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Physical Fitness and the Expeditionary Air Force

Elizabeth T. Lewis

PHYSICAL FITNESS AND THE EXPEDITIONARY AIR FORCE

THESIS

Elizabeth T. Lewis, First Lieutenant, USAF

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DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

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Elizabeth T. Lewis, BS

First Lieutenant, USAF

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Elizabeth T. Lewis, BS
First Lieutenant, USAF

Approved:

_____	_____
Stephen P. Chambal, Capt, USAF (Co-advisor)	date
_____	_____
Paul W. McAree, Maj, USAF (Co-Advisor)	date

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Elizabeth T. Lewis

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Abstract

The Air Force has been constantly evolving. With the many changes and the Expeditionary Air Force structure put in place, it is more important now than ever that the Air Force has a physical fitness program to keep its members healthy and productive. By doing this, it can ensure that the efforts put forth in completing the Air Force mission are successful while keeping the organization at the highest level of readiness possible.

This thesis looks at what the Air Force values in having a fitness program. These values are taken from documentation that is the backbone of the Air Force mission. Using these values, fitness programs can be evaluated to determine what kind of program would be best for the Air Force by including as many of the valued characteristics as possible. The results of this study show that programs similar to the Army's fitness program would be best and include most of the desired characteristics. This should be an important consideration when determining what type of fitness program the Air Force needs.

PHYSICAL FITNESS AND THE EXPEDITIONARY AIR FORCE

I. Introduction

Overview

"The mission of the U.S. Air Force is to defend the United States and protect its interests through aerospace power" (AF Posture Statement 2002).

Due to evolving and changing threats to the security of the United States, the United States Air Force (USAF) must be, and is, a dynamic organization. In recent years, the USAF has changed from a force of over 600,000 personnel in 1985 prepared to fight a major world war to a force of approximately 350,000 personnel shaped to respond to numerous threats (Air Force Magazine, May 2001). The Gulf War, Bosnia-Herzegovina, and Kosovo are just some examples that highlight the value of aerospace forces for providing strategic power and meeting its mission (AF Posture Statement 2000).

The USAF has maintained an overseas presence and role in this nations security. Since its inception in 1947, the USAF has maintained global reach and its ability to project force regardless of the downsizing and reduction in the number of permanent personnel assigned overseas. The focus of the USAF efforts changed at the end of the Cold War, however, the basic organizational structure remained until 2000. This resulted in tremendous organizational strain with the increase in contingency operations using a smaller force structured to fight a different type of war. This had many impacts on the

Air Force. Remaining fully ready and providing quality of life for their families became a tradeoff for many service members. (Dorn, 1996).

In 1997, Secretary of Defense William J. Perry put forth the following challenges to the military: keep the forces ready, modernize to maintain technological superiority, improve the ability to conduct joint operations, and improve the efficiency and effectiveness of the way the department does business (Pang, 1996).
These challenges coupled with quality of life concerns resulted in the Expeditionary Aerospace Force (EAF) concept (AF Posture Statement 2000).

The EAF is designed to operate with ten Aerospace Expeditionary Force (AEF) teams tailored to deploy and support the Air Force mission. Each AEF consists of aircraft and personnel from active duty Major Commands, Air Force Reserve Command, and the Air National Guard. The AEF is designed to provide the Air Force units, people, and their families deployment stability and predictability (An Introduction to the Expeditionary Aerospace Force, Air Force Link). According to the Chief of Staff of the Air Force, the AEF cycle needs to be the focus of daily operational business. The people in each AEF package are trained together, packed together, administered together, and deploying or waiting to be deployed together. This helps the USAF to maintain readiness with minimum quality of life tradeoffs to its people. For the EAF concept to work, all members must be ready to deploy with their AEF; and being ready to deploy means staying healthy and exercising regularly (Peppe, 2002).

Background

Keeping the troops healthy and "in-shape" has been a concern for the USAF since 1947. When its first physical fitness publication, Air Force Regulation (AFR) 50-5 was

released, this served as the basis for the Air Force physical fitness program until 1959 (Schellhous,1982). AFR 50-5 stated three goals for physical fitness training programs:

1. Develop and maintain a high level of physical fitness in the individual so that he can perform more efficiently his assigned duties.
2. Encourage regular and healthful exercise.
3. Foster an aggressive and cooperative team spirit, increase the confidence of the individual, develop sportsmanship, and increase pride through participation in competitive athletics.

In 1956, Air Force Manual (AFM) 160-26, Physical Conditioning was published for more guidance in establishing fitness programs (Schellhous,1982). AFM 160-26 designates responsibility to commanders in making sure their troops are physically, psychologically, and socially fit for the mission. No standards are set in either AFR 50-5 or AFM 160-26.

A complete program was established with guidelines and standards in 1962 when the Air Force adopted the Royal Canadian Air Force Five Basic Exercise (5BX) Plan (Schellhous,1982). The publications governing this program were Air Force Pamphlet (AFP) 50-5-1 (5BX) for men and 50-5-2, Ten Basic Exercise Plan, (XBX) for women (Schellhous,1982).

In 1969, Air Force Major Kenneth Cooper published a research paper on exercise in the Journal of the American Medical Association, which resulted in the 1-1/2 mile run as the standard test (Gindhart, 1999). In October 1992, the stationary bike test was adopted due to inaccurate measures of fitness and overexertion from the run (Gindhart, 1999). Since 1999, the Air Force fitness program consists of the annual submaximal cycle ergometry test and a body composition evaluation, which is included in a separate weight management program (Gindhart, 1999). In July 2000, the annual cycle test was expanded to include push-ups and crunches for assessment in muscular fitness (Tews,

2002). "Total physical fitness includes cardiovascular capacity, muscular strength and endurance, flexibility and body composition," said former Air Force Chief of Staff Gen. Michael E. Ryan.

Problem Statement

The USAF has evolved in many respects since 1947. The fitness requirements placed upon its members have also evolved. This research/study will document that a formal fitness program is necessary for the USAF in light of its most recent change to an EAF. Since the need for a physical fitness program exists, this study will include documenting the need, identifying the values, and building a hierarchy to give insight to possible programs. Alternative programs will be evaluated according to the values established and recommendations will be provided on which program is best.

Thesis Overview

Chapter two is a literature review documenting the fact that physical fitness is an important aspect of each individual's life and it is an important part of the workplace for many reasons. Chapter two also contains a literature review of what Value-Focused Thinking involves and the steps taken when using this tool. Chapter three contains the methodology used in finding a solution to the problem of this study, including steps 1 through 7 of Value-Focused Thinking. Chapter four contains the analysis of the model in this study. Chapter five contains the conclusions of this study along with some recommendations on future possible studies.

Chapter 2
Literature Review

2.0 Chapter Overview

A review of the benefits of physical fitness and exercise from the perspective of the individual is addressed in Section 2.1. In Section 2.2, the focus is on the role physical fitness programs play in the general workplace. Section 2.3 introduces the concept of Value-Focused Thinking and concludes with a review of the literature on the "Gold-Standard" technique. This technique is applied as the approach to this study.

2.1 Individual Physical Fitness

Physical fitness provides proven benefits for an individual in their daily lives. This section addresses the benefits to the individual from the health and cost perspective. Characteristics of an effective physical fitness program are also cited from the literature.

Fitness is defined by the President's Council on Physical Fitness and Sports as: "The ability to perform daily tasks vigorously and alertly, with energy left over for enjoying leisure-time activities and meeting emergency demands. It is the ability to endure, to bear up, to withstand stress, to carry on in circumstances where an unfit person could not continue, and is a major basis for good health and well-being." (President's Council on Physical Fitness and Sports, 2002). People of all ages can improve their lifestyles with moderate physical activity. Whereas, physical inactivity increases an individual's risk for health problems and disease (Blair et al., 1992). Five chronic diseases (heart disease, cancer, stroke, chronic obstructive pulmonary disease, and diabetes) are connected with obesity and account for over two-thirds of all deaths in the United States (Bush, 2002). In addition, physical activity improves mental health and is important for the health of muscles, bones, and joints (Manley, 1996). In an attempt to

change the behavior of American citizens in improving their health, the Surgeon General's Report was published to summarize existing research on physical fitness. This report shows the benefits of physical activity in preventing disease and to draw conclusions that can be useful to those Americans who wish to improve their well-being (Thomas).

A sedentary lifestyle will cause a person to develop more health problems and spend more health care dollars than a person who is active. Studies by the Department of Health and Human Services reveal that Americans spend about $117 billion per year dealing with obesity and weight-related issues and conclude that each individual will benefit from regular physical activity (U.S. Department of Health and Human Services, 2000). Researchers from the Centers for Disease Control and Prevention (CDC) found that Americans who engaged in regular physical activity had average annual direct medical costs of $1019 as compared to $1349 for inactive citizens (Centers for Disease Control and Prevention, 2002). For the active duty Air Force population, total medical care costs and lost productivity costs attributed to excess body weight in 1997 were $22.8 million (Robbins, 1997). If 10% of Americans started walking, $5.6 billion could be saved from heart disease alone (Bush, 2002). By leading a more active lifestyle, people can become healthier, stronger, and spend less on doctor bills.

In order to get the most effect from physical fitness, the proper program should be enforced. A fitness program needs to be complete and include activities that incorporate all components of physical fitness: cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility (President's Council on Physical Fitness and Sports, 2002). A general plan is used to maintain a person's level of fitness and includes

alternating weight training with cardio workouts (VanPelt, 2002). Including aerobic exercise, muscular strength/endurance conditioning, and flexibility exercise will help in weight management, reducing injuries, and preserving the range of motion in joints (ACE, 2002). Actively engaging in the appropriate program, a person could experience the maximum effectiveness of reaching any goal in making themselves healthier.

Because people are different, fitness programs can be created or chosen accordingly. When considering a program, goals, fitness level, age, health, skills, interest, and convenience are some factors to take into account. A variety of exercises can create a more "playful" atmosphere and be more interesting for an individual (Kennedy, 2001). Emphasizing amount rather than the intensity of physical activity offers more options to incorporate physical activity into daily lives (Manley, 1996). If a fitness program is more synchronized to the needs and interests of an individual, there is a higher probability of getting involved with the program.

2.2 Physical Fitness in the Workplace

Organizations gain many advantages when they include fitness programs for their workers. These advantages include better group cohesion, lower health care costs, less absenteeism, and fewer injuries.

When fitness programs are incorporated into the workplace, there is a strong sense of group cohesion that takes place. Hubbard Milling, a Minnesota company offers it's employees aerobic dance and jazz exercise programs and encourage participation by dividing into four teams that compete against each other. (Allegrante, Gruman, and Sloan, 1987). This helps with group cohesion by allowing the employees to work as a team by setting a single common goal that they want to achieve.

Health care is a challenging topic for all organizations. American companies lose $32 billion and 132 million workdays every year due to early deaths associated with cardio-vascular disease and face increasing health care costs that now exceed $1 trillion (Concannon, 2000). When employees participate in physical activities, they are less likely to get sick, which reduces health care expenditures (Doyle, 2002). This in turn saves the organization money when dealing with their health programs. Baun (1986) showed that employees participating in a Tenneco fitness program had $553 lower health care costs per person compared to non-exercisers. GE Aircraft employees who were members of the fitness center for three years lowered their average annual health care costs from $1044 to $757 per individual (Connors, 1992). A 1993 study from the University of Michigan found that worksite fitness programs saved $513 per person per year including medical claims and loss of productivity (Sattler, 1997). A study to include a corporate fitness center at Progressive Corp. in Cleveland, Ohio showed that medical costs for center participants were lower than non-participants by $400 (Musich, 1999). Physical fitness provides a clear financial impact on the organization.

Workers are less likely to get sick and miss workdays when a fitness program is used. In the Dallas Independent School District, a workplace fitness program averaged 1.25 fewer days of absenteeism (Allegrante, Gruman, and Sloan, 1987). Johnson & Johnson claimed that employees who got involved with an organized exercise program had taken 13% fewer sick days than in the past (Occhipinti, 2002). The fitness program of the Metropolitan Life Insurance Company in Canada reduced absenteeism rates by an average of one day per year (Brennan, 1983). Missing less time at work allows employees to be more productive for the company.

Fitness programs also reduce the risk of injury. Shore et al. (1989) reported that back fitness improved in municipal workers after six months of exercising and that injury-related absences dropped .25 day while non-participant absences increased 3.1 days. Tsai et al. (1988) showed that injury rates and costs associated with injuries decrease as physical activity levels increase. Cady (1985) showed that the fittest employees had only one eighth as many injuries as the least fit employees and that unfit employees incurred twice the amount of injury cost. With fewer injuries, organizations can save money on hospital visits and keep their workers more productive.

Physical activity plays an important role in aging. As people get older, they experience physiological changes, which include a decrease in skeletal strength. Research supports the fact that most of this decline is due to hypokinetic disease in which the process can be slowed by proper physical activity (Miller, 1986). Studies have shown that the more exercise bones get, the stronger they are and the less prone an individual is to injuries as they age (Cooper,1982). Back problems cost American industry an estimated $14 billion per year, and the frequency of musculoskeletal injuries in general is expected to increase as the workforce ages (Keyserling and Chaffin, 1986). With the proper fitness program, organizations can help prevent musculoskeletal injuries among their aging employees.

Another health risk that can be prevented with physical activity is obesity. Obesity increases the risk of back pain, which accounts for 93 million lost workdays per year (Oliver and Kirkpatrick, 1982). It was listed as one of the major coronary risk factors by the American Heart Association and is one of the most important factors in predicting potential coronary problems (Cooper, 1982). For every 5 pounds of extra fatty

tissue, 4 to 5 additional miles of blood vessels and capillaries are needed to supply the tissue with blood, which increases strain on the heart (Miller, 1986). Not only does obesity lead to coronary problems, it is the cause of other diseases such as cancer, stroke, and diabetes, which account for more than two-thirds of all deaths in the United States (Bush, 2002). Obesity can bring about a great decrease in an individual's quality of life due to the many problems that it is associated with.

In order to have a productive work environment, employers should consider what keeps their workers happy and healthy. Diet, exercise, smoking, drinking, and stress management are a few major risk factors that predict life expectancy and productivity, so it benefits the individual and their employer to reduce these risks (Allegrante, Gruman, and Sloan, 1987). It has been shown that fitness is an underlying factor that determines the physiological readiness to perform critical tasks and it is predictive of sick time and job performance (Wood, 2002). The efficiency and life expectancy of an organization and its people will benefit from preventative measures such as fitness programs (Allegrante, Gruman, and Sloan, 1987). By incorporating fitness programs, employers can keep their organizations healthy.

Another benefit of fitness in the workplace is that it helps to boost morale among the workers. The Michaels Group is a firm that builds new housing communities. Their headquarters in Malta was built with an addition of an exercise room, racquetball court, and locker rooms to incorporate physical fitness into the workers' days. By incorporating this program, employee morale is at an all-time high, workers feel less stressed, have more energy, and feel good about themselves and their jobs (Michaels, 2000). There are many corporations overseas that have fitness programs enforced. Dr. Kenneth Cooper

describes his experience with Japanese corporations in his book. The employees participate in "exercise breaks" instead of coffee breaks. A session in the morning and a session in the afternoon help to keep the workers fresh and alert while on the job. Because of this personal attention, Japanese workers have a strong sense of dedication to their companies. Having happier employees helps an organization to be more effective.

