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Determining the Optimum Strategy of Techniques from the Municipal Solid Waste Management Hierarchy to Maximize Social Value

Camille M. Still

DETERMINING THE OPTIMUM STRATEGY
OF TECHNIQUES FROM THE MUNICIPAL
SOLID WASTE MANAGEMENT HIERARCHY
TO MAXIMIZE SOCIAL VALUE

THESIS

Camille M. Still, Captain, USAF

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DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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THESIS

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Camille M. Still, B.S.

Captain, USAF

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Committee:	Name/Title/Department	Signature
Advisor	Jack M. Kloeber, LTC, USA Assistant Professor Department of Operational Sciences	
Reader	James R. Aldrich, Major, USAF Assistant Professor Department of Engineering and Environmental Management	
Reader	Wm. Brent Nixon, Major, USAF Assistant Professor Department of Engineering and Environmental Management	
Reader	Guy S. Shane, Ph.D. Associate Professor Graduate Department of Logistics Management	

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Camille M. Still

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Abstract

Environmental managers must make difficult decisions regarding how to manage solid waste generation and disposal. The primary waste management alternatives are source reduction, recycling, composting, incineration, and landfilling. Often, waste management policies are based entirely on technical considerations and ignore that actual disposal practices depend on individuals' attitudes and behaviors. This research formulated a decision analysis model that incorporates social value measures to determine the waste management strategy that maximizes the individuals' willingness to participate. The social values that are important and that were considered in the decision support model to assist with making decisions about solid waste management were convenience, feeling good about reducing waste, feeling good about leaving a good environment for future generations, and the value of recreation programs that can be provided with profit from a recycling program.

Focus group discussions were conducted where participants discussed their ideas about each of the waste management alternatives and completed a questionnaire which was made up of pairwise comparisons which were evaluated using the analytic hierarchy process.

The results of the research were strategies for waste management policy that would maximize individuals' willingness to participate. Recycling was the preferred method; source reduction, incineration and composting were the next best alternatives; and landfilling was the least preferred alternative.

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I. Introduction

Background

When we throw something away, there really is no "away". At the beginning of the twentieth century, the most commonly recognized methods for solid waste disposal were dumping on land, dumping in water, plowing into the soil, feeding to hogs, reduction, and incineration. Since the 1940's, our primary method of throwing away garbage has been to bury it (Tchobanoglous, et al., 1993:8). This process has evolved technologically from burial in open pits to sophisticated modern landfills which are designed to entomb the material and prevent contamination of surrounding areas. Modern landfills are designed with a specific volume capacity and lifespan, which is typically 20 years. When the useful life of an operational landfill is over and the landfill's capacity is exhausted, the public often has strong opposition to developing a new facility. Although most individuals are opposed to new landfills, the solid waste generation rates for the United States continue to increase (USEPA, 1990:79). These two factors, opposition to new landfills and increase in waste generated, create hard choices for environmental managers who must determine the best waste management options (USEPA, 1990:ES-1).

Congress passed the Pollution Prevention Act of 1990 in response to the solid waste disposal problem. The US Environmental Protection Agency (USEPA) has the responsibility to promulgate the national pollution prevention management strategy found in the act:

- Pollution should be prevented or reduced at the source whenever feasible
- Pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible
- Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible
- Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

(US Congress, 1990)

Department of Defense (DOD) installations are not immune from the solid waste management problems. The DOD has established a goal to reduce the weight of solid waste disposed by 50% by the end of 1997 from a 1992 baseline. The Air Force has kept track of its progress toward meeting this reduction goal, and when all the pounds of solid waste disposed for each base are added up, it appears that the goal is being met. The reported total solid waste generated by the entire Air Force in 1992 was 1,005,632 tons, and in 1994 was 794,328 tons (AFCESA, 1996:ES-1). This represents a solid waste reduction of 21%. However, during this time period, 20 bases closed (AFCESA, 1996:3-1), and thus no longer generate solid waste. On an individual level, many installations may benefit from guidelines that will assist in developing a waste management strategy that will meet the desired reduction goal.

The environmental manager at an installation is faced with the difficult challenge of establishing a solid waste management program that will reduce waste disposal to desired levels. The environmental manager most likely has an engineering or scientific background, approaches the problem as a purely technical one, and attempts to find a technical solution. Policies may be established detailing source reduction measures and mandating recycling and composting levels. Unfortunately, such policies ignore that individuals' decisions about handling trash involve complex human behavior and attitudes about social values (Stern and Oskamp, 1987:1048).

Research Problem

Environmental managers need a method of incorporating individuals' social values into the overall decision making process for managing solid waste. Recognition must be given to the fact that solid waste reduction methods such as source reduction, composting, and recycling can be characterized as conservation behavior which require action by an individual. Any analysis to measure the social value for a group of individuals must be accomplished by obtaining direct inputs from the group; the values cannot be estimated using technical methods.

Justification for the Research

A decision support model was developed by Capt John Muratore (Muratore, 1995) to help decision makers determine the most appropriate policy for waste management based on the following criteria: attainment of pollution prevention goals, waste diversion from landfills, economic cost, and social cost (Muratore, 1995:4). The model is a valuable asset to environmental decision makers because it aids the process of sorting through conflicting objectives. For example, we could design a materials recovery facility with highly technical sorting equipment, but the extremely high cost may not be justified. One shortfall of the model is that the inputs used for social cost were estimated by the researcher and did not account for individuals' values. The overall model could be improved if an appropriate method for determining social value is used. An appropriate method must not be biased toward a technological solution; rather it must recognize the importance of the social dimension of conservation policy (Stern and Oskamp, 1987:1068).

