

    a. The AOs were asked to weight the measures, fourth-tier, and third-tier values because they are considered the subject matter experts who understand the intricate programmatic issues associated with initiative execution.

2. Request six ongoing initiatives for practice scoring at the next meeting.

3. Establish next meeting date to weight the top-tiers of the hierarchy and practice score the six ongoing initiatives.

Meeting Highlights:

1. Capt Jurk explained the weighting procedure that would be followed.

    a. The local weights of one tier, within one branch, must sum to one.

    b. Where there were more than one measure per fourth-tier value those measures would weighted relative to each other.

    c. The process would progress steadily from left to right and bottom to the top (i.e., the third-tier) within the hierarchy.

    d. Animated PowerPoint slides were developed to assist the FPB personnel in visualizing their current weighting location within the hierarchy to more easily facilitate the weighting process.

2. The most important aspect of the weighting exercise was capturing the reasons the measures and values were weighted as they were.

    a. Lessons Learned: The animated PowerPoint slides helped everyone remain properly oriented within the hierarchy structure while assign weights.

3. An agreement was reached that the six ongoing initiatives would be determined before the next meeting date and their names would be emailed to Capt Jurk at AFIT.

4. The next meeting date was established as 13 Nov 02 to weight the top-tiers of the hierarchy (i.e., the second-tier and first-tier values) and practice score the six ongoing initiatives.

FPB AFIT Meeting 5: 13 Nov 2001

Location: FPB, Lackland AFB, TX

Present from FPB: Col Swaby, Maj Kock, Maj McFadden, CMSgt Jones, MSgt Mills, Mr. Jay Flaherty, Mr. John Shackell

Present from AFIT: Capt David Jurk, Capt Dee Jay Katzer

Meeting Purpose:

1. Instruct the FPB members in the scoring process by practice scoring the six ongoing initiatives. Leave electronic and hard-copy score sheets for the FPB members to use in their upcoming initiative scoring session.

2. Review the complete hierarchy with the FPB commander and subsequently have him weight the top-tiers (i.e., second-tier and first-tier) of the hierarchy.

Meeting Highlights:

1. The FPB members were given score sheets for each measure. These sheets included only the measure name and definition along with the definitions of their associated x-axis categories. The values associated with each x-axis category were not shown to prevent the members from "gaming" the score.

2. Each ongoing initiative was scored for a particular measure before moving on to the next measure. This procedure kept the definition of the measure and its categories fresh in the heads of the FPB members and encouraged consistency in scoring from one alternative to the next.

3. The FPB commander became unavailable to weight the top-tiers of the hierarchy. The acting deputy, Col Swaby, was inserted by the FPB commander as his proxy.

4. Col Swaby presented a list of items the commander wanted to ensure were accounted for within the hierarchy. These items included:

    a. Collaboration with other agencies. Addressed in *Fiscal Partnership*.

    b. Sponsorship (financial and advocacy) from requesting / suggesting agency. Addressed in both *Level of Request* and *Fiscal Partnership*.

    c. Legitimate requirement for the pursuit of the initiative. Addressed through *Level of Request*, *Degree of FP Correlation*, and *# of AF Core Competencies Advanced*.

d. Initiatives are truly innovative in nature (living up to the spirit of intent of battlelabs). Addressed specifically by *Innovativeness*.

e. Transition risk of the initiative. Addressed by *Performance Risk*.

5. Upon completion of the hierarchy review with Col Swaby, he agreed that it was exhaustive and adequately addressed the commander's concerns (a - e above).

6. Col Swaby subsequently assigned weights to the top-tier values.

   a. Second-tier value weights:
      1) Lean = 0.2
      2) Unique = 0.1
      3) Focused = 0.7
      4) Impact = 1.0 (a single value in a separate branch from *Lean*, *Unique*, and *Focused*)

   b. First-tier value weights:
      1) Rapidly ID & Prove Ideas = 0.3
      2) Core Competencies and Joint Warfighting = 0.7 (the single value *Impact* emanates directly from this first-tier value)

7. Col Swaby subsequently conferred with the FPB commander and received concurrence on the weights of importance he assigned to the top-tier values. Col Swaby also ensured the commander the hierarchy adequately addressed his listed concerns.

8. Blank score sheets and an electronic score bank was left with the FPB to facilitate the scoring of many potential initiatives and their subsequent forwarding to Capt Jurk at AFIT for deterministic analysis via the value model.

9. It was understood that the potential initiatives needed to be scored and those scores received by Capt Jurk NLT 30 Nov 01 for inclusion in the thesis effort write-up.