Physical fitness is good for many reasons. Some companies go one step further and make it mandatory. This is due to the requirements of the job. For these companies, not only is physical fitness valuable to employee health, but it is also required to fulfill their organizational objectives. These companies must ensure an adequate program. Every program is different and one must be selected that meets their objectives.

One type of organization that requires its members to be physically fit is the United States military. It is a vital part of combat readiness (Strong, 2002). It is stated in Joint Vision 2020 that the primary purpose of the armed forces is to fight and win the Nation's wars. Fred Pang, assistant secretary of defense for Force Management Policy, stated "Maintaining the peace through military training and preparedness -- and fighting a war if necessary -- calls for men and women who are extremely fit." Because of this requirement, it is pertinent that the military services make sure that their members are physically fit. Having physical fitness programs enforced so that all members participate will aid in this goal.

The Air Force conducts an annual assessment on the members to check fitness levels. This puts the responsibility of staying fit on each individual. There is no program that requires all members to participate, however, having one would ensure the fitness of all members. In order to determine what program would most benefit the Air Force, a

decision must be made by considering what the Air Force deems important in the fitness of its members. This is possible by using Value-Focused Thinking.

2.3 Value-Focused Thinking

Everybody makes decisions on a daily basis. Some decisions take more time and thought in finding a solution. Many techniques have been developed in helping with the decision making process. Using a strategic approach includes the following five steps and will ensure that all key aspects of the decision have been considered (Kirkwood, 1997):

1. Specify objectives and scales for measuring achievement with respect to these objectives.
2. Develop alternatives that potentially might achieve the objectives.
3. Determine how well each alternative achieves each objective.
4. Consider tradeoffs among the objectives.
5. Select the alternative that, on balance, best achieves the objectives, taking into account uncertainties.

One particular technique is Value-Focused Thinking (VFT). VFT is an approach taken to make the decision process more objective while employing a structured scheme. It is used to make decisions that are real, important, and complex with no clear "solution" (Keeney, 1992). Instead of looking at alternative choices at the beginning of the decision making process, values, or what a person wants to achieve through the decision (Leon, 1999), are concentrated on to determine what the person feels is important in making the decision. By using values from the beginning, constraint-free thinking will be focused on what is important to the decision maker and will bring about more desirable outcomes (Keeney, 1992). VFT provides the following: alternatives with more innovative characteristics, wider range of alternatives, the future consequences of decisions are taken more into account, alternatives that at first glance would not be considered are integrated,

and more desirable consequences are considered (Leon, 1999). An overview of the benefits of using value-focused thinking is seen in figure 1 (Keeney, 1992).

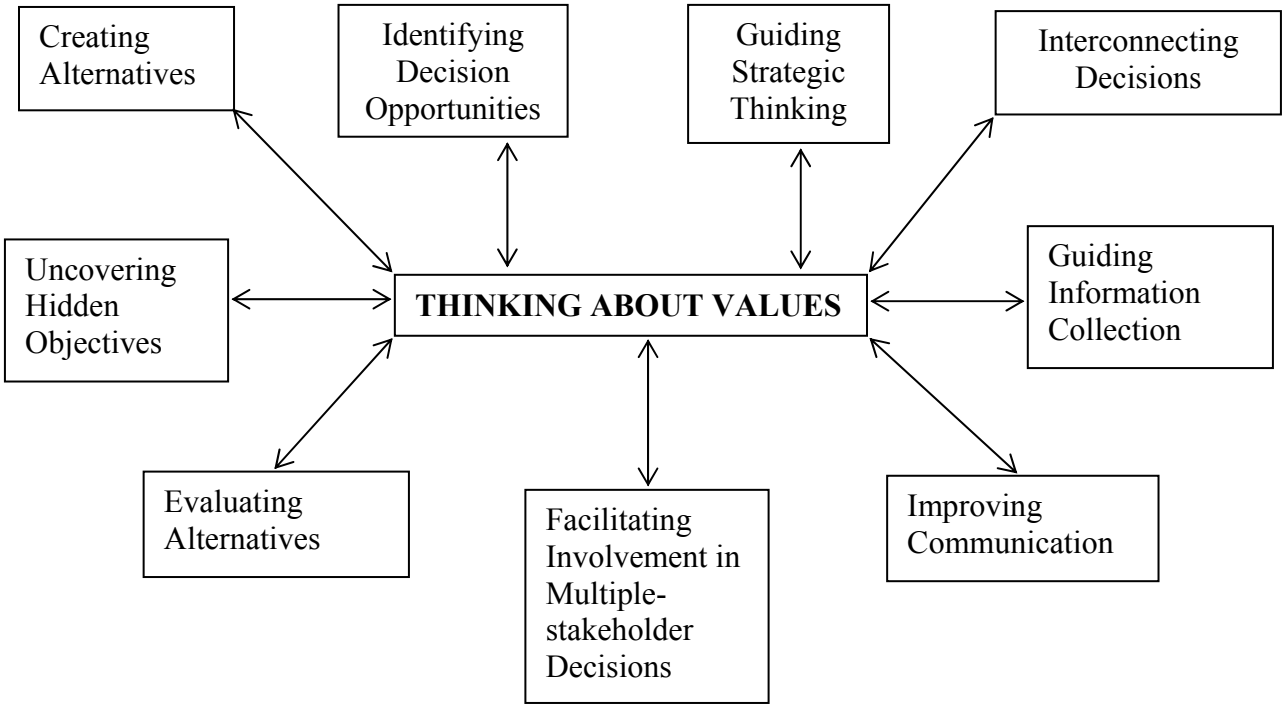


Figure 1. Benefits of Value-Focused Thinking

VFT is used in this study to identify the characteristics of a physical fitness program that would add the most benefit to the Air Force according to the values that are established in Air Force documents, publications, and statements made from commanders. Using these existing sources is called the "Gold Standard" in VFT and enables the building of a value hierarchy by determining the values from these sources. Two other standards can be used in categorizing the method to gather information in determining the values. These standards are "Silver" and "Platinum". The following chart shows the three standards and their characteristics (Parnell):

Gold Standard

- Use strategic objectives, vision, or plan
- Validity to senior leadership

Silver Standard

- Group sessions – large number of participants
- Simpler, more logical structure

Platinum Standard

- Interview senior leaders and key technical personnel

Figure 2. Standards of Value-Focused Thinking

Decision analysis using VFT can be accomplished in ten steps that were compiled by Shoviak (2001) and derived in part from the writings of Keeney (1992) and Kirkwood (1997). These steps do not necessarily follow an order, but are iterative. Each step will be briefly explained.

Step one is identifying the problem. This step is a very important part of this decision making process. If the problem has not been identified correctly, the final outcome could represent an incorrect solution. Keeney refers to this as identifying a decision "opportunity" since the idea is to improve upon the current situation.

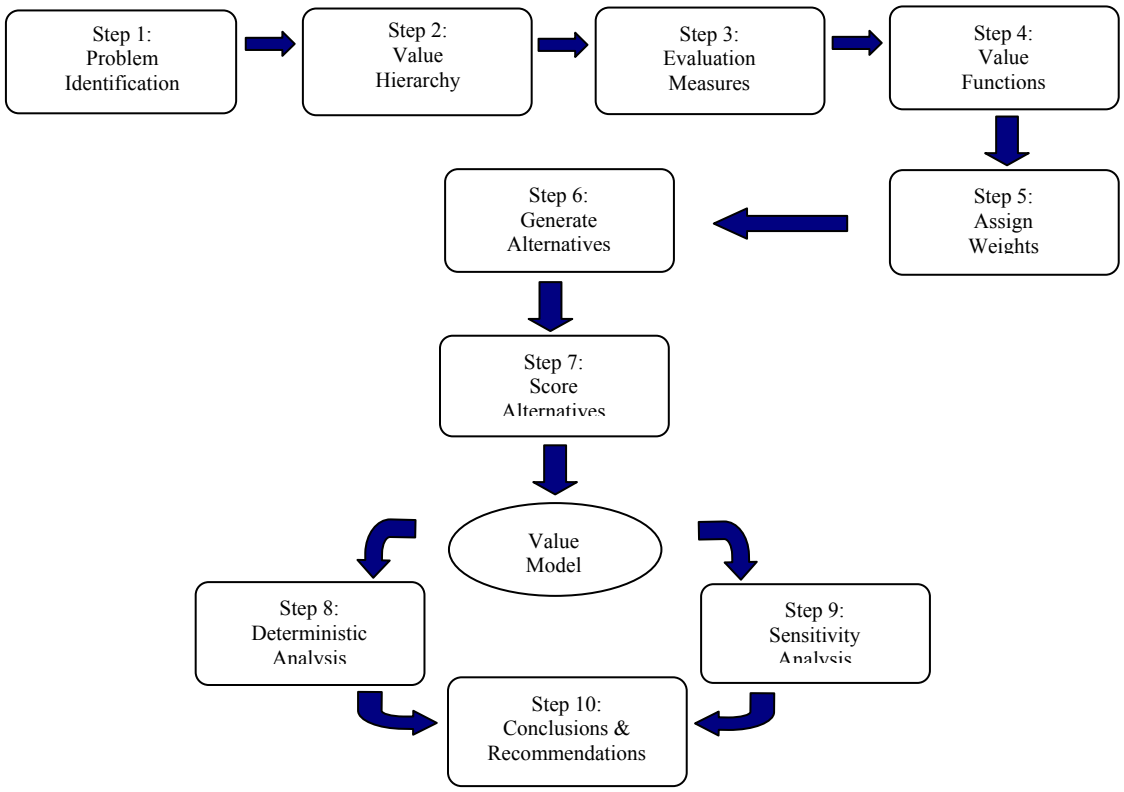


Figure 3. 10 Step Process

Step two is developing the value hierarchy. The identified problem is the first block in this hierarchy and is the fundamental objective of the problem. The value hierarchy then breaks down into branches that include horizontal tiers. Properties that should be included in building a value hierarchy are completeness, non-redundancy, decomposability, operability, and small size (Kirkwood, 1997). Completeness and non-redundancy are also referred to by Kirkwood (1997) as "collectively exhaustive and mutually exclusive", respectively, meaning all aspects concerning the fundamental objective should be included in the hierarchy and no values included in the hierarchy should overlap. Decomposability refers to the possibility of breaking down the hierarchy into smaller pieces. Operability describes the ability of the decision maker to use the

hierarchy in making a decision. Small size is important in keeping the hierarchy from becoming too complex for the user.

Step three is developing the measures for each of the values in the lowest tier. The ranges of these measures aid in the decision process by providing a rating of how well each alternative scores with respect to the objectives (Kirkwood, 1997). These measures need to consist of data that can be collected.

Step four is creating the single dimension value functions. The purpose for this step is to give the measures a common scale in which to score alternatives according to the objectives included in the hierarchy. Each measure developed is given a 0 to 1 scale on the y-axis with the x-axis consisting of scales that are natural or constructed and direct or proxy (Kirkwood, 1997). Natural and direct deal with the obvious while constructed and proxy deal with creatively constructing measures to represent quantitative insight. Each function must be created to be monotonically increasing. The function can be adjusted by the decision-maker according to their judgments.

Step five is weighting the value hierarchy. Weighting can be done globally or locally depending upon which approach is taken in building the hierarchy. Global weighting is used with the bottom-up approach and overall value calculations. Each entire tier sums to 1. Local weighting is used with the top-down approach and each tier within a branch sums to 1. The decision-maker assigns weights to each of the values depending on how important each of these values rank with respect to each other. A popular method in assigning these weights is thinking about a collection of 100 marbles. The marbles would be divided among the values by the highest number going to the most

important value. This process is called direct weighting. Weighting could also be completed by swing weighting which includes the following steps (Kirkwood, 1997):

1. Consider the increments in value that would occur by increasing each of the evaluation measures from the least preferred end of its range to the most preferred end, and place these increments in order of successively increasing value increments.
2. Quantitatively scale each of these value increments as a multiple of the smallest value increment.
3. Set the smallest value increment so that the total of all the increments is one.
4. Use the results of step 3 to determine the weights for all the evaluation measures.

Step six is generating alternatives. Looking at the value hierarchy can help with thinking about different alternatives. Another tool in creating alternatives is the use of a strategy generation table (Kirkwood, 1997). This table is a listing of all outcomes that the decision maker could choose. These possibilities are then used as alternatives to score.

Step seven is scoring these alternatives according to the measures that were developed. Each alternative is scored on each measure according to the x-axis of the single dimension value functions created. The alternative is assigned a position on the x-axis and the value of that measure for that alternative lies on the function above the assigned position. The scales of the measures should pass the "clairvoyance test" in order to score each alternative. This means that the scales should not be ambiguous and a clairvoyant should be able to assign a score to each alternative without confusion (Kirkwood, 1997).

Step eight is performing deterministic analysis by generating an overall value function using a weighted average of all value functions. The following summation is used: $\sum w_i \times v_i (x_i)$

W_i represents the global weight given on a particular measure i. V_i represents the value of the single dimension value function on alternative i determined from the score given on measure i, X_i.

Step nine is performing sensitivity analysis and observing the changes in the ranking of the alternatives by adjusting the weights. Each weight can be adjusted and the outcome can be evaluated according to which objectives contribute the most to altering the final decision.

Step ten is presenting conclusions and offering recommendations to the decision-maker. This should be accomplished by presenting the information in a way that the decision maker will be able to understand. The analyst does not provide the final decision because the purpose of using VFT is to give insight to the decision maker for him or her to make a better and informed decision.

VFT has been shown to be successful in many studies. A few examples are discussed in this research. VFT was used to evaluate future technologies in "An Operational Analysis for *Air Force 2025:* An Application of Value-Focused Thinking to Future Air and Space Capabilities" written by LtCol Jack A. Jackson, Jr., LtCol Brian L. Jones, and Maj Lee J. Lehmkuhl. This study was set forth by the chief of staff of the Air Force, Gen Ronald R. Fogleman, to investigate concepts, capabilities, and technologies that are required to keep the United States as the dominant air and space force. The value model used for this paper was entitled ***Foundations 2025*** and it offers a framework for air and space doctrine. This study included the "Silver Standard" since over 200 military experts participated for over a year. "Gold Standard" documents were also used to help identify objectives. Since this study was a combination of gold and silver, we can

categorize it as the “Platinum Standard”. An affinity diagram was used to find and position 134 attributes into a value hierarchy using a bottom-up approach. 43 futuristic system concepts were scored according to this hierarchy in order to provide insights about the best concepts. The results were used successfully (Foundations 2025, 1997).

Research was carried out by the Jet Propulsion Laboratory, California Institute of Technology in simulation modeling for space mission design using Value-Focused Thinking and Probabilistic Risk Assessment. Modeling multiattribute decision criteria with risk aversion was integrated with performance and resource parameters for the systems (spacecraft, etc.) and environmental (surface of planets, etc.) models. The information derived from this study was used to identify optimal systems for the future Mars Exploration Program (Miles, 2000).

Value-Focused Thinking has been used to plan tourism. In an article by T. McDaniels and W. Trousdale, tourism was planned for Guimaras, Philippines. During a multi-stakeholder workshop, objectives were ranked and weighted and new alternatives were developed. Since there were stakeholders involved in the decision making process, this example is not considered “Gold Standard”. With this method to decision making, tourism planning was substantially changed with two new approaches (McDaniels, 1999).