Social value is very difficult to quantify. A clearly defined methodology for evaluating social value would be very valuable to decision makers. Evaluations and the resulting decisions based solely on the judgment of a "technically skilled elite" (MacLean, 1986:43) are not generally accepted by society as a whole. To remedy this situation, MacLean suggests:

> The private marketplace is often a useful source of both information concerning the present and estimates about the future. There is much to be said for designing a more public process of cost-benefit analysis for social decisions that would incorporate as much information from the private marketplace as possible. (MacLean, 1986:43)

The methodology proposed in this research takes individuals' social value into consideration, quantifies it in terms of its effect on the success of various solid waste management programs, and allows the decision maker to use this value to determine an appropriate strategy for solid waste management.

Research Objective

The objective of this research is to develop a decision support model that accurately portrays an aggregation of Air Force base residents' and workers' social values regarding different solid waste management options.

Research Questions

1. What are the attitudinal variables that influence conservation behavior and determine an individual's social value with respect to solid waste management?
2. How can these attitudinal variables be quantified to allow them to be used by decision makers in determining conservation policy?
3. What is the most accurate way to incorporate these variables into a decision support model to provide the optimum solid waste management strategy?
4. Using data obtained from individuals at Wright-Patterson AFB, and the decision support model, what solid waste management strategy maximizes social value?

Scope and Limitations

This research will focus on the social value of programs addressing the following specific components of the municipal solid waste stream - paper, glass, plastic, metal, and yard and food waste. These components account for approximately 89% of the municipal solid waste stream (USEPA, 1990:ES-5). The solid waste management methods that will be considered by the model are source reduction, composting, recycling, incineration, and landfilling.

The research effort will consider the values of two stakeholder groups: workers on an installation, and residents of military family housing. Other stakeholder groups that have been identified by the decision maker are members of the local community and the municipal solid waste contractor. These groups have been omitted from further analysis based on the following assumptions: 1) members in military family housing are representative of members of the local community in that they share the same social values regarding environmental conservation and 2) the values of contractors are reflected in the economic cost to the installation for the contract, thus their values are adequately reflected in the financial portion of Muratore's solid waste management model.

The data obtained through this research and quantitative output from the model will only be applicable at this installation. However, the methodology to quantify social value can be used at any military installation to improve solid waste management strategy.

This decision support model considers only social value. Other criteria, such as attainment of pollution prevention goals, waste diversion from landfills, and economic cost must also be considered. The output from this model must be incorporated into a more comprehensive model to determine the true optimum solid waste management policy.

Research Approach

The attitudinal variables will be determined by conducting a series of focus groups. Distinct focus group sessions will be conducted for workers on the installation and military family housing residents, because their behaviors are likely to be different in the different settings. The focus groups will produce qualitative information from a guided discussion, and a questionnaire will be administered which will be analyzed using an appropriate technique, such as the analytical hierarchy process.

A decision support model structure will be developed that considers the important attitudinal variables related to each solid waste management method - source reduction, composting, recycling, incineration, and landfilling. The data obtained from the focus groups will be used to demonstrate how the model can be used by an environmental manager to generate a solid waste management strategy.

Four separate decision support models will actually be used to generate solid waste management strategies distinguished by the waste generator and the waste material. Each model considers the same social values and uses the same methods and calculations.

Different models will be developed to recognize that the optimum strategy for base workers could be different from the strategy for housing residents. The waste management program at Wright Patterson AFB is managed differently for the main base area and the family housing area. The strategy may be different for various materials as well, for example, the optimum strategy for paper waste management could be different from glass waste management. The four decision analysis models are:

1. Base workers for the category of plastic, glass, and aluminum management.
2. Base workers for the category of paper management.
3. Housing residents for the category of plastic, glass, and aluminum management.
4. Housing residents for the category of paper, yard waste, and food waste management.

Organization of the Research Report

Chapter 2, Literature Review, presents and summarizes literature in the areas of solid waste management techniques, decision analysis techniques, focus groups, conservation behavior, environmental attitudes, and policy development.

Chapter 3, Methodology, details the research approach and methods used to collect and analyze data that quantifies the attitudinal variables, and to develop the decision support model.

Chapter 4, Analysis and Findings, presents the results of the research.

Chapter 5, Conclusions and Recommendations, presents conclusions reached from the analysis and recommendations for future research efforts.

II. Literature Review

Overview

This chapter presents a review of the literature that formed the basis of the research effort. First, the Air Force Pollution Prevention guidance is explained. This guidance establishes the requirement that an Air Force installation develop a comprehensive solid waste management program. Then, the municipal solid waste management alternatives are introduced and the integrated solid waste management hierarchy is explained. A description is provided for each of the solid waste management techniques - source reduction, recycling, composting, incineration, and landfilling.

The concept of social value is introduced and its relevance to environmental management is defined. Psychological approaches to solving environmental resource problems are described along with social marketing strategies for policy formulation. These two concepts are important factors to consider when developing an effective solid waste management program.

The construct of environmental satisfaction is introduced. Environmental satisfaction is gained in two distinct ways: satisfaction from avoiding waste and satisfaction from saving resources for future generations. The recreation value that can be obtained from extrinsic rewards and the influence that convenience has on environmental behavior are explained. Participation is introduced as a way to explain the amount of satisfaction that individuals receive from their environmental behavior. The influence that awareness level has on environmental attitudes and behavior is described. Focus group discussions are introduced as a method of collecting research data. Important characteristics of focus groups are explained.