Appendix C: Scores of the Six Ongoing Initiatives

The following four tables (i.e., Tables 57, 58, 59, and 60) display the actual scores the Force Protection Battlelab's six ongoing initiatives received during the working group meeting on 13 Nov 01. The alternative scores displayed in Table 57 fall under the *Lean* branch.

Table 57. Alternative Scores from the *Lean* Branch

Measure		Alternative					
		CBAWS	RFT	CSC2	MCI	K-9 BOSS	IBD 2020
Full or Part Time							
	Full	0	-	0	-	-	0
	Part	-	1	-	1	1	-
Any AFSC as AO							
	No	-	-	-	-	-	-
	Potentially	0.2	-	-	-	0.2	-
	Yes	-	1	1	1	-	1
Infrastructure Location							
	External	0	0	-	0	0	-
	Combination	-	-	0.5	-	-	0.5
	Internal	-	-	-	-	-	-
% Cost Bore by Others							
	None	-	-	-	0	0	-
	Low	-	-	0.25	-	-	0.25
	Moderate	-	-	-	-	-	-
	High	0.75	0.75	-	-	-	-
	Very High	-	-	-	-	-	-
Total Est Initiative Cost							
	Exorbitant	-	-	-	-	-	-
	High	0.1	-	-	-	-	-
	Intermediate	-	-	0.3	-	0.3	-
	Reasonable	-	0.7	-	0.7	-	0.7
	Low	-	-	-	-	-	-
Favorability of Disbursement							
	Unfavorable	-	-	-	-	-	-
	Not Disbursed	-	-	-	0.6	-	-
	Favorable	1	1	1	-	1	1

The alternative scores displayed in Table 58 fall under the *Unique* branch.

Table 58. Alternative Scores from the *Unique* Branch

Measure		Alternative					
		CBAWS	RFT	CSC2	MCI	K-9 BOSS	IBD 2020
Innovativeness							
	Intended Purpose	-	-	-	0	-	-
	Modified Purpose	0.7	-	-	-	-	-
	Innovative Purpose	-	1	1	-	1	1
Degree FP Correlation							
	Real Stretch	-	-	-	-	-	-
	Limited	0.3	-	-	0.3	-	-
	Direct	-	1	1	-	1	1
Degree of Similarity							
	Identical	-	-	-	-	-	-
	Similar	0.3	-	0.3	-	-	-
	Different	-	0.8	-	0.8	0.8	-
	Very Different	-	-	-	-	-	1

The alternative scores displayed in Table 59 fall under the *Focused* branch.

Table 59. Alternative Scores from the *Focused* Branch

Measure		Alternative					
		CBAWS	RFT	CSC2	MCI	K-9 BOSS	IBD 2020
Level of Request							
	Unit	0	0	0	-	0	-
	Base Level	-	-	-	-	-	-
	NAF	-	-	-	-	-	-
	MAJCOM	-	-	-	0.8	-	-
	HQ AF	-	-	-	-	-	1
Urgency							
	Routine	0	0	0	-	-	-
	Urgent	-	-	-	0.3	0.3	-
	Priority	-	-	-	-	-	0.7
	Highest Priority	-	-	-	-	-	-
Rapidness to Complete Initiative							
	Very Slow	-	-	-	-	0	-
	Slow	0.1	0.1	0.1	-	-	0.1
	Relatively Quick	-	-	-	0.7	-	-
	Quick	-	-	-	-	-	-
Cost Risk							
	High	-	-	-	-	-	-
	Med	0.7	0.7	0.7	-	0.7	0.7
	Low	-	-	-	1	-	-
Schedule Risk							
	High	-	0	-	-	-	-
	Med	0.3	-	-	-	-	0.3
	Low	-	-	1	1	1	-
Performance Risk							
	High	-	-	-	-	-	-
	Med	0.2	-	0.2	-	0.2	0.2
	Low	-	1	-	1	-	-
Sensibile Initiative							
	Not at All	-	-	-	-	-	-
	Somewhat	-	-	-	-	-	-
	Very	1	1	1	1	1	1
Leverage Technology							
	None	-	-	-	-	-	-
	Some	-	-	-	-	0.6	0.6
	All	1	1	1	1	-	-
Leverage Contracts							
	None	0	-	-	0	-	-
	Some	-	-	0.8	-	0.8	-
	All	-	1	-	-	-	1
Leverage Expertise							
	None	-	-	-	-	-	-
	Some	-	-	-	-	-	-
	All	1	1	1	1	1	1
Leverage POC Venues							
	None	-	-	-	-	-	-
	Some	-	-	-	-	-	-
	All	1	1	1	1	1	1

The alternative scores displayed in Table 60 fall under the *Impact* branch.