Value-Focused Thinking was also used to gain insight into people’s values regarding climate change policies. The focus was climate change policy choices facing governments in North America over the next 20 years (McDaniels et al., 1999). A hierarchy was constructed to determine what people care about and what the value tradeoffs were from the experts. At the time of the collaboration, it was predicted that the results would be used for defining information requirements for evaluation of policy

alternatives, providing a basis for creating more attractive alternatives, providing a basis for quantitative evaluation of alternatives, and providing a basis for future dialogue and refinement of values.

Chapter 3
Methodology

3.0 Chapter Overview

The first seven steps in the ten step process of Value-Focused Thinking are applied to the problem in this study. Section 3.1 defines the problem so that there is a foundation to build the hierarchy. Section 3.2 explains how the hierarchy was built and what values were determined to be included. Section 3.3 describes the measures that are included in the model. Single dimension value functions are composed in section 3.4. Weighting the hierarchy is completed in section 3.5. Section 3.6 gives descriptions of the alternatives chosen for this study. The scoring of these alternatives takes place in section 3.7.

3.1 Step 1: Define the Problem

For step 1, the problem is defined by looking at the current physical fitness activities of the Air Force. The Air Force does not have an actual program that all members participate in, but it has an annual test that members take. The evaluation includes a bike test, push ups, and sit ups. Since the Air Force is a military service and the military's primary job is to protect the interests of the United States, it is questionable whether fitness testing is enough to keep the Air Force as an effective organization. The literature shows that physical fitness helps individuals and groups in multiple ways. Therefore, the problem defined for this study is to determine what the Air Force values in having a physical fitness program.

3.2 Step 2: Build the Hierarchy

Step 2 is creating the hierarchy. Now that the problem has been defined, Air Force values are identified and put into a hierarchy structure. To determine what the Air

Force values, organizational documents such as the Air Force Doctrine, Air Force Regulations, Air Force Instructions, etc. are analyzed according to the physical fitness of the members.

An affinity diagram is used in order to find the important objectives that are included in the hierarchy. Affinity diagrams are the organized output from a brainstorming session (School Improvement by Design, 2002). It is used when there are many complex issues and it is unclear on how to deal with the problem (University of Massachusetts, 2002). Affinity diagrams help to encourage creativity, break down communication barriers, uncover problems, and increase overall understanding (Texas Tech University, 2002). To construct an affinity diagram, a brainstorming session is conducted to generate ideas. Once these cards are completed, they are arranged into their natural groupings (Jackson, 1996). These groupings become the values that are used in building the hierarchy.

With the Air Force fitness program problem, ideas were taken from the official documents and put on index cards. Once the documents were reviewed, there were a total number of 180 cards. These cards were divided into 24 groups and fell into three major areas. These three general areas are used as the values in the top tier of the hierarchy. The top tier of the hierarchy is seen in figure 4.

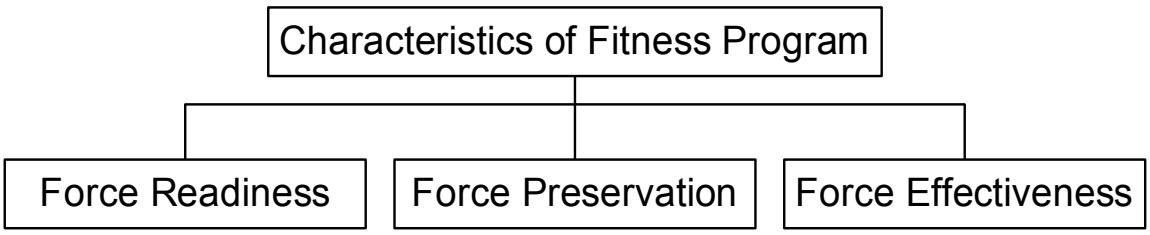


Figure 4. Top Tier

Force Readiness is the first branch of the hierarchy and describes the ability of the Air Force to deploy rapidly in order to accomplish any mission that it is tasked with. Maintaining a fit and healthy lifestyle will ensure that airmen are battle ready (Air Force Doctrine Document 2-4, 1999). General "Hap" Arnold stated "No man expects to live forever. But the man in perfect physical condition will live longer, especially in combat" (Army Air Force Manual 50-35-1, 1945). Airmen must be ready and able to defend themselves and their units at all times due to the possibility of violence in any operation (Air Force Basic Doctrine, 1997).

Force Preservation describes the importance of keeping the Air Force at a strong enough force to accomplish the mission. To sustain the force is to maintain combat support to all users throughout the theater for the duration of the operation and requires care of the people in order to be successful (Air Force Doctrine Document 2-4, 1999). Care of the people would include their quality of life while serving in the Air Force.

Force Effectiveness describes the performance of the Air Force in accomplishing the mission. Physical fitness is paramount to mission accomplishment (Air Force Doctrine Document 2-4, 1999). Air Force Chief of Staff Gen. Michael E. Ryan stated "Physical fitness remains an essential component of combat readiness and expeditionary competence. We will continue to research methods to improve the health and performance of the Force." The physically demanding environment of military operations requires fit personnel in order to complete mission tasks more efficiently and effectively (Air Force Doctrine Document 2-4, 1999).

Under Force Readiness, the Air Force values Physical Readiness and Mental Readiness as seen in figure 5.

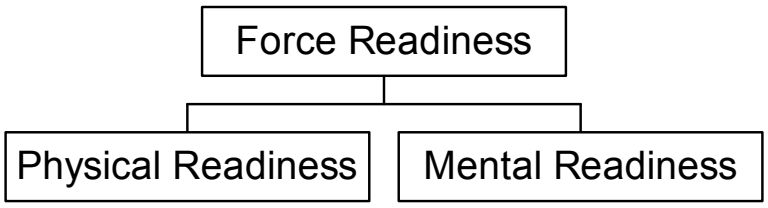


Figure 5. Breakdown of Force Readiness

Physical Readiness describes the increasing physical capability of each individual in the Air Force to work as part of the force in accomplishing the mission. Physical factors are crucial in war (Air Force Basic Doctrine, 1997). Secretary of the Air Force, F. Whitten Peters stated in the AF Posture Statement 2000, "Personal fitness contributes to Air Force readiness by increasing productivity, providing preventive health benefits, and long-term medical cost savings." Physical stress outlives any technological progress when war is concerned (Air Force Basic Doctrine, 1997).

Mental Readiness describes the increasing mental capability of the individuals in the Air Force to work as a part of the force in accomplishing the mission. President John F. Kennedy stated "Physical fitness is not only one of the most important keys to a healthy body, it is the basis of dynamic and creative intellectual activity." Air Force Fitness Centers exist because they directly contribute to readiness by enhancing the physical and mental fitness of military personnel (AFMAN34-137, 1995).

Physical Readiness is broken down into Preventative Physical Health and Improved Physical Ability as seen in figure 6.

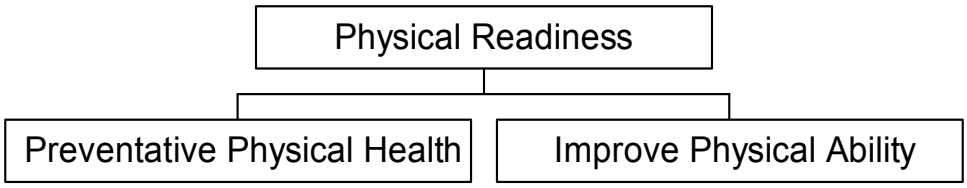


Figure 6. Breakdown of Physical Readiness

Preventative Physical Health describes the importance of preventing any future injuries that could cause an individual to be unable to perform in accomplishing the force's mission. Exercise aids in decreasing fatigue and promotes strong and healthy bones, which will help to prevent injuries (Cooper, 1982). Historically, disease and non-battle related injuries caused the greatest force eradication during both peace and war (Air Force Doctrine Document 2-4, 1999). Having an active lifestyle maintains a higher level of readiness and decreases "health-related expenditures" (AFI40-501, 2002).

Improved Physical Ability describes the importance of improving physical abilities such as strength, endurance, and flexibility in order to accomplish the force's mission. Fitness and sports programs contribute to cardiovascular fitness, strength conditioning, and flexibility, i.e., total fitness (AFMAN34-137, 1995).

Mental Readiness is also broken down into Preventative Mental Health and Improved Mental Ability shown in figure 7.

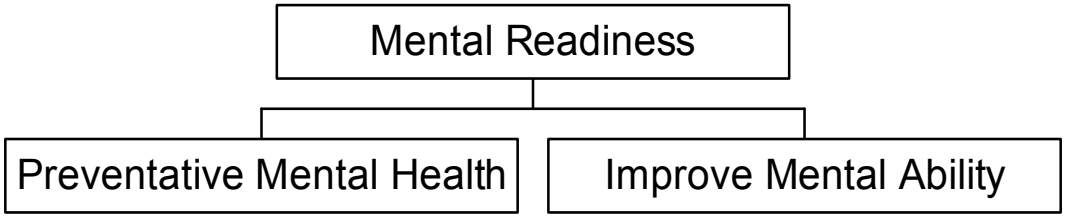


Figure 7. Breakdown of Mental Readiness

Preventative Mental Health describes the importance of maintaining mental balance so that each individual can participate in accomplishing the Air Force mission. A person

who is physically fit is more prepared to cope with mental stress and has a less chance of developing depression (Miller, 1986). Dr. Cooper states that one of the benefits of exercise is that it acts as an "antidote" for emotional disturbances. Physical activity helps to relieve anxiety and improve mood (Manley, 1996). Mental health can be kept at a good state by having an active lifestyle.

Physical activity can help to improve mental ability. This describes the mental awareness and capacity that a person would have while taking part in an exercise program in order to accomplish the Air Force mission. Dr. Cooper lists one benefit of exercise as the improvement of intellectual capacity and increase of productivity. He describes a report by a Florida psychiatrist Dr. Ray Killinger that showed greater originality, concentration increase, and faster mental response time are results of exercise.

The second branch of the hierarchy consists of Force Preservation. This describes the ability of the Air Force to keep the organization at a strong enough level to accomplish its mission. Force Preservation is broken down into Retention and Quality of Life as seen in figure 8. Quality of Life is essential for voluntary continuation of an individual's career in the military (AF Posture Statement, 2000).

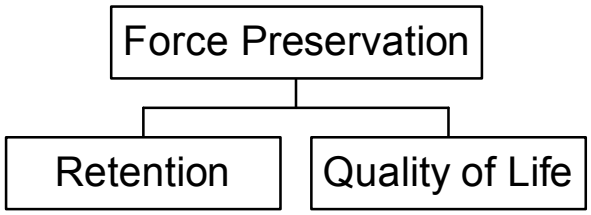


Figure 8. Breakdown of Force Preservation

Retention describes the Air Force's ability to keep members in the organization without a forced ejection due to the inability to follow rules. Because retention is important to the military, there are programs such as the morale, welfare, and recreation (MWR) program

that commanders view as a vital tool for keeping troops (Becraft, 1998). Retention is broken down into Meeting Standards and Long Term Health shown in figure 9.

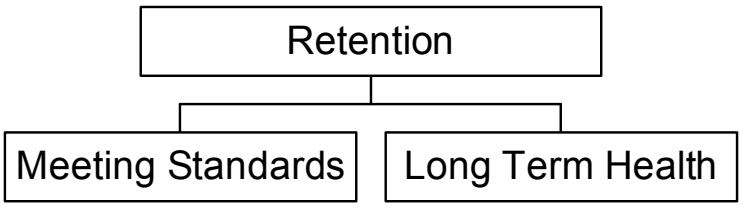


Figure 9. Breakdown of Retention

Meeting Standards is an important factor in the military. In order to keep people in the Air Force, the members must meet standards that are set. The United States military has had body composition standards since World War II in order to ensure proper military bearing and appearance (Robbins et al., 1997). Retired Master Sgt. Bruce Brady stated that the Air Force loses more than 450 troops per year due to weight standards (Phillips, 2002). According to a presentation made by Maj Lisa Schmidt of Health Promotion Operations, 12% of Air Force members fail the current ergometry test and 21% fail to take it. The Air Force fitness standards represent the minimum accepted levels and members are encouraged to exceed the standard. A fitness program would help to keep members within the given standards.

Long Term Health is another important factor in retention of troops. If members have an active and healthy lifestyle, there is less chance for illness and a greater chance for a longer life, which means longer retention. Military service's fitness programs are to be used as general health and lifestyle enhancement programs according to DoD Directive 1308.1. Air Force Policy Directive 40-1 states that the key to carrying out the Air Force mission is long term health and fitness.

Quality of Life refers to making lifestyle changes for each member in order to improve their overall well-being, which will affect their performance in mission accomplishment. This objective is broken down into Better Lifestyle and Sense of Community as seen in figure 10.

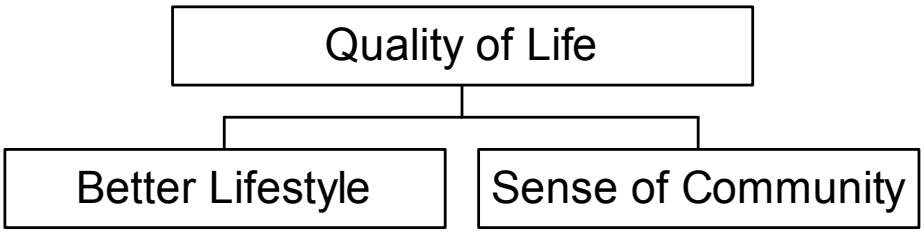


Figure 10. Breakdown of Quality of Life

Better Lifestyle describes the importance of a more active lifestyle to keep each individual of the force energetic so that they can be more productive in accomplishing the force's mission. Mission accomplishment is achieved by balanced lifestyles, including physical conditioning, of the members (Cook, 2002). Activity is something that bodies and minds need in order to function properly (Cooper, 1982). A more active lifestyle will help a person to be more effective in the workplace.

Sense of Community is the importance of the relationships that each member of the Air Force has with the communities in which they live and work. Fostering strong community ties is a desired trait for military members (AFDD 2-4, 1999). A high quality of life helps in building those ties.

Force Effectiveness is the third value on the top tier. This objective describes the performance of the Air Force in accomplishing the mission. Tasks are completed more efficiently and effectively by physically fit personnel (AFDD 2-4, 1999). Force Effectiveness is broken down into Esprit de Corps, Leadership Characteristics, and Unit Performance. This is seen in figure 11.

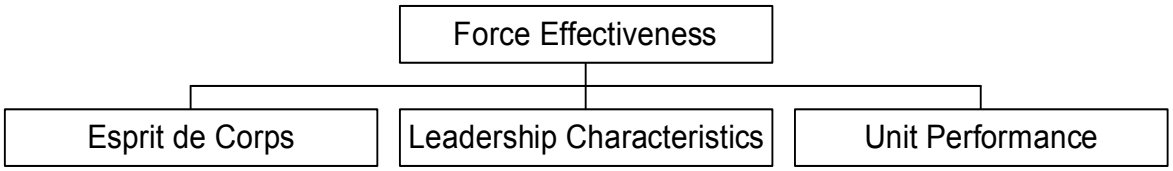


Figure 11. Breakdown of Force Effectiveness

Esprit de Corps is what the individuals in the Air Force need to work together towards a common goal, the mission. It consists of the morale and spiritual aspects of working together as a group. AFI34-266 states that Air Force fitness and sports improves productivity by promoting esprit de corps. Leadership Characteristics are the characteristics that the Air Force values in each member in order to accomplish the mission. These characteristics are built during initial training into the service (Air Force Academy Web Site). Unit Performance tells how physical fitness increases the Air Force's performance overall in accomplishing the mission. Fred Pang, assistant secretary of defense for Force Management Policy, praised an initiative for improving fitness programs by stating that a benefit is "having a total workforce that does the job better than ever before."