Finally, decision analysis techniques are described. A formal decision analysis process is very helpful when an analyst is faced with a difficult problem. The formal process is described, then the Decision Programming Language (DPL) software is introduced as an effective aid for conducting the process. The analytic hierarchy process (AHP) is a special decision analysis technique to assist with solving complicated multi-criteria problems. It is explained and the Expert Choice software is introduced which assists with the AHP analysis process. Finally, the group analytic hierarchy process is introduced. The group process is a method of problem solving that involves a number of people rather than one individual decision maker.

Air Force Pollution Prevention

The requirements for the Air Force's pollution prevention program are implemented in Air Force Instruction (AFI) 32-7080, Pollution Prevention Program. The instruction recognizes that pollution prevention necessitates a "proactive and dynamic management approach." Installations are instructed to develop and execute pollution prevention management plans that address the following issues:

- the process required to run a pollution prevention program
- the program required to fund pollution prevention projects

- the road map to achieve Air Force pollution prevention goals
- the actions required to execute the program

The pollution prevention plan must include a management strategy for municipal solid waste.

The AFI also sets forth requirements for a recycling and composting program. Materials that must be recycled include metals, plastic, glass, high quality copier paper, cardboard, and newspaper. Each installation must also either operate a composting program or participate in a regional composting program.

The Air Force's municipal solid waste reduction goal is to reduce the weight of solid waste disposed by 50% by the end of 1997 from a 1992 baseline. Interim goals called for a 10% reduction by 1993 and a 30% reduction by 1996 (AFCEE, 1994:3-17). Each installation must conduct an opportunity assessment on an annual basis to evaluate their waste streams and determine potential areas for reduction.

Municipal Solid Waste Disposal Alternatives

Integrated Solid Waste Management (ISWM) is the "selection and application of suitable techniques, technologies, and management programs to achieve specific waste management objectives and goals" (Tchobanoglous et al., 1993:15). The Environmental Protection Agency (EPA) has developed an integrated strategy which incorporates the following methods: source reduction, recycling, composting, incineration, and landfilling.

Source Reduction is defined by the EPA as "the design, manufacture, acquisition, or reuse of materials to eliminate or minimize the quantity and toxicity of waste produced. Source reduction prevents waste by ... changing patterns of consumption, use, and waste generation." (USEPA, 1994:13) Individuals in a workplace or household can practice source reduction by adopting selective buying patterns and reusing materials. Specific ways to achieve source reduction include:

- Eliminate unnecessary or excessive packaging
- Use products that are durable or easily repaired
- Decrease reliance on disposable, single-use products
- Use fewer resources, such as making two-sided copies (Tchobanoglous et al., 1993:142-143)

Source reduction requires individuals to change habits and daily routines. Source reduction starts with changes in manufacturing processes, distribution practices, and marketing of consumer goods. Individuals practice source reduction through the choices they make in the supermarket and other retail stores. It continues in the household or workplace where specific actions are required that may be perceived as being too inconvenient, such as making draft copies on the unused side of paper or cleaning coffee mugs and reusable containers instead of simply discarding single-use items. Individuals also must realize that source reduction actions may also have a damaging impact on the environment. For example, rinsing multi-use containers requires an increase in water use (USEPA, 1992).

Recycling requires that waste materials be separated and collected; prepared for reuse, reprocessing, or remanufacture; and either reused, reprocessed or remanufactured into another material or product (Tchobanoglous et al., 1993:16). Recycling can occur on-site, when a waste product is reprocessed for further use. One example is the prevalence of solvent recycling machines in industrial shops. Recycling occurs off-site when the waste is collected and transported to another facility where it is transformed into another usable item. Examples of this process include used aluminum cans that are remanufactured into new aluminum cans or used plastic soda bottles that are remanufactured into new lawn furniture.

There are two primary options to separate recyclable material from the rest of the waste stream and collect it for processing. The separation may occur at the source when a household or office uses special designated bins for disposal of recyclable material. Or the separation could occur at a materials recovery facility where recyclable material that is commingled with other refuse is separated and sorted.

When the recyclable material is separated at the source it must be collected and transported to a processing facility. The collection can occur in many different ways, including voluntary drop-off locations, buyback centers where individuals are paid for the recyclable material, commercial collection programs in offices, and residential curbside collection. Methods to encourage participation in these recycling programs range from charging a fee-per-bag for refuse removal to imposing strict fines and penalties for disposing of recyclable material with other refuse.

Separation that occurs at a material recovery facility significantly enhances the ease of use for individual waste generators, however this method has drawbacks as well. A material recovery facility can be very expensive to operate and some potentially recyclable material could become contaminated when it is commingled with other wastes (Tchobanoglous et al., 1993:720).

In order for a potentially recyclable material to actually be remanufactured, a market must exist for the material. Recycling markets fluctuate enormously. Economics play a role in this process. If the value of a particular material is low, some recyclers will stockpile the material until it becomes worth more money. When the value increases, these stockpiles are released on the market, which drives the value down. Government incentives also significantly aid the recycling market. Federal regulation requires that high-grade office paper that is used by government agencies must have a specific percentage of recycled content material. This requirement ensures that paper producers will develop a manufacturing infrastructure that includes provisions for processing recycled paper products.