Table 60. Alternative Scores from the *Impact* Branch

Measure		Alternative					
		CBAWS	RFT	CSC2	MCI	K-9 BOSS	IBD 2020
Level of Impact							
	Localized	-	-	-	0	-	-
	Global	1	1	1	-	1	1
Time to Field Initiative							
	Long Time	-	-	-	-	-	-
	Intermediate	-	0.4	-	-	-	0.4
	Short Time	1	-	1	1	1	-
Longevity							
	Temporary	0	-	0	0	-	-
	Permanent	-	1	-	-	1	1
# of AF Core Comps Advanced							
	0	-	-	-	-	-	-
	1	-	0.6	-	0.6	0.6	-
	2	0.7	-	0.7	-	-	-
	3	-	-	-	-	-	-
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
	6	-	-	-	-	-	1
Revisions to Organizations							
	Not	0	-	0	0	0	-
	Slightly	-	0.3	-	-	-	-
	Very	-	-	-	-	-	1
Revisions to Doctrine							
	Not	0	0	0	0	0	-
	Slightly	-	-	-	-	-	-
	Very	-	-	-	-	-	1
Revisions to Training							
	Not	-	-	-	0	-	-
	Slightly	0.8	0.8	0.8	-	0.8	-
	Very	-	-	-	-	-	1
Revisions to Requirements							
	Not	-	-	-	0	-	-
	Slightly	0.2	0.2	0.2	-	0.2	-
	Very	-	-	-	-	-	1
Revisions to Acquisitions							
	Not	-	-	-	-	-	-
	Slightly	0.2	0.2	0.2	0.2	0.2	0.2
	Very	-	-	-	-	-	-
Joint Involvement							
	No	-	-	-	0	0	0
	Potentially	-	0.7	0.7	-	-	-
	Yes	1	-	-	-	-	-

Appendix D: Description of the Six Ongoing FPB Initiatives

The following information serves to describe the six ongoing initiatives used in the focus case of this research. They are listed in alphabetical order (Flaherty, 2001).

Chemical/Biological Aerosol Warning System (CBAWS): This initiative seeks to prove the worth of a lightweight, effective chem/bio detection and identification, C2-linked system for "first in" alert and warning capability. This will enhance situational awareness and provide early warning of aerosol chem/bio attacks, with a high level of confidence to improve local collective protection decisions.

Combat Support Command and Control (CSC2): The CSC2 is a computer based situational awareness tool that could link combat support functions to the Survival Recovery Center. It fuses sensor data, intelligence information, and base status information into a common tactical picture.

Integrated Base Defense 2020 (IBD 2020): This initiative…investigate[s] new methods to protecting our bases through the year 2020. This initiative…investigate[s] all aspects to base defense to include the roles of all combat support functionals. The initiative…use[s] system effectiveness assessments to measure the impact of changes in TTPs [(i.e., training, tactics, and procedures)] and technologies.

Military Working Dog Biosearch Feasibility Study (K-9 BOSS): The purpose of the K-9 BOSS initiative is to demonstrate the feasibility of using Military Working Dogs (MWDs) to detect the presence of biological agents that are containerized for transport before their release by terrorists. This capability would augment current explosive and drug detection capabilities.

Missile Field Communication Initiative (MCI): The MCI project is improving missile field communication by providing a vehicle based radio repeater for response forces. This will eliminate communication "dead spots" and improve overall response and safety.

Response Force Tracking Capability (RFT): This initiative seeks to prove the worth of providing response commanders with real-time location of forces. This could help reduce friendly fire incidents, speed response, deconflict airfield operations, and improve training.

Bibliography

AFDC (Air Force Doctrine Center). *Air Force Basic Doctrine, Air Force Doctrine Document 1*. HQ AFDC, Maxwell AFB AL, September 1997.

AIA/PA (Air Intelligence Agency Office of Public Affairs). "Air Intelligence Agency Fact Sheet." http://www.af.mil/news/factsheets/Air_Intelligence_Agency.html. September 2001.

AU (Air University). *Air Force 2025 Executive Summary*. Air University Press, Maxwell AFB AL, August 1996.

Cassady, Allan. Chief, Advanced Concepts, Space Battlelab, Schriever AFB CO. Personal Correspondence. 17 September 2001.

Chambal, Stephen. Class notes, OPER 643, Advanced Decision Analysis. School of Systems and Engineering Management, Air Force Institute of Technology, Wright-Patterson AFB OH, Summer Quarter 2001.