The breakdown of Esprit de Corps is seen in figure 12.

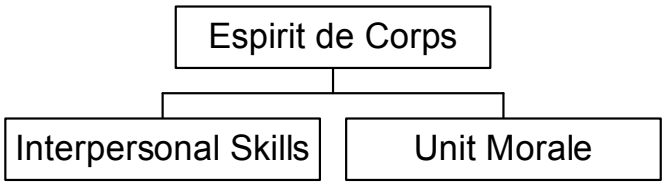


Figure 12. Breakdown of Esprit de Corps

Interpersonal Skills refers to the importance of communication and relationships among the individuals in the Air Force and the positive aspects of them in order to accomplish the mission. These relationships are built when members work as a team (Air Force Academy Web Site). Unit Morale describes the desired feeling for success towards the

Air Force as a whole in order to accomplish the mission. Unit Morale is an important issue in maintaining the security of the nation (Becraft, 1998).

Leadership Characteristics are divided into Drive Towards Success and Individual Traits Desired for Success shown in figure 13.

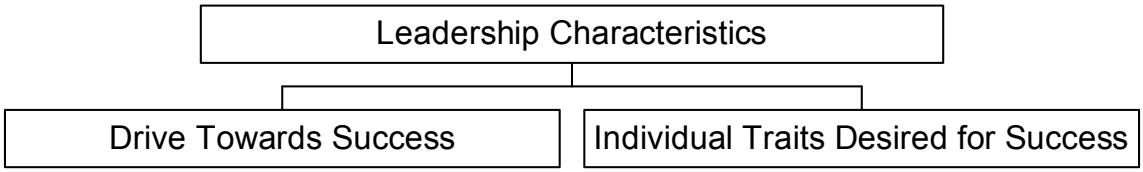


Figure 13. Breakdown of Leadership Characteristics

Drive Towards Success explains the characteristics that the group should have that will keep them driven to complete the mission and succeed. Individual Traits Desired for Success are the characteristics that the Air Force wants each individual to have in order to work together as a group to excel and successfully complete the mission.

Unit Performance is broken down into Productivity and Unit Cohesion seen in figure 14.

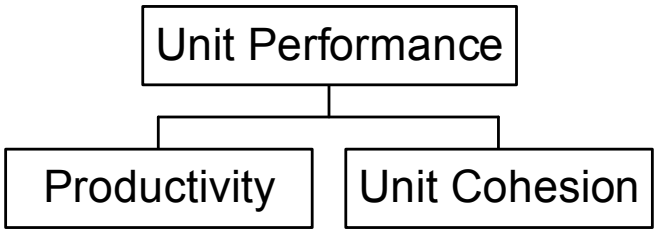


Figure 14. Breakdown of Unit Performance

Productivity describes how physical fitness can increase productivity of the Air Force in accomplishing the mission. AFI40-501 states that an active lifestyle will increase productivity of an Air Force member. Unit Cohesion refers to how a group works together while accomplishing the mission. It describes the closeness of the group and how well members work as a group. Air Force Basic Doctrine states that the essence of

successful operations is cooperative effort towards a common goal. DODI 1308.3 mandates that the military services will maintain a level of fitness that enhances cohesion in units.

With all values defined, the hierarchy consists of three branches with a total of 24 values. The total hierarchy is seen in figure 15.

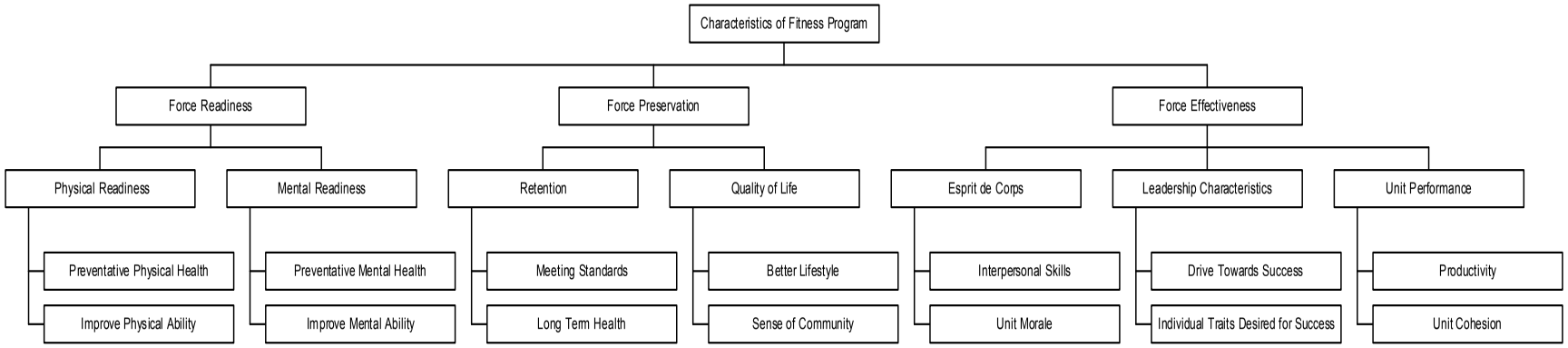


Figure 15. Complete Hierarchy

3.3 Step 3: Develop the Measures

Having the hierarchy built, measures are developed for the objectives on the bottom tier. For Force Readiness, the bottom values include Preventative Physical Health, Improve Physical Ability, Preventative Mental Health, and Improve Mental Ability. From the Preventative Physical Health value, one measure was constructed, Injury Prevention. Its lower bound is "does not prevent injuries" which is assigned a score of zero while its upper bound is "prevents injuries" and is assigned a score of one. This process is repeated for all bottom values of the hierarchy and is seen in Table 1.

Table 1. Measures and Bounds

Top Tier Branch	Bottom Value	Measure	Lower Bound	Upper Bound
Force Readiness	Preventative Physical Health	Injury Prevention	does not prevent injuries	prevents injuries
	Improve Physical Ability	Aerobic Endurance	does not increase	increases
		Body Fat	does not decrease	decreases
		Flexibility	does not increase	increases
		Strength	does not increase	increases
	Preventative Mental Health	Depression	does not prevent and reduce	prevents and reduces
		Stress	does not prevent and reduce	prevents and reduces
	Improve Mental Ability	Capacity	does not increase	increases
Force Preservation	Meeting Standards	Physical Fitness	does not keep physically fit	keeps physically fit
		Weight Control/Body Fat	does not help control weight	helps control weight
	Long Term Health	Illness	does not prevent illness	prevents illness
	Better Lifestyle	Well-Being	does not build active lifestyle	builds active lifestyle
	Sense of Community	Relationships	does not build	builds
Force Effectiveness	Interpersonal Skills	Communication	does not increase	increases
		Respect	does not increase	increases
		Trust	does not increase	increases
	Unit Morale	Pride	does not increase	increases
		Spirit	does not increase	increases
	Drive Towards Success	Dedication	does not foster	fosters
		Enthusiasm	does not foster	fosters
		Motivation	does not foster	fosters
		Optimism	does not foster	fosters
		Perseverance	does not foster	fosters
	Individual Traits Desired for Success	Courage	does not build	builds
		High Standards	does not build	builds
		Integrity	does not build	builds
		Self Confidence	does not build	builds
		Self Control	does not build	builds
		Self Discipline	does not build	builds
		Selflessness	does not build	builds
	Productivity	Effort	low level of effort	high level of effort
	Unit Cohesion	Effectiveness	does not increase	increases
		Team Outcome	requires no effort of team	requires full effort of team

3.4 Step 4: Create Single Dimension Value Functions

Single Dimension Value Functions are created for all measures so that they are evaluated on the same scale. In this study, all measures are discrete and values on the x-axes have been categorized into bins. Only the measures that deviate from the 0/1 or yes/no scores are shown. This includes 13 out of 33 total measures constructed. All measures are set up in the same manner where zero is the least desired and one is the most desired. Figures 16 through 28 show the values of each bin for the different measures:

Figure 16. Histogram for Capacity

Figure 17. Histogram for Communication

Figure 18. Histogram for Respect

Figure 19. Histogram for Trust

Figure 20. Histogram for Motivation

Figure 21. Histogram for Courage

Figure 22. Histogram for High Standards

Figure 23. Histogram for Self Confidence

Figure 24. Histogram for Self Control

Figure 25. Histogram for Self Discipline

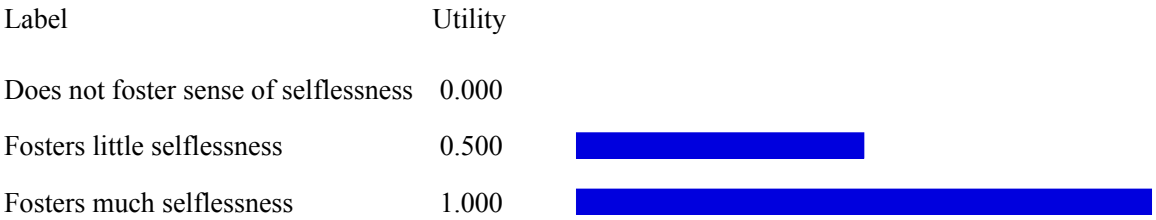


Figure 26. Histogram for Selflessness

Figure 27. Histogram for Effort

Figure 28. Histogram for Team Outcome

3.5 Step 5: Weighting the Value Hierarchy

Since the "bottom-up" approach was taken to build this hierarchy, global weighting is used. With the lack of subject matter experts to determine which values should carry more weight and since the values were established directly from official documentation, the measures were assumed to be equally important and each was assigned a global weight of .03. This number was calculated with 33 measures of which the sum of all weights is one. So, for each measure, $1 / 33 \approx .03$. To get better analysis, subject matter experts should be involved with determining the weights. For this study, sensitivity analysis will be done to see how sensitive the alternatives are to the measures.

Using global weights requires that each tier sum to one. All weights of the measures add to one. Measures that are linked to one value are added together to be the global weight of that value. This is repeated up the hierarchy until all values are included.

The following table shows the weights of all values in the hierarchy:

Table 2. Global Weights

Value	Global Weight
Fitness Program for AF	1
Force Readiness	0.242
Mental Readiness	0.091
Preventative Mental Health	0.061
Improve Mental Ability	0.03
Physical Readiness	0.152
Preventative Physical Health	0.03
Improve Physical Ability	0.121
Force Preservation	0.152
Retention	0.091
Meeting Standards	0.061
Long Term Health	0.03
Quality of Life	0.061
Better Lifestyle	0.03
Sense of Community	0.03
Force Effectiveness	0.606
Esprit de Corps	0.152
Interpersonal Skills	0.091
Unit Morale	0.061
Leadership Characteristics	0.364
Drive Towards Success	0.152
Individual Traits Desired for Success	0.212
Unit Performance	0.091
Productivity	0.03
Unit Cohesion	0.061

Values are indented according to the level tiers they are on. The sum of the weights within each tier is one.

3.6 Step 6: Generate Alternatives

Six alternatives evaluated in this study are the current fitness program for the Air Force, the Army's fitness program, the National Air Intelligence Center's fitness

program, WarFit's basic guidelines, 90th Medical Support Squadron's WarFit program, and the fire department's fitness program.

The United States Air Force believes that all members must be physically fit to support the constant changing in the requirements of the Air Force mission. It is the responsibility of each member to keep physically fit in order to face the day to day demands. In measuring the aerobic fitness of each member, the Air Force has an annual cycle ergometer test (a modified Astrand-Rhyming test) that requires full participation. It uses heart rate monitors, receivers, and software to record the performance during the test. The work rates are adjusted at specific times and a VO_2max score is estimated. This score is an indication of a member's fitness level because it shows the body's ability to deliver the maximum amount of oxygen to the working muscles. Muscular fitness testing has been initiated and includes push-ups and sit-ups, however, these scores are not yet official.

Physical training in the Army is used to enhance soldiers' abilities to meet the demands of war. Survival on the battlefield depends on their level of "motor" fitness which includes speed, agility, muscle power, eye-hand coordination, and eye-foot coordination. The Army's fitness program is set up to improve or maintain cardio-respiratory endurance, muscular strength, muscular endurance, and flexibility along with each soldier's "motor" fitness level and is used for all branches of the Army including the USAR and ARNG.

Commanders are responsible for the physical fitness of their units and are required to provide facilities and funds for programs that help to improve each soldier's level of fitness. They designate qualified leaders to supervise and conduct the training and use

Master Fitness Trainers (MFTs) to help build a program that will achieve the fitness goals of the unit. MFTs are graduates of a special course taught by the U.S. Army Physical Fitness School and have the technical expertise on all elements of fitness. The programs are planned according to each unit's mission. Commanders are responsible for making sure the objectives that they establish from their assessment of the unit's mission-essential task list (METL) are met.

The Army uses FITT (frequency, intensity, time, type) factors when planning the fitness programs. Figure 29 gives a description of how the FITT factor works and what is considered (FM 21-20, 1992).

FITT Factors Applied to Physical Conditioning Program

	Cardiorespiratory Endurance	Muscular Strength	Muscular Endurance	Muscular Strength and Muscular Endurance	Flexibility
F	Frequency 3-5 times/week	3 times/week	3-5 times/week	3 times/week	Warm-up and Cool-down: Stretch before and after each exercise session Developmental Stretching: To improve flexibility, stretch 2-3 times/week
I	Intensity 60-90% HRR*	3-7 RM*	12+ RM	8-12 RM	Tension and slight discomfort, NOT PAIN
T	Time 20 minutes or more	The time required to do 3-7 repetitions of each exercise	The time required to do 12+ repetitions of each exercise	The time required to do 8-12 repetitions of each exercise	Warm-up and Cool-down Stretches: 10-15 seconds/stretch Developmental Stretches: 30-60 seconds/stretch
T	Type Running Swimming Cross-Country Skiing Rowing Bicycling Jumping Rope Walking/Hiking Stair Climbing	Free Weights Resistance Machines Partner-Resisted Exercises Body-Weight Exercises (Pushups/Situps/Pullups/Dips, etc.)			Stretching: Static Passive P.N.F.

* HRR = Heart Rate Reserve * RM = Repetition Maximum

Figure 29. FITT Factors

The frequency of exercise is specified in Army Regulation 350-15 which states that "vigorous physical fitness training will be conducted 3 to 5 times per week". Intensity is

varied according to what exercise is being done. With cardio-respiratory workouts, the activity must be energetic enough to raise the heart rate to between 60 and 90 percent of the heart rate reserve (HRR). For muscular strength and endurance, 8-12 repetitions of lifting the maximal weight correctly are used for improvement. For time, 20-30 continuous minutes of intense exercise is required for cardio-respiratory improvement, 10 to 15 seconds per stretch for warm-ups, and 30 to 60 seconds per stretch for cool-downs. Type is the fourth FITT factor on the chart and refers to the kind of exercises that a commander feels necessary for his troops.

The Army also has the fitness program broken down into phases depending on ages, fitness levels, and past physical activities. The first phase is the preparatory phase and consists of moderate work loads with a steady increase to build up to the standards. The second phase is the conditioning phase when the intensity begins to increase. The third phase is the maintenance phase when progression stops and includes a 45 to 60 minute workout at the right intensity three times a week.