The aluminum can industry did not need external motivation for creating a recycling infrastructure. In the mid-1960's, the large aluminum producers and manufacturers begun actively promoting aluminum can recycling. The industry has developed collection and processing centers, a transportation network, and reprocessing plants. The industry supports this infrastructure because recycling has become a source of approximately one-third of the domestic requirement for aluminum whereas most of the bauxite required to produce new aluminum must be imported. Also, the energy required to produce a can from recycled aluminum is less than 5% of the energy required to produce the can from raw materials (Tchobanoglous et al., 1993:721).

Composting is considered by the EPA to be a subset of recycling as a method to manage solid waste. However, the composting process is different from the recycling process and will be considered separately. Composting is a natural biological process where organic wastes undergo bacterial and fungal decomposition until a stabilized humus material remains (Tchobanoglous et al., 1993:188). Composting can be accomplished by individual households in a backyard compost bin. An installation-wide composting program can be accomplished with a low-technology turned windrow method or may be a high-technology complex in-vessel system.

A backyard composting bin is an effective way for a household to manage its waste at the source. The bin can be built by the resident, or a bin specially designed for composting can be purchased. The plastic bins available commercially present a neater appearance and help prevent the composting material from attracting pests. Grass clippings, dried leaves, and some food wastes can easily be composted in a backyard bin. The rich humus that results after the compost process is complete can be used as fertilizer in a garden, landscape planting material, or as top dressing for the lawn.

An installation can initiate a low-technology composting operation such as the turned windrow method with a relatively low financial and manpower investment. This method is good for grounds maintenance debris and yard waste such as grass clippings, leaves, and chipped tree limbs. Typical windrows are approximately 8 to 12 feet long and 5 to 8 feet high, although they can be much larger. They should be turned at least once per week which facilitates the natural aerobic decomposition process. This method takes between 3 and 18 months to produce the finished product (Denison and Ruston, 1990:86). The humus material that results from this operation can be used as landfill cover, topsoil for construction projects, or mulch.

A high-technology composting method is the in-vessel system which carefully monitors and regulates temperature, moisture, and nutrient content and which will compost nearly the entire organic fraction of municipal solid waste, including paper products. The composting process takes about 30 to 60 days to complete in an in-vessel system. This method is more expensive than the windrow method, but since the process occurs in an enclosed vessel there are fewer problems with odor control, leachate management, and pests. This method can also compost a larger fraction of the waste stream not only including yard waste, but also household food waste, commercial food processing waste, and food contaminated paper (Denison and Ruston, 1990:88).

Incineration of waste material is used to recover the energy value of the material and to reduce the volume of waste that is ultimately disposed in a landfill. Incineration does not eliminate the need for waste disposal, rather it changes the form and reduces the volume of waste (Liptak, 1991:88).

Incinerators often employ an energy recovery system which offsets operating costs and the cost of air pollution control equipment (Tchobanoglous et al., 1993:623).

The total quantity of energy recovered depends on the Btu content of the solid waste stream that arrives at the facility. Typical Btu values for waste stream components are shown in Table 1.

Table 1. Typical Btu values for waste stream components

Component	**Energy, Btu/lb**
Food wastes	2000
Paper	7200
Cardboard	7000
Plastics	14000
Yard wastes	2800
Glass	60
Tin cans	300
Aluminum	--
Other metals	300

(Tchobanoglous et al., 1993:84)

For energy recovery to be a viable option, the facility must receive a consistent stream of suitable waste fuel (Tchobanoglous et al., 1993:856). Concurrent recycling initiatives in a community with a waste-to-energy facility could be detrimental to a successful operation.

Perhaps the most obvious benefit of incineration is the reduction of waste volume achieved. A reasonable range for volume reduction is 80 to 90 percent by volume relative to the original amount of uncompacted waste. The actual volume reduction experienced varies depending on the combustion efficiency of the incineration process employed and the original composition of the waste stream. The combustion efficiency is affected by operational and design parameters such as waste feed rate, temperature, residence time, and air turbulence (Denison and Ruston, 1990:63).

Refuse-derived fuel production is a specialized incineration process where solid waste is processed to serve as fuel for boilers used to produce steam or electricity. Typically, the refuse-derived fuel is waste that has been sorted to remove the noncombustible portion of the waste, which are metals and glass (Tchobanoglous et al., 1993:749). Then the combustible portion is converted into a uniform, pelletized fuel through particle size reduction. The refuse-derived fuel process decreases incineration residue by 50%, thus reducing the amount of ash that needs to be sent to a landfill if the noncombustable materials are recycled. Refuse derived fuel production is not a popular alternative because it is an expensive and maintenance-intensive alternative to low-technology "mass burning" incineration techniques (Liptak, 1991:95).

Public concern about incineration is centered around the fear of dangerous, uncontrolled air pollution emissions. The most common air pollutants released by incinerators are particulate matter, sulfur dioxide, hydrogen chloride, and nitrogen oxides. Particulate emissions are controlled using electrostatic precipitators or wet scrubbers. Nitrogen oxide emissions are reduced by using techniques such as combustion modification, catalytic decomposition, adsorption, and ammonia injection (Liptak, 1991:191).

The incinerator ash residue is composed of fly ash, heavy bottom ash, partly melted and burned metals, and glass. The ash residue frequently contains heavy metals and dioxins which could cause the disposal of incinerator ash in regular municipal solid waste landfills to be banned. There is considerable economic impact if the ash must be disposed in landfills designed for hazardous waste (Liptak, 1991:96). Public acceptance of the process could also be decreased based on the impression that process is creating toxic waste.