Chief of Staff USAF, "Implementation of AF Force protection Actions." Electronic Message. 150911Z, November 1996.

Clemen, Robert T. *Making Hard Decisions, An Introduction to Decision Analysis* (2nd Edition). Belmont: Wadsworth Publishing, 1996.

Cox, Steven M. *Ranking and Generating Alternatives for the National Air Intelligence Center's (NAIC) Resource Allocation Strategy*. MS thesis, AFIT/GOA/ENS/97M-03. School of Systems and Engineering Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 1997.

Cropsey, Luke C.G. Action Officer, Force Protection Battlelab, Lackland AFB TX. Personal Correspondence. September 2001.

Department of the Air Force. *Air Force Battlelab Policy*. AFPD 10-19. Washington: HQ USAF, 1 October 1997.

Department of the Air Force. *Air Force Battlelab Responsibilities, Processes, and Documentation*. AFI 10-1901. Washington: HQ USAF, 1 October 1997.

Department of the Air Force. *Air Force Vision 2020*. Excerpt from electronic pamphlet. Page 7. http://www.af.mil/vision. October 2001.

Department of Defense. *Universal Joint Task List*. CJCSM 3500.04B. Washington: GPO, 1 October 1999.

Dillard, Tommy. Commander, Force Protection Battlelab, Lackland AFB TX. Personal Interview. 1 November 2001.

Downing, Wayne A. *Force Protection Assessment of USCENTCOM AOR and Khobar Towers, Report of the Downing Assessment Task Force*. Washington: The Pentagon, 30 August 1996.

Dyer, James S. *A Methodology for the Analysis and Selection of Alternatives for the Disposition of Surplus Plutonium*. Amarillo TX: Amarillo National Resource Center for Plutonium, August 1999 (ANRCP-1999-23).

Dyer, James S., Thomas Edmunds, John C. Butler, and Jianmin Jia. "A Multiattribute Utility Analysis of Alternatives for the Disposition of Surplus Weapons-Grade Plutonium," *Operations Research*, 46: 749-760 (November / December 1998).

Flaherty, John A. Vice President, Flaherty Technical Services, Force Protection Battlelab, Lackland AFB TX. Personal Correspondence. November 2001.

Flug, Marshall, Heather L. H. Seitz, and John F. Scott. "Multi Criteria Decision Analysis Applied to Glen Canyon Dam," *Journal of Water Resources Planning and Management*, 126: 270-276 (September / October 2000).

Fogleman, Ronald R. Message to Air University, 23 December 1994.

Howard, Ronald A. "Decision Analysis: Practice and Promise," *Management Science*, 34: 679-695 (June 1988).

Jackson, Jack A., Brian L. Jones, Lee J. Lehmkuhl, Harry W. Conley, and John Andrew. "Air Force 2025 Operational Analysis," *Military Operations Research*, 3: 5-20 (1997)

Katzer, Dee Jay. Graduate Student. "Decision Analysis with Value-Focused Thinking as a Methodology in Structuring the Civil Engineer Operations Flight." Thesis Defense. School of Systems and Engineering Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH. 13 February 2002.

Keeney, Ralph L. *Value Focused Thinking, A Path to Creative Decisionmaking*. Cambridge: Harvard University Press, 1992.

Keeney, Ralph L. Creativity in Decision Making with Value-Focused Thinking," *Sloan Management Review*, 35: 33-41 (Summer 1994).

Kirkwood, Craig W. *Strategic Decision Making, Multiobjective Decision Analysis with Spreadsheets*. Belmont: Wadsworth Publishing Company, 1997.

Oral, Muhittin, Ossama Kettani, and Pascal Lang. "A Methodology for Collective Evaluation and Selection of Industrial R&D Projects," *Management Science*, 37: 871-885 (July 1991).

Parnell, Gregory S.; Harry W. Conley, Jack A. Jackson, Lee J. Lehmkuhl, and John M. Andrew. "Foundations 2025: A Value Model for Evaluating Future Air and Space Forces," *Management Science*, 44: 1336 - 1350 (October 1998).

SAB (United States Air Force Scientific Advisory Board). *Quick Look Report on USAF Battlelabs*. Washington: HQ USAF, August 2000 (SAB-TR-00-04).

Shoviak, Mark J. *Decision Analysis Methodology to Evaluate Integrated Solid Waste Management Alternatives for A Remote Alaskan Air Station*. MS thesis, AFIT/GEE/ENV/01M-20. School of Systems and Engineering Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 2001.