Each member is evaluated biannually using the Army Physical Fitness Test to check their level of fitness and the effectiveness of the program in place. This test includes push-ups, sit-ups, 2-mile run, and an alternative aerobic event chosen from 800-yard-swim test, 6.2-mile-stationary-bicycle ergometer test, 6.2-mile-bicycle test on a conventional bicycle, or 2.5-mile-walk test. Each event is categorized by age and gender and is based on a 100 point scale, except for the alternative aerobic event.

The National Air and Space Intelligence Center (NASIC) located at Wright-Patterson Air Force Base has established a fitness policy for their unit personnel. The goal of this policy is to enforce a structured fitness program to maintain and improve the well-being

of the members and promote esprit de corps (NASIC, 2002). All members participate in a mandatory fun run each Monday and Friday. Participation is also mandatory for the multi-sports events every Wednesday. Members who are in the Weight Management Program are required to participate in a supervised aerobics program for five days during the week. Any member that is in noncompliance of this policy faces disciplinary actions.

WarFit is a program that has been enforced at seven bases of the Air Force Space Command. It was brought about because of the many loses of troops due to failing the standards of the current weight management program. This program puts emphasis on fitness rather than fattness and is designed to set lifestyle changes that will include regular exercise. Deena Ellin, Air Force Space Command Fitness Program Specialist explains that fitness will become a part of the mission rather than just extra curricular activities. WarFit enforces the requirement that all members will perform 30 minutes of aerobic activity three times a week and encourages squadrons to exercise together. It emphasizes unit and individual fitness. There is a comprehensive fitness assessment that is based on cardio-vascular, body composition, and muscular strength (sit-ups and push-ups). This score will determine the amount of unit oversight and support that will be given to the individual. It is the responsibility of the individual to take part in the exercise programs that are mandatory at his or her base. The basic requirement is that each squadron creates a tracked program with the three workouts during the week and members must be able to complete the number of sit-ups and push-ups for their age group. Members with lower risk scores will get less oversight than the members with the higher risk scores. This will ensure that all members are participating in regular exercise.

Each squadron is encouraged to create their own program that is tailored to their missions and needs. The 90th Medical Support Squadron at Francis E. Warren Air Force Base requires that each member exercise with the squadron once a week. They can choose to exercise as a group or individually for the other two days. The sessions include warm-up stretches, push-ups, sit-ups, and thirty minutes of aerobic activity. Team sports are often played afterwards.

Ohio fire departments do not have formal physical fitness programs for the firefighters. Each fire house has a fitness room that includes weights, tread mills, and stair climbers that can be used at any time. In the past, firefighters were given 1 hour in their schedules to be used for any kind of physical activity. Station 3 put up a basketball goal outside of the station to be used during this hour. Because there were issues on members getting hurt while working out, this hour was removed from their schedules leaving them to work out on their own. The firefighters are working to get a fitness program set up for them in order to ensure that all members are in top shape to prevent any loss of life, the victims or the firefighters.

In order to apply for a job as a firefighter, the C-PAT (Candidate Physical Ability Test) must be passed. Administrators are in the process of standardizing this test to make it equal and fair for everyone that takes it. This test includes activities that are job related such as dragging fire hoses and dummies for a certain distance, raising ladders, breaking down doors, and a timed session on a stair climber with extra weight on the shoulders. It is valid for one year and can be used when applying to any fire department.

The highest rate of death for firefighters is due to heart attacks. (Burleson, 2002). Their situation is slightly different than the military, however. Their jobs are very

stressful but their heart rates do not remain at a slightly higher level. They have times when there is nothing to do and they are able to sleep, but when the alarm sounds, their stress level significantly increases. It is very important for firefighters to be in good physical shape so that their hearts can cope with this sudden change. (Burleson, 2002).

3.7 Step 7: Scoring the Alternatives

In scoring the alternatives, the scores given are based on the actual requirements of the programs. Suggested or recommended exercises are not. For example, a program may state that "an individual will run" or "it is recommended that an individual runs." Only the first is considered for scoring. The following tables show how the alternatives score according to each measure:

Table 3. Alternatives and Scores

	Score		
Measure	**Current AF Program**	**Army**	**NASIC**
Aerobic Endurance	does not build	builds	builds
Body Fat	does not lower	lowers	lowers
Capacity	does not stimulate thinking	stimulates much thinking	stimulates much thinking
Communication	no communication	much communication	much communication
Courage	does not build	builds much	builds little
Dedication	does not foster	fosters	fosters
Depression	does not prevent	prevents	prevents
Effectiveness	does not increase	increases	increases
Effort	no effort	much effort	much effort
Enthusiasm	does not foster	fosters	fosters
Flexibility	does not increase	increases	does not increase
High Standards	sets high standards	sets high standards	sets high standards
Illness	does not help prevent	helps prevent	helps prevent
Injuries	does not help prevent	helps prevent	helps prevent
Integrity	does not build	builds	builds
Motivation	little	much	much
Optimism	does not foster	fosters	fosters
Perseverance	does not foster	fosters	fosters
Physical Fitness	does not keep fit	keeps fit	keeps fit
Pride	does not increase	increases	increases
Relationships	does not build	builds	builds
Respect	does not increase	increases much	increases much
Self Confidence	does not build	builds much	builds much
Self Control	need much	need much	need much
Self Discipline	need some	need much	need much
Selflessness	does not foster	fosters much	fosters much
Spirit	does not increase	increases	increases
Strength	does not increase	increases	does not increase
Stress	does not reduce	reduces	reduces
Team Outcome	no effort of group	much effort of group	much effort of group
Trust	does not build	builds much	builds much
Weight Control/Body Fat	does not provide	provides	provides
Well-Being	does not make active	makes active	makes active

Table 4. Alternatives and Scores

	Score		
Measure	**WarFit**	**90th MSS**	**Fire Department**
Aerobic Endurance	builds	builds	does not build
Body Fat	lowers	lowers	does not lower
Capacity	does not stimulate thinking	stimulates little thinking	does not stimulate thinking
Communication	little communication	little communication	no communication
Courage	does not build	does not build	does not build
Dedication	fosters	fosters	does not foster
Depression	prevents	prevents	does not prevent
Effectiveness	increases	increases	does not increase
Effort	little effort	little effort	no effort
Enthusiasm	does not foster	fosters	does not foster
Flexibility	does not increase	increases	does not increase
High Standards	does not set high standards	does not set high standards	does not set high standards
Illness	helps prevent	helps prevent	does not help prevent
Injuries	helps prevent	helps prevent	does not help prevent
Integrity	does not build	builds	does not build
Motivation	little	much	little
Optimism	fosters	fosters	does not foster
Perseverance	fosters	fosters	does not foster
Physical Fitness	keeps fit	keeps fit	does not keep fit
Pride	does not increase	increases	does not increase
Relationships	does not build	builds	does not build
Respect	does not increase	increases little	does not increase
Self Confidence	builds little	builds little	does not build
Self Control	need much	need much	need much
Self Discipline	need some	need much	need some
Selflessness	does not foster	fosters little	fosters much
Spirit	does not increase	increases	does not increase
Strength	increases	increases	does not increase
Stress	reduces	reduces	does not reduces
Team Outcome	no effort of group	little effort of group	no effort of group
Trust	does not build	builds little	does not build
Weight Control/Body Fat	provides	provides	does not provide
Well-Being	makes active	makes active	does not make active

Better scores could be determined with the availability of a participant from each program to do the scoring. The scores given are based on contents of the literature.

Steps 1 through 7 set up the model in using VFT. The problem is determined in step 1. Step 2 is the actual hierarchy building. Steps 3 and 4 develop the measures. Step 5 requires weighting the hierarchy. Step 6 is generating alternatives. Step 7 is scoring these alternatives. Once these steps have been completed, the analysis can be conducted.

Chapter 4
Analysis

4.0 Chapter Overview

Chapter four includes explanations of steps 8 and 9 applied to the given problem. Section 4.1 describes step 8 and the deterministic analysis of the alternatives used with the constructed model. Section 4.2 describes step 9 and the sensitivity analysis of these alternatives. Section 4.3 describes step 10, which gives conclusions and recommendations.

4.1 Step 8: Deterministic Analysis

Using Logical Decisions, the generated alternatives were entered into the computer with their scores for each measure that was included in the hierarchy. The total score on each alternative is given as "utility" on the figures constructed in Logical Decisions and are calculated by $\sum w_i \times v_i(x_i)$. The score for each alternative on each measure ($v_i(x_i)$) is multiplied by the global weight assigned to that measure (w_i). For each alternative, the calculations for all measures are added together to get the overall score for the alternative.

Looking at the ranking of the alternatives (figure 30), it is seen that the Army Fitness Program scores highest when considering all measures that were determined from the values of the Air Force. NASIC scores second with 90th MSS and WarFit following. WarFit is low due to the fact that scoring the measures was restricted to actions that were strictly required in the fitness program. When WarFit is tailored to a specific squadron like 90th MSS, the score goes up considerably. The Fire Department's program and the Current Air Force Program score very low because they are assessments and not actual

on-going programs. Therefore, they would not have scored at all for most of the measures, such as Body Fat, Stress, Relationships, and Team Outcome.

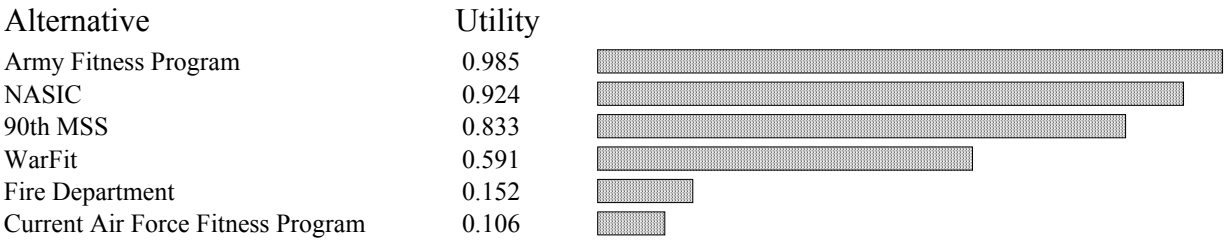


Figure 30. Ranking of Alternatives

Looking at the stacked bar graph in figure 31, the Army Fitness Program and NASIC score the same in regards to Force Effectiveness since they both encourage teamwork. Force Readiness and Force Preservation look about the same for the Army, NASIC, 90th MSS, and WarFit. The Fire Department and the Current Air Force Program did not score for Force Readiness and Force Preservation since they do not increase physical and mental abilities or help individuals to meet standards.

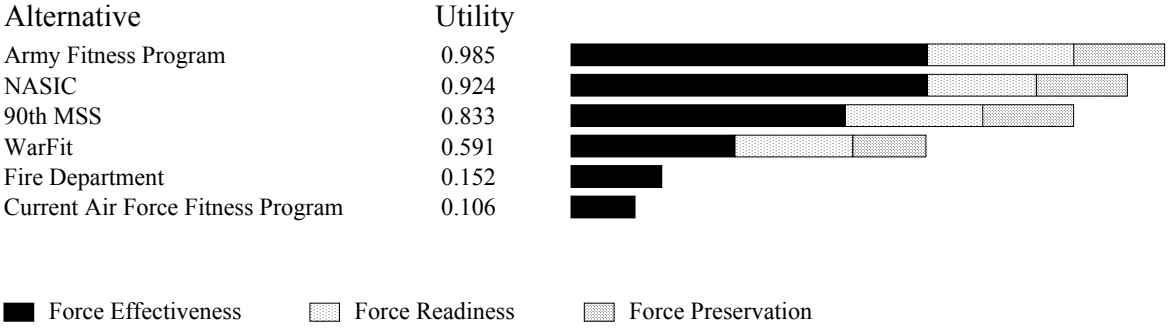


Figure 31. Ranking by Top Tier

Breaking down the problem into the three values in the top tier, Force Readiness reveals that the Army Fitness Program and 90th MSS score the same for Physical Readiness since they both help to increase the physical and mental components. The Army Fitness Program, 90th MSS, WarFit, and NASIC score the same for Mental Readiness because they aid in preventing any mental disorders. The Fire Department and the Current Air Force Program do not score for these values since they do not contribute to a person's physical or mental well-being, as seen in figure 32.

Alternative	Utility
Army Fitness Program	1.000
90th MSS	0.938
WarFit	0.812
NASIC	0.750
Fire Department	0.000
Current Air Force Fitness Program	0.000

Physical Readiness Mental Readiness

Figure 32. Ranking for Force Readiness

Force Preservation demonstrates that the Army Fitness Program, NAIC, 90th MSS, and WarFit score the same for Retention, shown in figure 33, because they are focused on keeping individuals healthy and happy. WarFit scores lower for Quality of Life. The general requirements for WarFit do not promote relationship building, which caused the score for Quality of Life to be low. The Fire Department and the Current Air Force Program do not score for Retention or Quality of Life since they do not keep individuals physically fit or help build relationships.

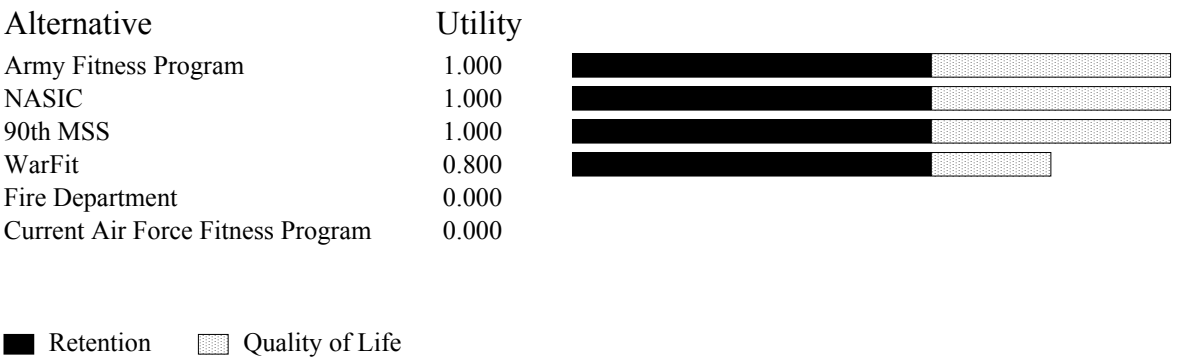


Figure 33. Ranking for Force Preservation

Force Effectiveness shows that the Army Fitness Program and NASIC score the same for Leadership Characteristics, Esprit de Corps, and Unit Performance (figure 34) because they focus on success and unit cohesion. 90th MSS is slightly less due to less team focus. WarFit scores low on Esprit de Corps for the same reason given for Quality of life.