Landfilling is historically the most economical and environmentally acceptable method for disposal of our municipal solid wastes. The other methods in the integrated waste management hierarchy will never reduce waste to zero; there will always be a residual which must be handled (Tchobanoglous et al., 1993:362). The methods used to operate a landfill have evolved along with technology. We no longer dispose of wastes in open or burning dumps (Liptak, 1991:29). The term sanitary landfill refers to "an engineered facility for the disposal of municipal solid waste designed and operated to minimize public health and environmental impacts." (Tchobanoglous et al., 1993:362)

Frequently, there is significant public concern when landfill facilities are proposed for a local area. Concerns about a landfill operation include the uncontrolled release of noxious odors, the uncontrolled release of leachate that could contaminate groundwater or surface waters, and the breeding and harboring of disease vectors in improperly managed landfills (Tchobanoglous et al., 1993:370).

Landfilling was historically the least expensive method available to manage solid waste. The recent enactment of the Resource Conservation and Recovery Act (RCRA) subtitles C and D has made the regulatory requirements for landfill operation stricter and more comprehensive; however, with the exception of certain geographic regions of the United States, most communities continue to find that landfilling is the most cost-effective way to handle their waste.

When the operational costs are computed and tipping fees determined, environmental and social costs are often ignored, which underprices landfills and inhibits the development of other waste management options. Landfills create social impacts such as increased truck traffic, visible air pollution, aesthetic degradation, and limited land utility (Hirshfeld et al., 1992).

Social Value

Effective public policy cannot be formulated without consideration of social value. According to Stern and Oskamp:

> Environmental regulation is a social process as well as a technical one. Regulation cannot be instituted or maintained without continued public support and acceptance, a perception of fairness, and the successful resolution of conflicts of political, economic, and regional interests. (Stern and Oskamp, 1987:1071)

Psychological approaches are useful in solving environmental resource problems because these problems involve human behavior in a central and important way. From a psychological point of view, there are two key questions to consider when investigating an environmental problem:

1. Which actors can make an important difference by ameliorating, exacerbating, or preventing the problem?
2. For each type of actor, which actions have a large impact on the problem?

(Stern and Oskamp, 1987:1049)

Continuing with the suggested terminology, one major actor is the consumer of goods and services with environmental implications. Actions may either affect resources directly, such as throwing away trash; or may indirectly affect resources, such as preventing problems, for example, reducing solid waste by minimizing the use of paper packaging (Stern and Oskamp, 1987:1049).

Environmental managers have often overlooked the crucial role of social and behavioral variables in creating or reducing problems of waste management. Very few "low technology" community recycling programs, such as hand sorting at or near the source of the waste, have been designed with input from experimental research findings or psychological consultants.

A *social marketing strategy* can be applied by government policy makers to encourage the acceptance of public policy by stakeholders. Environmental policy is designed to provide benefits for the stakeholders, however, it also imposes constraints on them. Social marketing is defined as "the design, implementation, and control of programs seeking to increase the acceptability of a social idea, cause or practice in a target group." (Altman and Petkus, 1994:39)

Social marketing can be used by policy makers to minimize the adverse impacts of public policy, which may be real or imagined to be real by the stakeholders. The problem definition should be based on the wants, needs, desires, and interests of the stakeholders. As the policy is further developed, policy makers should actively include stakeholders in the process and determine their specific interests, concerns, and awareness. To minimize uncertainty as the policy is developed and to formulate more effective and efficient policy, survey research and stakeholder analysis can be used (Altman and Petkus, 1994).

Environmental Satisfaction

Environmental managers try to exploit motivational reasons that lead individuals to participate in waste reduction programs. The motivation may come from extrinsic or intrinsic sources. Examples of extrinsic incentives include paying the individual for recycling waste materials, entering recyclers in a lottery with potential rewards, or conducting contests to promote recycling (Porter et al., 1995). Unfortunately, the extrinsic incentives do not promote long-term, enduring changes in behavior (DeYoung, 1986:438). On the other hand, intrinsic motivations are closely associated with satisfactions that individuals derive from behaving in an environmentally responsible manner (DeYoung, 1986:439). Intrinsic satisfactions that have been investigated include satisfaction gained from avoiding waste (DeYoung, 1986:441) and saving resources for future generations (Vining et al., 1992:790).

Satisfaction gained from avoiding waste can also be described as *a good feeling from reducing waste*. Frugality and hard work are distinguishing characteristics of the American culture. Satisfaction from frugality is derived from practices that avoid creating waste and is applied to daily living in areas such as what items we purchase, what activities we undertake, and how we dispose of our waste (DeYoung, 1986:443). A personal source of satisfaction can be derived from the frugal use of ordinary household resources (DeYoung, 1985-86:288).

Saving resources for future generations can be described as *feeling good because you are leaving a good environment for future generations*. Individuals practice environmentally conservative behaviors to save natural resources, such as land, fossil fuel, trees, minerals, and other raw materials, for future generations (Vining et al., 1992:790). The price of products that have excess packaging or that are designed for single use does not reflect the future cost of depleting natural resources. Future generations will have to pay for pollution and waste that is created by the present generation (Bernheim, 1992:957, 959). Future generations may also lose the utility value of an area of land that is used as a landfill for the present generation (Hirshfeld et al., 1992:478).