Space Battlelab. "Air Force Space Battlelab Quantitative Value Model." Schriever AFB CO. 10 December 1998.

Space Battlelab, "Space Battlelab Mission Statement." Excerpt from unpublished article. n. pag. http://www.schriever.af.mil/battlelab. September 2001.

UASF Battlelab Wargaming and Experimentation Division. Excerpt from unpublished article. n. pag. http://www.xo.hq.af.mil/afbattlelab. October 2001.

Winthrop, Michael F. *Technology Selection for the Air Force Research Laboratory Air Vehicles Directorate: An Analysis Using Value Focused Thinking*. MS thesis, AFIT/GOR/ENS/99M-18. School of Systems and Engineering Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 1999.

Vita

Captain David M. Jurk graduated from Port Huron High School in 1987. He attended Michigan Technological University in Houghton, Michigan and graduated, Cum Laude in 1992, with a Bachelor of Science in Civil Engineering. He was commissioned through the Air Force Reserve Officer Training Corps at Michigan Tech, Detachment 400, and was recognized as a Distinguished Graduate.

Captain Jurk's first assignment was as a student pilot to Vance AFB, Oklahoma. He moved on to Griffiss AFB, New York where he served as a base level civil engineer from 1994 to 1995. His next assignment was as a student at Explosive Ordnance Disposal (EOD) School, Phase I at Eglin AFB, Florida and Phase II at Indian Head Naval Surface Warfare Center, Maryland. He graduated from EOD school in November of 1995 and was assigned as the support officer, and later the division chief, for the 75th Civil Engineer Group, Explosive Ordnance Disposal Division, Hill AFB, UT. In October of 1997, Captain Jurk became the Civil Engineer and EOD officer on the staff of the Force Protection Battlelab. As an action officer, he affected the successful execution of multiple innovative force protection initiatives. He still performs rolls as a force protection ambassador, serving as a guest lecturer at the Air Force Civil Engineer and Services School. Captain Jurk entered the Engineering and Environmental Management program within the Graduate School of Engineering and Management, Air Force Institute of Technology, Wright-Patterson AFB, OH, in September of 2000. Upon graduation, Captain Jurk will join the 51st Civil Engineer Squadron at Osan Air Base, South Korea.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
26-03-2002	**Master's Thesis**	Aug 2000 – Mar 2002

4. TITLE AND SUBTITLE

DECISION ANALYSIS WITH VALUE FOCUSED THINKING AS A METHODOLOGY TO SELECT FORCE PROTECTION INITIATIVES FOR EVALUATION

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Jurk, David, M., Captain, USAF

5d. PROJECT NUMBER
ENR # 2001-113

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 P Street, Building 640
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GEE/ENV/02M-05

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US AIR FORCE FORCE PROTECTION BATTLELAB (FPB)
Attn: COLONEL TOMMY DILLARD, USAF FPB/CC
1820 ORVILLE WRIGHT PLAZA, STE 3 DSN: 473-0051
LACKLAND AFB TX 78236-5558 e-mail: Tommy.Dillard@lackland.af.mil

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Emphasis on homeland defense is high. Decision makers responsible for enhancing the protection of both military and civilian personnel require additional insight when selecting ideas, concepts, or technologies to pursue with constrained resources. They are faced with multiple criteria and multiple objectives; yet they have no defensible, objective, and repeatable selection process to assist them in making their decisions.

This thesis explores whether the value-focused thinking (VFT) process is appropriate for providing the necessary insight to those decision makers. To prove the VFT process is appropriate and viable; this thesis focuses on constructing a value model, scoring alternatives, and analyzing the results for a focus case -- the Air Force Force Protection Battlelab (FPB). The FPB evaluates the worth of innovative force protection ideas and concepts.

The results from the focus case prove that through the VFT process, decision makers are able to make objective decisions regarding which innovative force protection ideas contribute the most value to their mission. It provides justifiable defense for their decisions and enables future decisions regarding selection of innovative protection technologies with the same objectivity and defensibility.

15. SUBJECT TERMS

Decision Analysis, Multi-Objective Decision Analysis, Decision Theory, Value-Focused Thinking, Multi-Attribute Utility Theory, Value Hierarchy, Operations Research, Force Protection, Force Protection Battlelab, Battlelab, Homeland Defense, Homeland Security, Initiative Selection, Innovative Ideas, Innovation

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Alfred E. Thal, Jr., Lt Col, USAF (ENV)
U	U	U	UU	242.	**19b. TELEPHONE NUMBER** *(Include area code)* (937) 255-3636, ext 4591; e-mail: Alfred.Thal@afit.edu

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