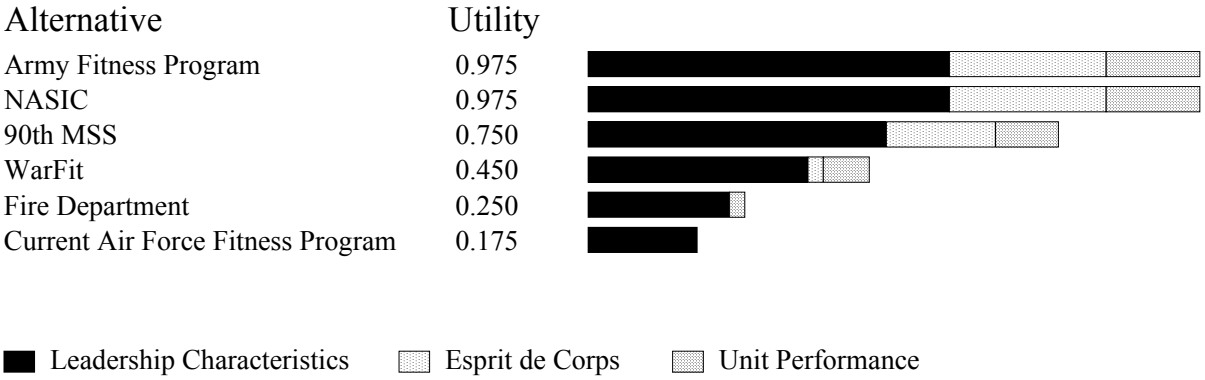


Figure 34. Ranking for Force Effectiveness

The following line graph (figure 35) shows that as ranking is accomplished with each value of the top tier, the order of the alternatives changes slightly. It is seen that there is dominance between 90th MSS and WarFit since the 90th MSS line stays above

WarFit for all values. This makes sense due to the fact that the program enforced by the 90th MSS is the WarFit program, but tailored and improved to meet the goals of that unit.

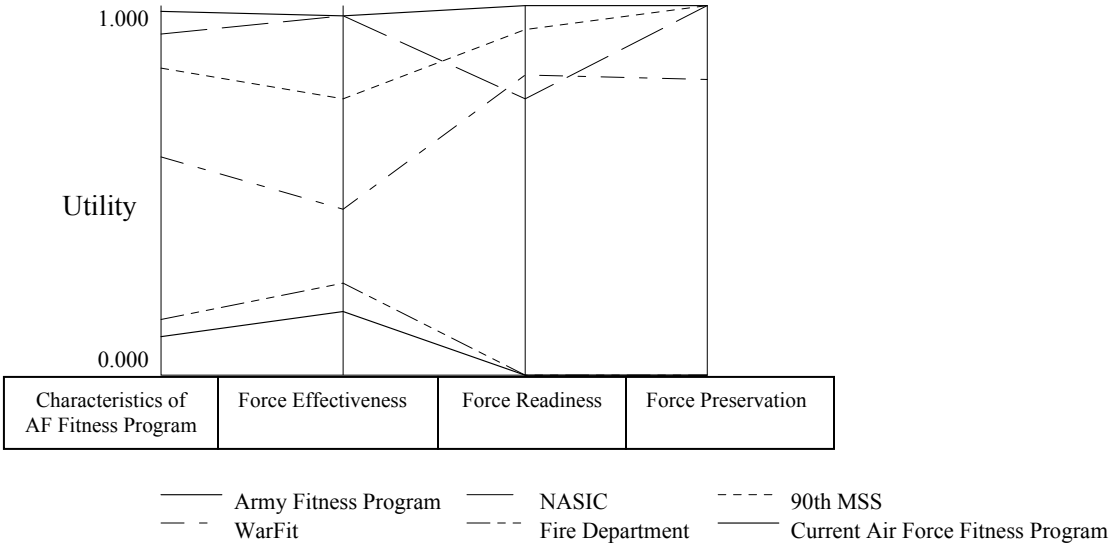


Figure 35. Dominance

4.2 Step 9: Sensitivity Analysis

Sensitivity analysis is accomplished in order to find out how sensitive the alternatives are to the measures as they are adjusted. The following figures show the differences in the scores of the alternatives compared to each other. The measures listed are those that have a difference between the two alternatives. The top bar indicates the total difference. The bars on the right describe the higher score for the alternative with the higher ranking while bars on the left describe the higher score for the lower ranking alternative. The longer the bar, the more influence that measure has on the overall ranking of the alternative. Figure 36 shows that the Army scores higher in strength, flexibility, and courage than NASIC, while NASIC scores higher in selflessness.

Overall Utility for	Army Fitness Program	0.985
	NASIC	0.924
	Difference	0.061

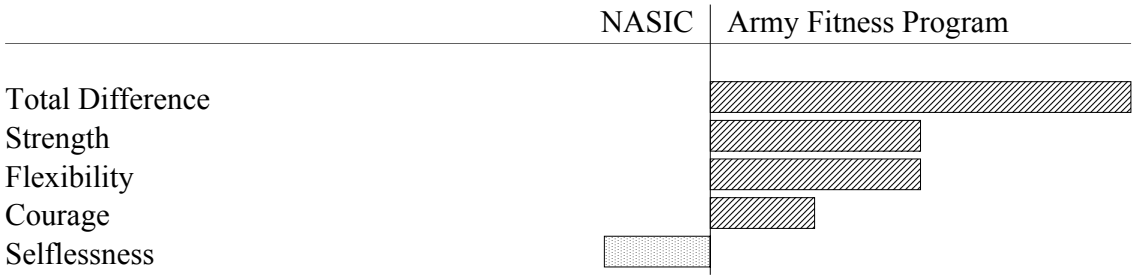


Figure 36. Army/NASIC Comparison

This pairwise comparison is done for each program and can be seen in Appendix A. Looking at these bar graphs, it appears that Strength, Flexibility, and Selflessness provide the most influence on ranking the alternatives. This is concluded by observing the number of times these measures appear within the comparisons and the lengths of the bars when they do appear. Since they appear in multiple comparisons, this shows that differences exist with these measures between more than two of the alternatives. Because these measures provide the most influence, the sensitivity graphs for these measures are looked at in addition to the graphs for the top tier. The following line graphs (figures 37 through 42) show how the better alternative changes as the percentage of the total weight of the values and measures range from zero to 100:

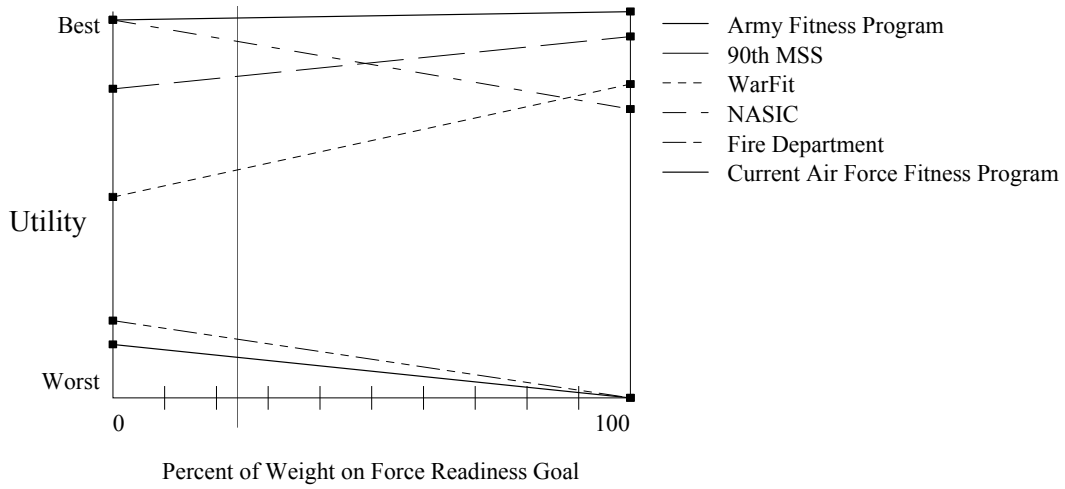


Figure 37. Force Readiness Sensitivity

The Army Fitness Program rates the highest in the Force Readiness category. When the percentage of weight for Force Readiness goes over 50, ranking between NASIC and 90th MSS changes with 90th MSS ranking better. When the percentage goes over 90, WarFit becomes better than NASIC.

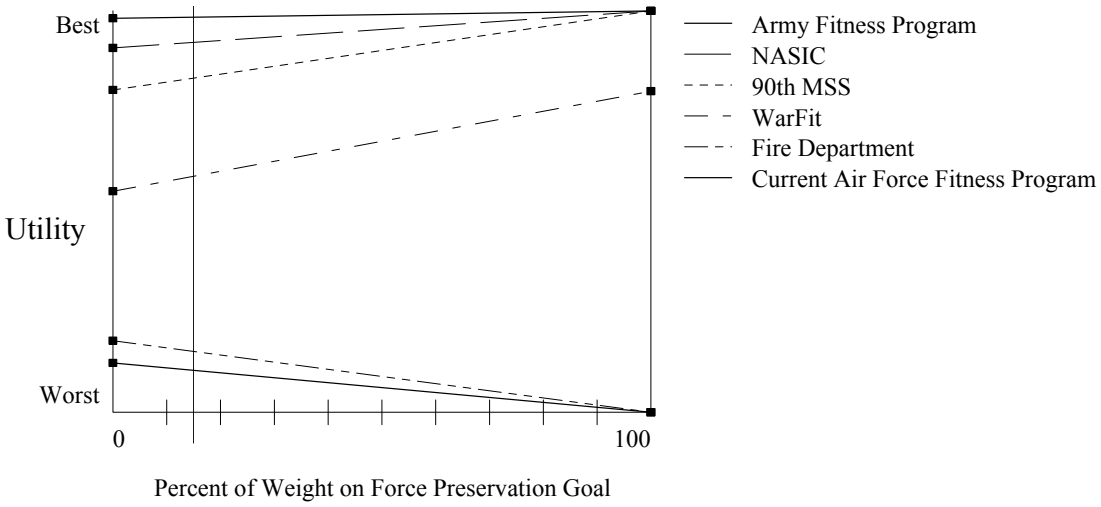


Figure 38. Force Preservation Sensitivity

For Force Preservation, there are no changes as the percentage of weight goes from zero to 100. The Army Fitness Program remains the best.

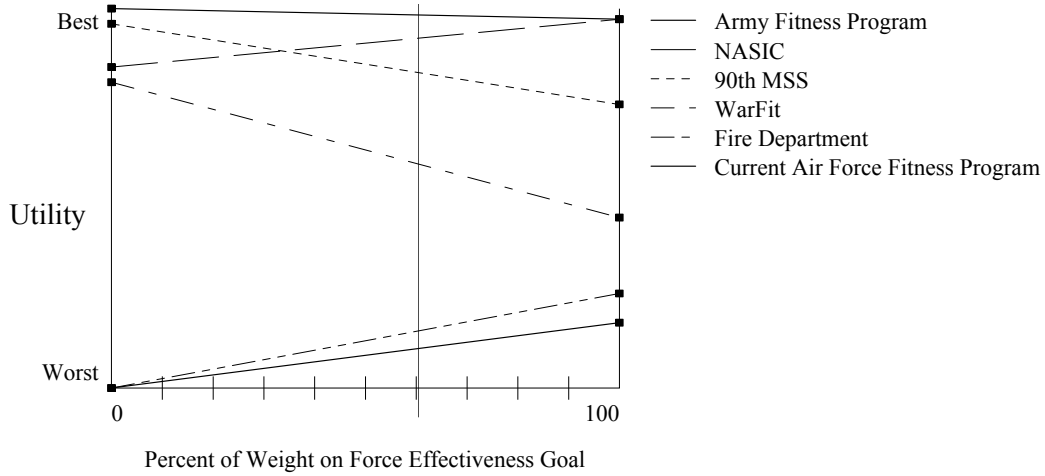


Figure 39. Force Effectiveness Sensitivity

For Force Effectiveness, the Army Fitness Program is best. When the percentage of weight on Force Effectiveness goes over 35, NASIC becomes better than 90th MSS.

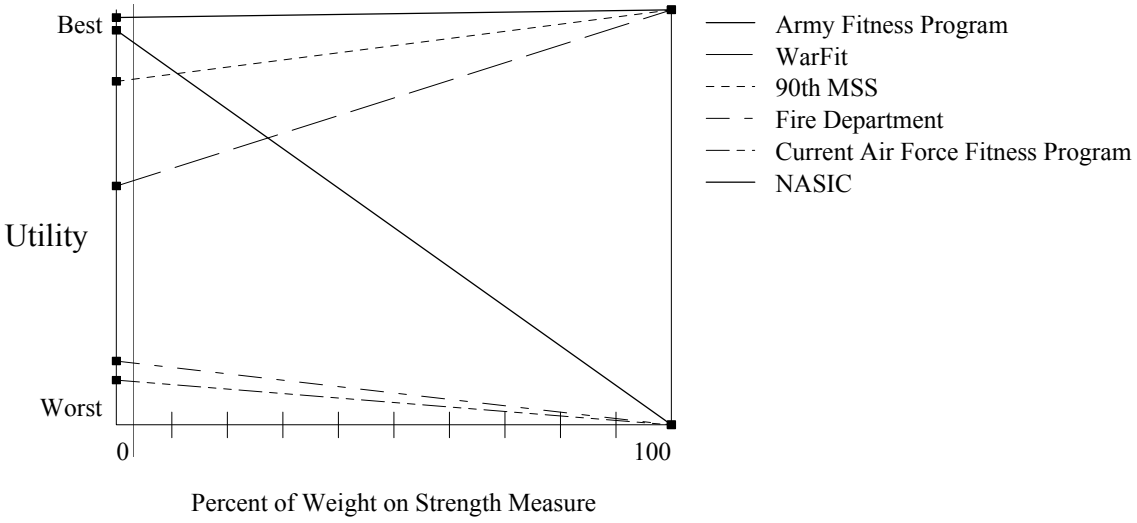


Figure 40. Strength Sensitivity

Looking at Strength, the Army Fitness Program is best. When the percentage of weight on Strength goes over 12, 90th MSS becomes better than NASIC. Once the percentage passes 30, WarFit becomes better than NASIC.

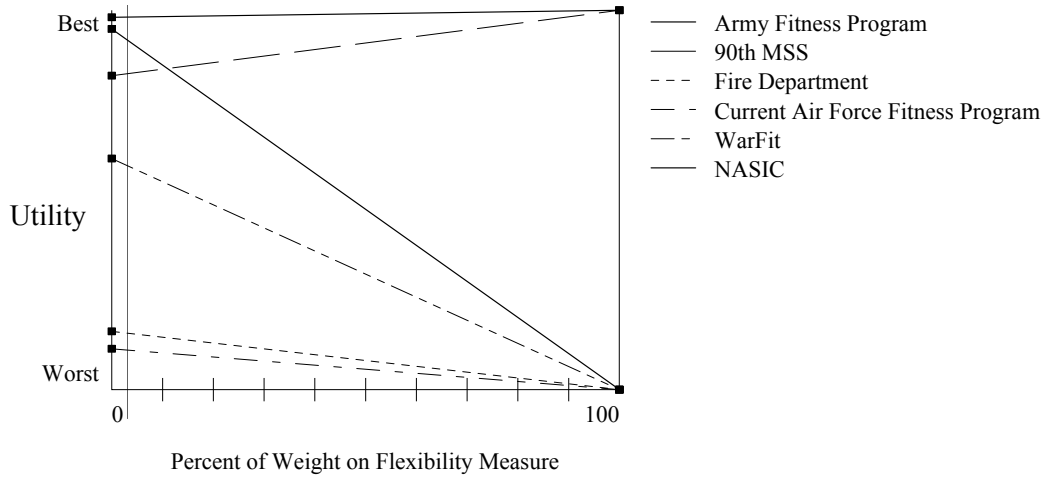


Figure 41. Flexibility Sensitivity

For Flexibility, the Army Fitness Program is best. When the percent of weight on Flexibility goes over 12, 90th MSS becomes better than NASIC.