Recreation Value

Another potential motivation for conservation behavior, particularly recycling, is *feeling good because funds from recycling go to support recreation programs for the* *base.* Research has found that extrinsic rewards are often not successful at maintaining recycling behavior, especially after the reward is discontinued (Porter et.al, 1995:122). However, Air Force installations have the ability to fund base recreation activities with profits from a recycling program. Guidelines for funding base recycling programs and distributing proceeds are provided in AFI 32-7080, Pollution Prevention Program. According to AFI 32-7080, proceeds gained from the sale of recyclable materials must first be used to reimburse operation and management costs for the program, including manpower, equipment, and utility costs. After these costs have been reimbursed, any remaining proceeds can be used for recreation activities. The potential for a lasting, ongoing funding source for recreation may promote recycling behavior beyond the short term programs such as lotteries and contests that are described in the literature.

Convenience

The factors described in the previous two sections are often cited as reasons that individuals practice environmentally conservative behavior. Convenience is a counterbalancing factor that could dissuade conservation behavior. Individuals perceive that recycling is inconvenient and provide this as a reason for not recycling. The inconvenience can be attributed to the time, space, and trouble that it takes to prepare, store, and transport recyclable materials. Incentives, either intrinsic or extrinsic, may not be enough to outweigh the inconvenience (Vining, et.al., 1992:786).

Participation

Research on motivation has found that a good deal of human behavior can be explained in terms of goals and rewards that arise out of active participation in an ongoing activity (DeYoung, 1986:438). Involvement and participation in an activity foster the sense of being needed, of having a chance to influence how things are decided, and are a necessary part of our psychological well-being. Conservation behavior, such as participating in recycling programs or practicing source reduction, gives participants satisfaction from acting in ways that make a difference and from helping to bring order to the world (DeYoung, 1986). Conservation behavior is viewed as an opportunity to participate in a community activity, as a way to make a difference in the long run, and as a way of taking actions which can change the world (DeYoung, 1985-86:288).

Awareness

An important factor in encouraging and increasing environmental conservation behavior is to increase awareness of the consequences of waste management behaviors. Efforts designed to provide information to participants in a solid waste management program help people understand the nature of the environmental problem they are facing, the necessary behavior needed to resolve the problem, and the steps required to carry out this behavior (DeYoung, 1993:487). Techniques that can be used to encourage conservation behavior include altering attitudes and beliefs, identifying attitude-consistent behavior, removing knowledge barriers , and providing feedback (Cook and Berrenberg, 1981:74-75).

If people don't understand the need for conservation behavior or believe in the effectiveness of conservation actions, their behavior may be changed by altering their attitudes and beliefs about conservation behavior. Influential information is provided about the resource problem, the negative consequences of the problem are identified, and recommended conservation actions are identified. The information must come from a credible source and the recommended actions should not deviate too far from existing practices for this technique to be successful (Cook and Berrenberg, 1981:77-78).

Research has shown that the American public is concerned about environmental issues, but their actual pro-environmental efforts do not concur with their environmental worries. There is a large gap between popular attitudes and daily behavior (Roper, 1990:79). Holt studied the environmental attitudes and behaviors of Air Force members and found that pro-environmental attitudes are not strong predictors of pro-environmental behaviors (Holt, 1995:4-8). This phenomenon may be explained by a lack of knowledge about effective conservation actions. Conservation behavior can be encouraged by providing information about the opportunities for such behavior that is consistent with the pro-environmental attitudes. The information should be displayed at the point of the required action and at the appropriate time for the action and it should identify the specific person who is responsible for the action (Cook and Berrenberg, 1981:81).

The previous techniques may be successful in developing an inclination toward conservation behavior, but still not bring about a behavior change. Knowledge barriers such as lack of knowledge of appropriate conservation actions, difficulty of access to conservation actions, and the anticipated negative consequences of conservation actions may prohibit an otherwise conservation-minded individual from practicing the behavior. The amount of conservation behavior is more strongly related to knowledge about the specifics of necessary conservation actions rather than the general knowledge about the environmental problem (Gamba and Oskamp, 1994:590). Individuals must have convenient access and opportunity to take appropriate actions. Finally, individuals often perceive negative consequences to appropriate conservation behaviors, such as the time and trouble it takes to participate in conservation programs (Vining and Ebreo, 1990:58).

Feedback is critical to maintain conservation actions once the actions are started. Feedback can provide individuals with knowledge of their level and rate of resource consumption. It can also be effective in providing cumulative information about benefits of conservation behaviors when the incremental benefits are small and difficult to measure. If a conservation goal has been implemented, feedback is necessary to let the individuals know if they are making satisfactory progress toward the goal (Cook and Berrenberg, 1981:97). A study about the effect of feedback on recycling rates indicated that feedback was successful in increasing paper recycling approximately 77% above baseline levels (Porter et al., 1995:140).

Focus Groups

The focus group is a method of collecting qualitative research data. A focus group is appropriate when the purpose of the research is to determine factors relating to complex human behavior or motivation. Focus groups are successful at bridging "understanding gaps" (Krueger, 1994:44) between professionals or other experts and the general public.

Krueger states the following distinct characteristics which separate focus groups from other methods for collecting research data (Krueger, 1994:16-20).

1. Focus groups typically include 6-10 participants. The size of the group is a careful balance, small enough to give everyone equal chance to provide opinions, yet large enough to provide a range of perceptions.

2. The focus group interviews are conduced in a series of sessions. The researcher cannot rely on one single group interview to provide significant useful data. Experience has shown that three or four sessions covering a single topic area will provide sufficient information.

3. The focus group participants should be people who are similar to each other. The desired common factors can be broadly or narrowly defined, depending on the requirements of the research.

4. Focus groups are used to provide data that can be used by researchers. Their purpose is not to reach consensus or make decisions among alternatives. Focus groups work well

when they are used to determine perceptions, feelings, and manner of thinking with regards to a particular service or opportunity.

5. The qualitative data that is the result of a focus group provides insights into the attitudes, perceptions, and opinions of the participants. The group setting allows participants to influence and be influenced by other members, just as they are in a natural setting.

6. The topics of discussion during a focus group are carefully predetermined and guided with a series of open-ended questions.

One advantage of using focus groups as a method of collecting research data is the socially-oriented nature of the research. People do not live in a vacuum; they are social creatures and are influenced by and make decisions based on the comments and advise of others. The focus group discussion encourages interaction among the members (Krueger, 1994:34).

The participants in a focus group do not have to be selected based on a rigid random selection process. Random selection is often used to make inferences about a larger population. However, the intent of focus groups is not to make inferences, rather it is to understand and provide insights about how people perceive a situation (Krueger, 1994:87).

Focus group results cannot be determined on the basis of conducting just one group discussion. Typically, the first two groups provide a considerable amount of new information, but by the third or fourth session most relevant information has already been covered. Three focus groups is the recommended target (Krueger, 1994:88).

Decision Analysis Techniques

Some decisions are inherently difficult to make, so a structured decision analysis approach to the problem may help the decision maker. Clemen has identified four basic reasons that make a decision difficult: (Clemen, 1991:2-3)

1. A decision can be hard because of its complexity.
2. A decision can be difficult because of the inherent uncertainty in the situation.
3. A decision maker may be interested in working toward multiple objectives, but progress in one direction may impede progress in others.
4. A problem may be difficult if different approaches to the problem lead to different conclusions.

Good decision analysis begins with careful analysis of the problem. A common error is treating the wrong problem. After the right problem is determined, the relevant objectives and alternatives must be identified. Objectives are the important things that are influential to the decision. The alternatives are the different solutions that are available for the problem. Then the problem can be decomposed to further understand the problem structure. At this point, it is beneficial to create a representation of the decision problem using an influence diagram or decision tree. The decision maker then can consider the elements of uncertainty in the different parts of the problem. Sensitivity analysis can be performed to determine if small changes to one aspect of the problem changes the optimal decision. The entire process is an iterative one and should continue if new objectives or alternatives are identified, if the model structure changes, or if the models of uncertainty and preferences need to be changed (Clemen, 1991).

The influence diagram is a simple graphical representation of a decision problem. Each element of a decision problem including the decisions to make, uncertain events, and the value of outcomes are shown on an influence diagram as different shapes. A computer software program, such as Decision Programming Language (DPL), can assist the decision maker with structuring and solving complicated decision problems.

Decision Programming Language (DPL) is a decision analysis software program to facilitate the accurate structuring of a complicated decision problem. Traditional influence diagrams are simple to build in DPL. The analyst can define the elements of the problem and the relationships among the elements. Data such as probabilities and values can be entered. When the influence diagram is properly structured, the program can be used to determine the optimum decision policy. Value sensitivity comparison can then be performed to determine the relative impacts of changes to different values in the model on the decision policy outcome. A sensitivity comparison is called a tornado diagram. The tornado diagram is used to determine which variables in the model warrant further detailed analysis (DPL, 1995).

The Analytic Hierarchy Process (AHP) was designed by Thomas Saaty in the 1970's and is a decision analysis technique with logical and scientific foundations yet recognizes that decisions are dependent on a creative formulation process (Harker, 1989:4). The overall philosophy of the AHP is to provide a scientific method to aid in the creative formulation and analysis of a decision problem.

The process is based on three fundamental ideas (Kloeber, 1992:2):

1. A human is good at making accurate, relative comparisons between two subjects or alternatives.

2. All important problems are essentially multiple criteria problems that have some kind of inherent hierarchical structure.

3. The accurate pairwise comparisons can be consistently combined within the hierarchical structure to yield the best alternative or to rank the available alternatives.

Conducting decision analysis using AHP requires two basic tasks: formulating the problem as a hierarchy and eliciting judgments in the form of pairwise comparisons. The hierarchy is constructed with the overall goal at the top level. The criteria that must be considered when making the decision are represented on the next level. Any or all of these criteria may have sub-criteria represented below them. Finally, all alternatives are identified at the bottom level of the hierarchy. Pairwise comparisons are made between each of the criteria and between each of the alternatives with respect to each of the criteria. The pairwise comparisons can be combined using an approximation to an eigenvector to yield scores for the alternatives within a criterion and the weights of the criteria within the hierarchy (Kloeber, 1992:2).

The decision process is made easier for decision makers when it is broken down into a series of pairwise comparisons. However, it is still difficult for individuals to be perfectly consistent when making comparative judgments, especially when the judgments deal with intangibles and have no quantitative scale of measurement. The AHP recognizes this and an inconsistency ratio (IR) can be determined for each set of pairwise comparisons. An IR equal to zero indicates perfect consistency. A general rule of thumb is that an IR up to 0.1 is acceptable. An IR greater than 0.1 indicates that the judgments should be reconsidered (Expert Choice, 1995:115).