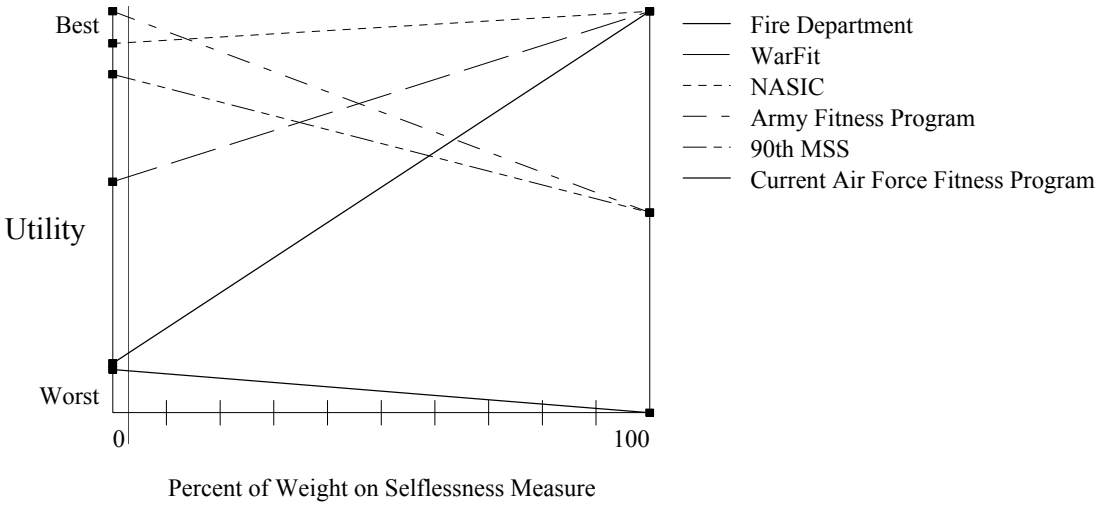


Figure 42. Selflessness Sensitivity

For Selflessness, the Army Fitness Program starts off best. When the percentage of weight on Selflessness goes over 15, NASIC becomes better than the Army. When the percentage goes over 35, WarFit becomes better than 90th MSS. The Fire Department becomes better than 90th MSS when the percentage is over 60 and the Fire Department becomes better than the Army when the percentage is over 65.

4.3 Step 10: Conclusions and Recommendations

To conclude the analysis, the top-scoring alternative with respect to all values that the Air Force deems important in a physical fitness program is the Army's fitness program. It scores very high in all measures resulting in the highest total score of all alternatives considered. It includes activities involving the betterment of each individual and improvements in team efforts to support the mission.

Adjusting the weights on Force Readiness, Force Effectiveness, Strength, Flexibility, or Selflessness will result in different ratings of the alternatives for that value or measure. A decision should be made on what the actual weight should be if any of these values or measures are of particular importance to the decision maker.

Chapter 5
Conclusions

5.0 Chapter Overview

This chapter gives an explanation of the findings in this study. Section 5.1 gives the conclusions in evaluating different alternatives. Section 5.2 gives recommendations for future study of this topic.

5.1 Summary

A hierarchy was constructed to include all characteristics that the Air Force finds important in a physical fitness program. Measures were included to evaluate different alternatives according to the values. Single dimension value functions were created to evaluate these measures on a common scale. The hierarchy was globally weighted so that scores could be calculated for different alternatives. Different alternatives were generated to use with the model in determining the best fitness program for the Air Force. Analyzing the data, it is shown that the Army Fitness Program scores the best overall with regards to the values that the Air Force holds. If the Air Force wants to have an effective program to enforce, the Army Fitness Program would have the most of what the Air Force would require from a fitness program.

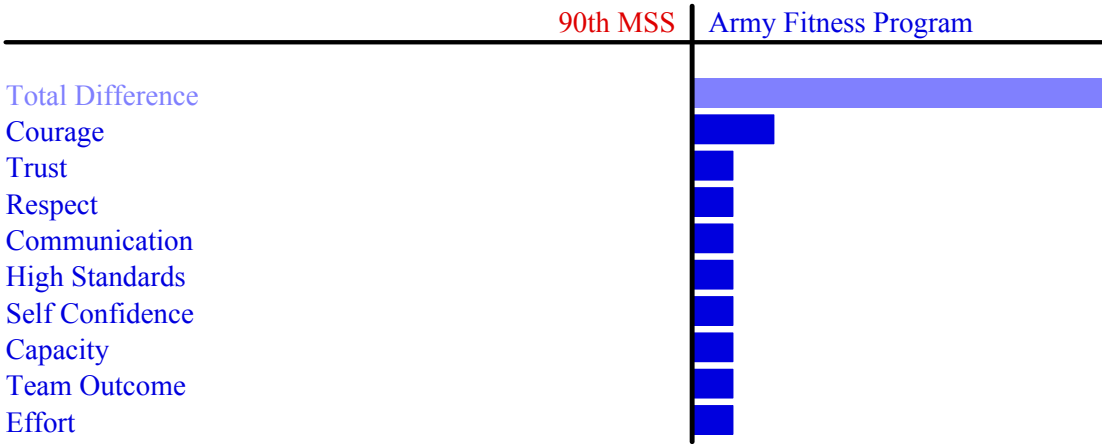
5.2 Future Studies

Future work on this study should include more detailed information from several subject matter experts in order to gain a more accurate evaluation of the exact values of the Air Force. A study including the intensity and frequency of activity should be included to determine the measures that will give a more precise calculation when analyzing the alternatives. Using the FITT (frequency, intensity, time, type of activity) principle would help in making the study more realistic by considering human body

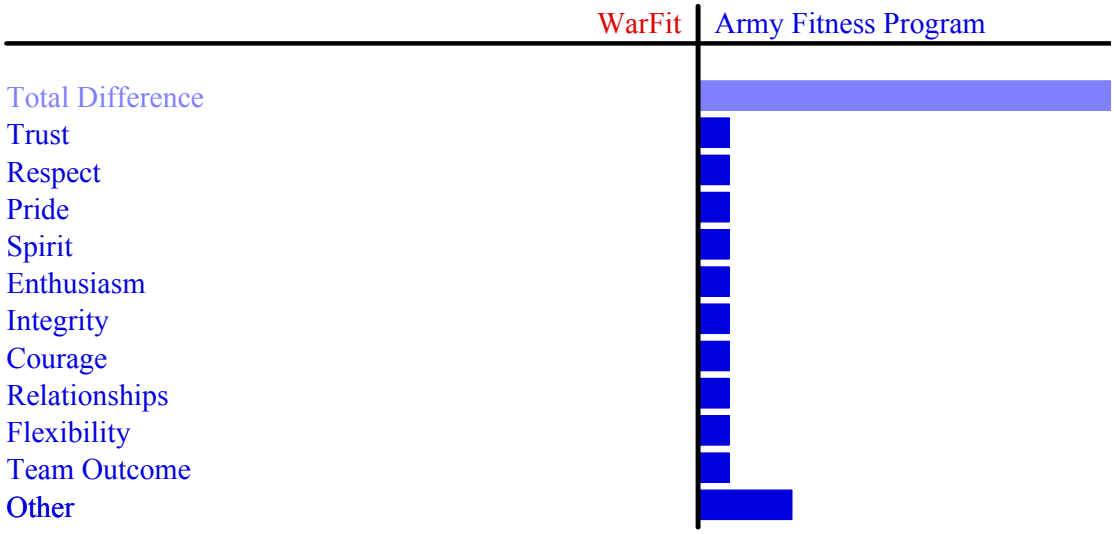
reactions to certain activities. When incorporating this with the measures, the suggested decision outcome will be more accurate because it will relate human performance with the values of the Air Force.

Appendix A: Pairwise Comparisons

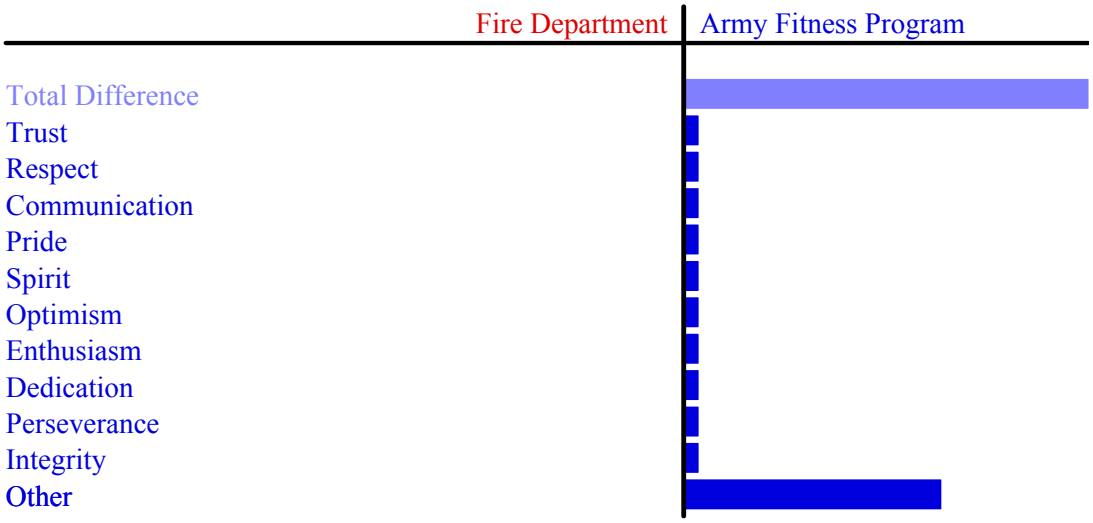
Overall Utility for	Army Fitness Program	0.985
	90th MSS	0.833
	Difference	0.152



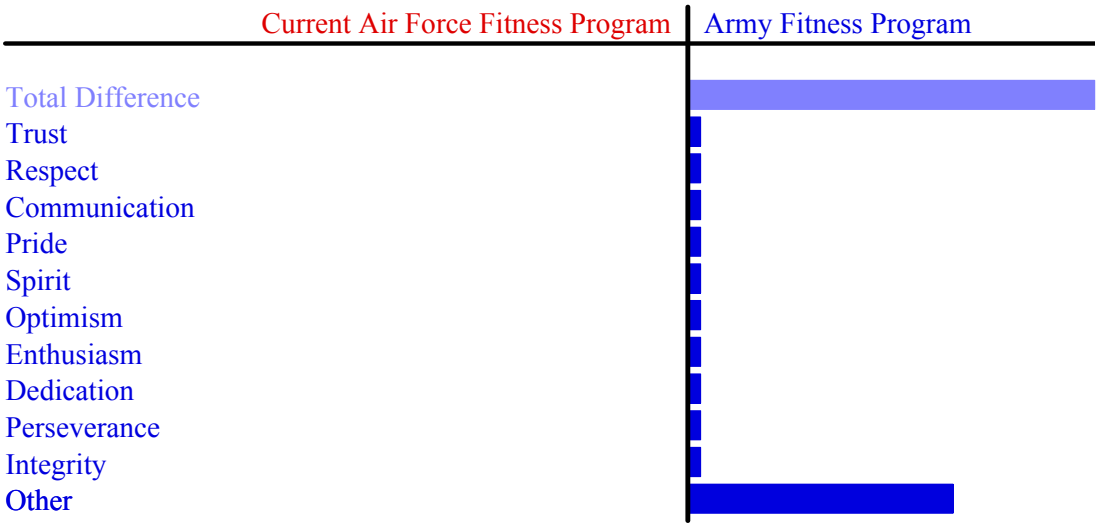
Overall Utility for	Army Fitness Program	0.985
	WarFit	0.591
	Difference	0.394



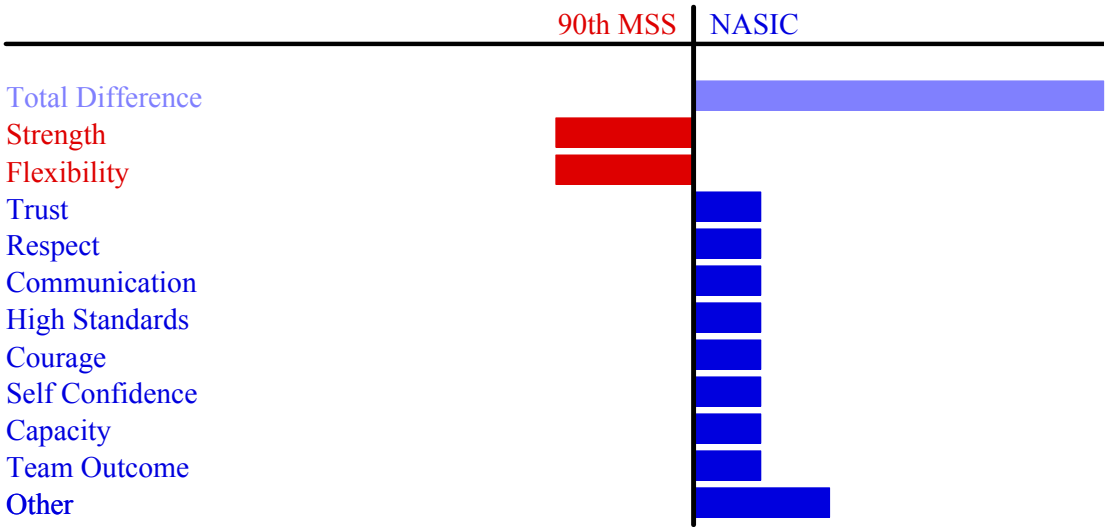
Overall Utility for	Army Fitness Program	0.985
	Fire Department	0.152
	Difference	0.833



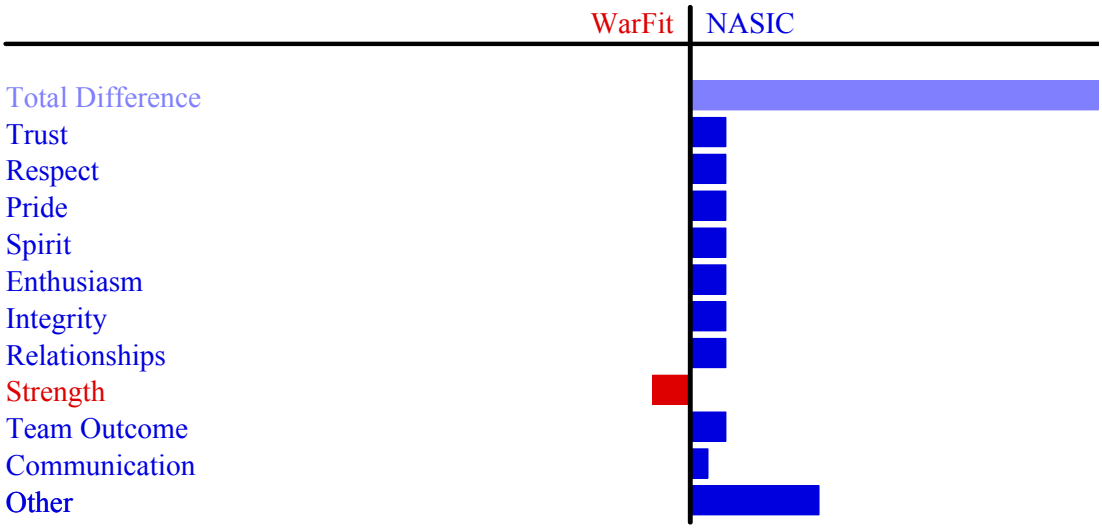
Overall Utility for	Army Fitness Program	0.985
	Current Air Force Fitness Program	0.106
	Difference	0.879



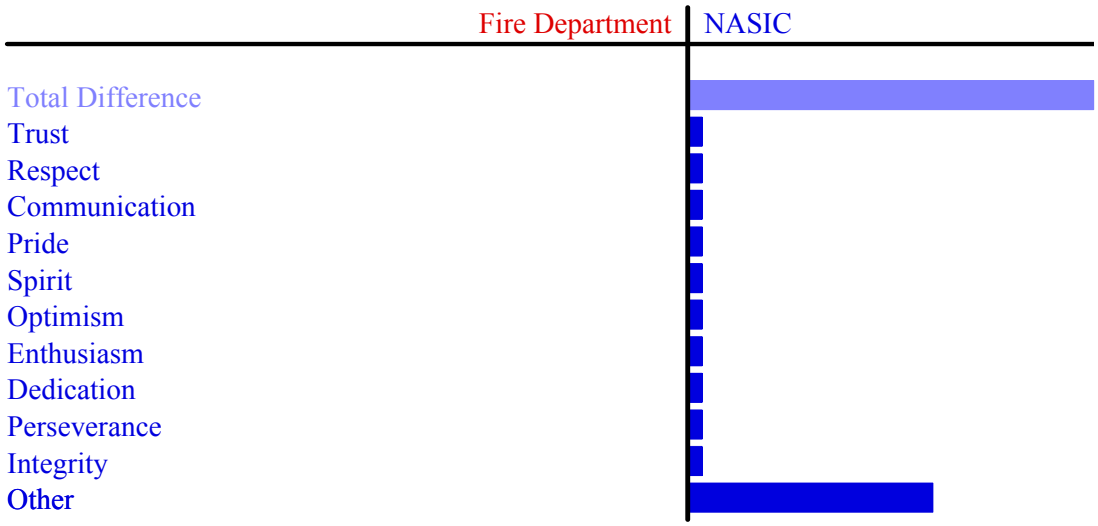
Overall Utility for	NASIC	0.924
	90th MSS	0.833
	Difference	0.091



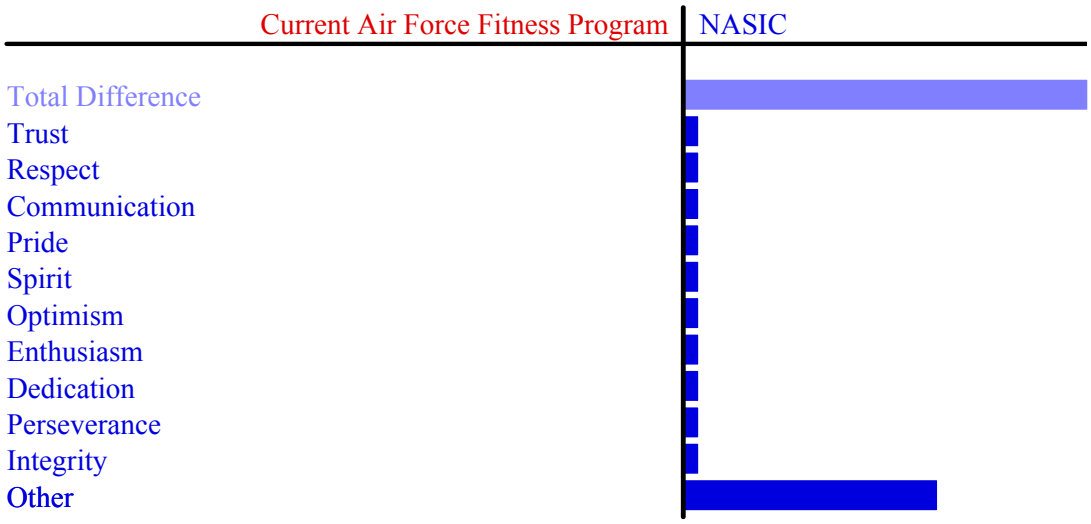
Overall Utility for	NASIC	0.924
	WarFit	0.591
	Difference	0.333



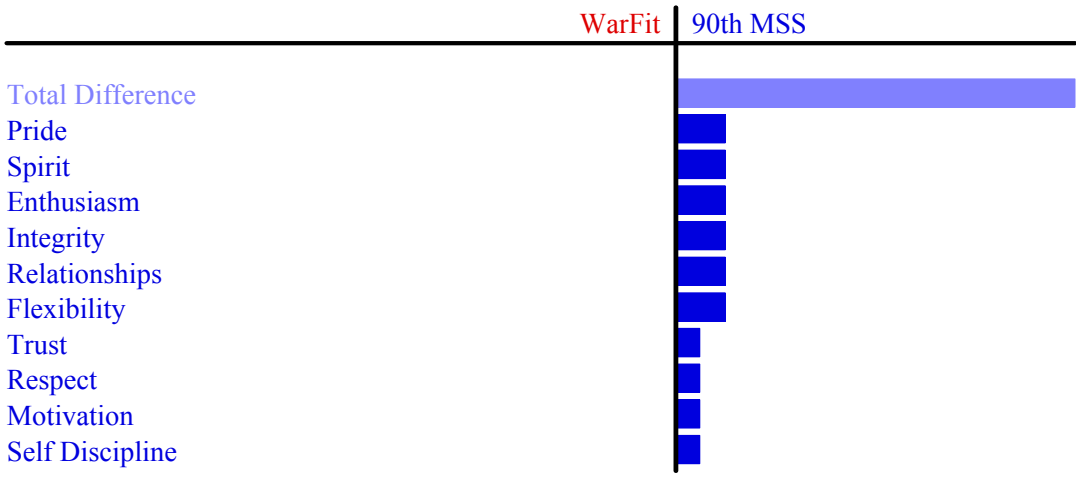
Overall Utility for	NASIC	0.924
	Fire Department	0.152
	Difference	0.773



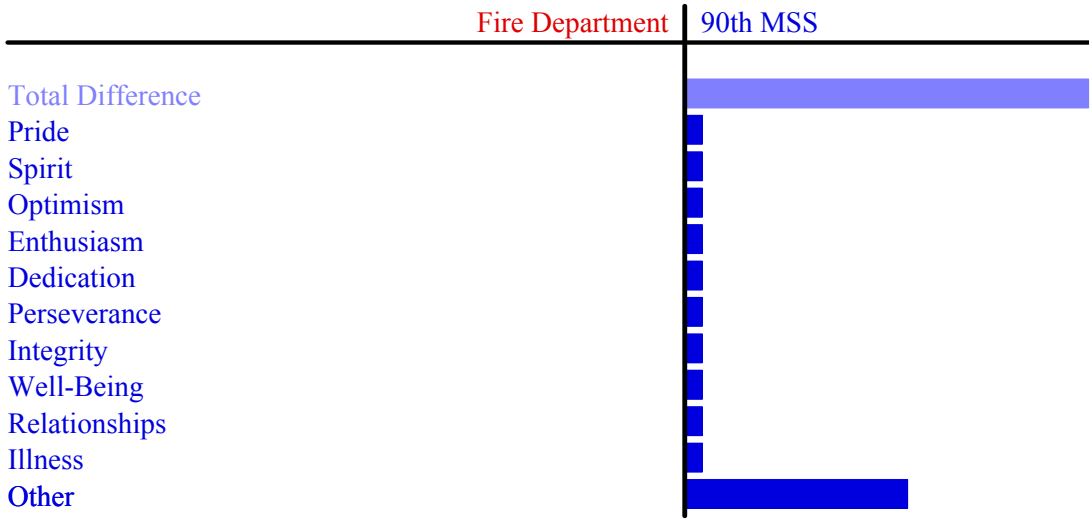
Overall Utility for	NASIC	0.924
	Current Air Force Fitness Program	0.106
	Difference	0.818



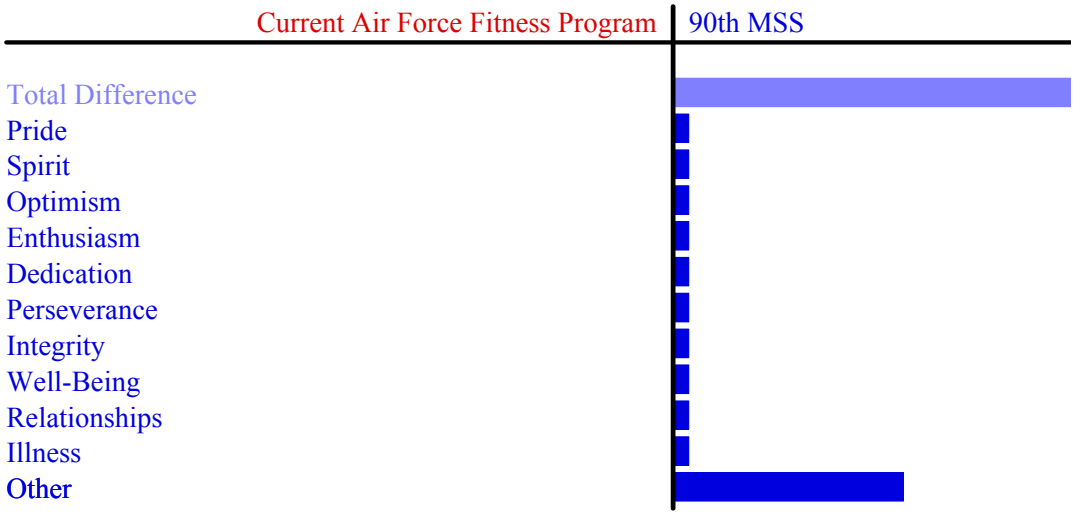
Overall Utility for	90th MSS	0.833
	WarFit	0.591
	Difference	0.242



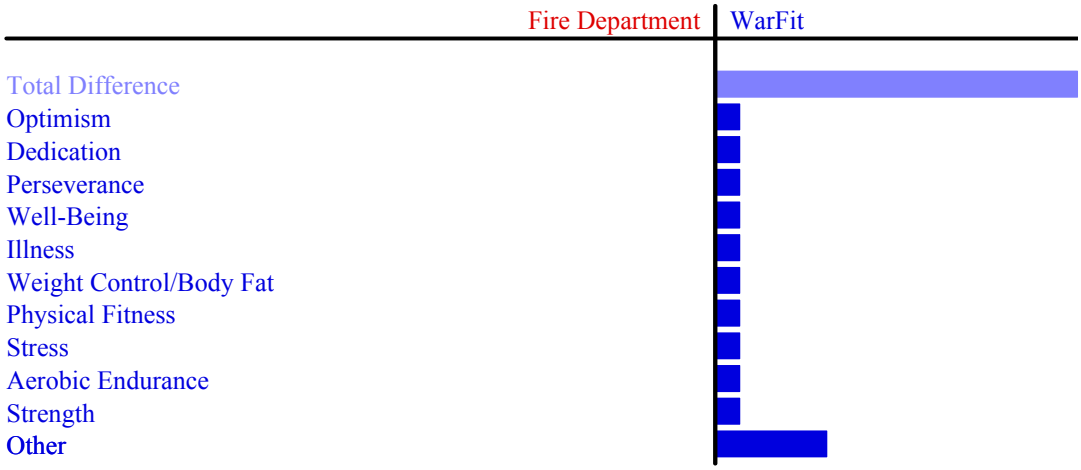
Overall Utility for	90th MSS	0.833
	Fire Department	0.152
	Difference	0.682



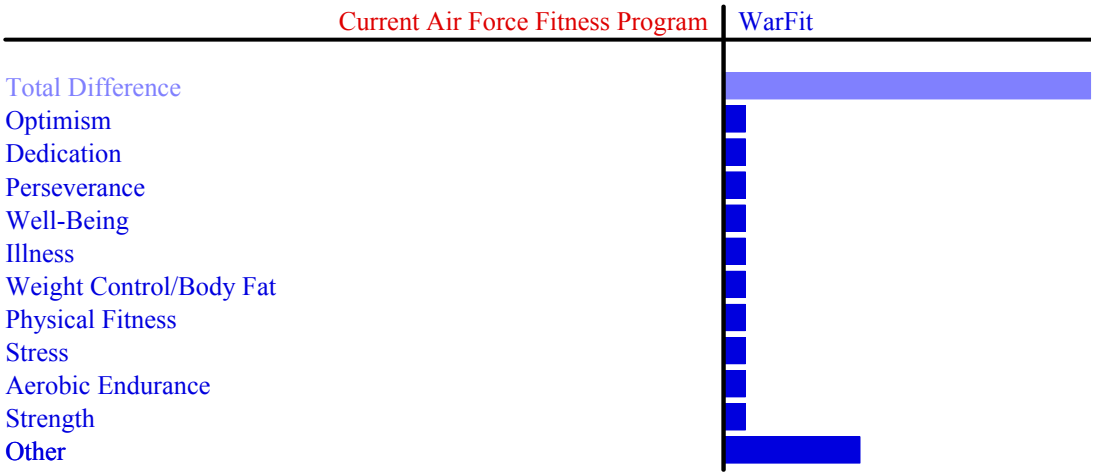
Overall Utility for	90th MSS	0.833
	Current Air Force Fitness Program	0.106
	Difference	0.727



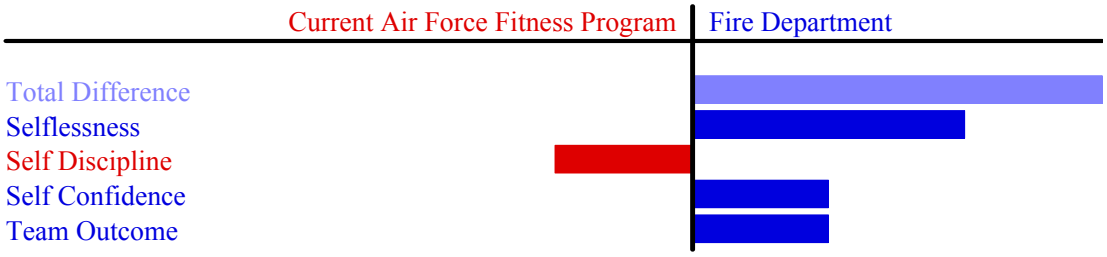
Overall Utility for	WarFit	0.591
	Fire Department	0.152
	Difference	0.439



Overall Utility for	WarFit	0.591
	Current Air Force Fitness Program	0.106
	Difference	0.485



Overall Utility for	Fire Department	0.152
	Current Air Force Fitness Program	0.106
	Difference	0.045



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Vita

First Lieutenant Elizabeth T. Lewis graduated from Austin Peay State University in Clarksville, Tennessee. She graduated in 1997 with a Bachelor of Science degree in Mathematics with a minor in Secondary Education. She was commissioned through Officer Training School at Maxwell Air Force Base in Alabama.

Her first assignment was at Tinker AFB as an analyst for the 552nd Operational Support Squadron. In September 2001, she entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, she will be teaching in the Math Department at the Academy.

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14. ABSTRACT

The Air Force is constantly evolving. With the many changes and the Expeditionary Air Force structure put in place, it is more important now than ever that the Air Force has a physical fitness program to keep its members healthy and productive. By doing this, it can ensure success in completing the Air Force mission while keeping the organization at the highest level of readiness possible. This thesis looks at what the Air Force values in having a fitness program. These values are taken from Air Force doctrine and related instructions. Using these values, fitness programs can be evaluated to determine what program would be best for the Air Force. This decision is based on the doctrinal and instruction values. The results of this study show that programs similar to the Army's fitness program would be best and include most of the desired characteristics. This should be an important consideration when determining what type of fitness program the Air Force needs.

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U	U	U	UU	85	19b. TELEPHONE NUMBER *(Include area code)* (937) 255-6565, ext 4314; e-mail: Stephen.Chambal@afit.edu