Expert Choice is a decision support software program to facilitate the construction of decision hierarchies and the analysis of pairwise comparisons. A hierarchy can be built that indicates the ultimate goal, the relevant criteria, any sub-criteria, and the decision alternatives. The numerical pairwise comparisons can be entered and the weights are then easily determined. The program also indicates the inconsistency ratio so the analyst can determine if the comparisons need to be reconsidered.

The software is sophisticated and user-friendly. It summarizes all the required comparisons for the defined criteria and works out the synthesis over all the criteria. The software also ranks the alternatives based on the comparisons provided (Carlsson and Walden, 1995:25).

Group Analytic Hierarchy Process has evolved because a shift in organizational decision-making to frequent group decision-making meetings. The AHP is an effective tool to aid in the group decision-making process. Three key areas in the group decision-making process with AHP are: assembling the group, running the decision-making session, and implementing the results (Saaty, 1989:59).

Complex decisions with high uncertainty often necessitate the participation of many individuals in a group decision-making process. In some cases there is a pre-existing group that can effectively solve the problem, otherwise the members of the group must be carefully selected. The group should be a mix of experts, non-experts, staff personnel, and upper-level managers; however, if powerful members of the organization are included, they may implement their own preferred solution without considering the observations of other members of the group. One way of dealing with this situation is include participants in the group who have equal responsibility and stature within the organization (Saaty, 1989:60).

After the group is assembled, the members should formalize their agenda and define the purpose of the decision-making session. Following are several questions that will help set the ground rules for a group decision-making session: (Saaty, 1989:60)

- Is the purpose of the session simply to improve the group's understanding of an important problem?
- Is the purpose to reach a final solution to the problem?
- Are the participants committed to generating and implementing a final solution?
- What is the best way to combine judgments of the participants on various issues in order to produce a single group judgment?

Before the actual decision-making process begins all group members should be in agreement about the purpose they are working toward.

When the ground rules are understood and agreed upon by all the group members, they can proceed with the decision-making process. First, they should construct the hierarchy that best represents the problem. The hierarchical structure helps the group focus on each aspect of a complicated decision problem and take all relevant aspects into consideration (Saaty, 1989:61).

After the hierarchy is defined, the group members can complete the pairwise comparisons for each level of the problem. The group can either use individual judgments and have each member complete the required comparisons, or the group can reach a consensus vote and have one set of comparisons that represents compromise of the group. If the group uses individual values, they can be combined by using the geometric mean of the individual judgments to obtain the group judgment. The geometric mean is the appropriate rule for combining judgments because it preserves the reciprocal property in the combined pairwise comparisons (Saaty, 1989:63).

When the group arrives at an acceptable decision, it must then be implemented. The implementation will be more successful if all group members accepted and believed in the efficacy of the group decision-making process. The AHP is not a tool for one-time, isolated decisions, but must be viewed by the group as a process that has ongoing validity and usefulness (Saaty, 1989:66).

III. Methodology

Introduction

This chapter presents a methodology for including social values that influence conservation behavior in a decision analysis model that determines the combination of solid waste management techniques that maximize the individuals' willingness to participate in the solid waste management program. The social values used in the decision analysis model were described in the review of the literature. The methodology used in this research consisted of three distinct parts: 1) the focus group method of collecting data was determined to be the best method to obtain inputs about social value measures from the individuals who participate in the solid waste management program; 2) a questionnaire was developed that used a series of pairwise comparison questions that could be analyzed using the analytic hierarchy process to determine the preferences of the individuals; 3) and finally, the decision analysis problem was broken down into decisions and values and structured using an influence diagram to present the individual problem components and their influences on the final outcome.

Obtaining Inputs About Social Value Measures

The social value factors that will be included in this model are:

1. Convenience
2. The good feeling from reducing waste

3. The good feeling from leaving a good environment for future generations, and

4. The incentives for recycling because profits can be used to fund recreation activities.

These values can only be determined from directly questioning individuals who participate in the solid waste management program. They are difficult for the decision maker to either estimate or assume. Focus group discussions provide an effective means to obtain direct input for each of the values from random individuals.

Separate focus groups were held for base workers and residents in military family housing because motivations for practicing environmentally conservative behaviors are likely to be different in the two settings (Lee and DeYoung, 1994:69). The participants representing base workers were recruited from the membership of the unit environmental committee and the facility manager's list. Members of both of these groups were chosen because they have a basic environmental knowledge, are more likely to participate in a discussion on the subject matter, and are aware of their co-worker's solid waste disposal practices and willingness to participate in current environmental programs. The participants representing military family housing residents were recruited from a list of randomly selected family housing residences. Each selected resident was sent a letter informing them that they may be contacted to participate in the focus group discussion. The letter is included in Appendix A.

Potential participants were contacted by telephone, briefly introduced to the nature of the research and purpose of the group, and asked if they were interested in participating in the discussion. The script used by the researcher is included in Appendix

B. A log of each phone call placed is included in Appendix C. If the researcher reached a voice-mail recording when placing a call, typically, no message was left because of the detailed nature of the script.

Each individual who agreed to participate in a discussion was scheduled for a session. In most cases, a letter was mailed to the participant to serve as a reminder of the meeting and reinforce the importance of attending the meeting. An example of the letter is included in Appendix D. Before the scheduled meeting, the researcher called most scheduled participants to give a final reminder of the meeting.

Twelve focus group meetings were conducted. Six meetings were attended by base workers and the discussion was directed toward workplace issues. Six meetings were attended by family housing residents and the discussion was directed toward household issues. Table 2 presents a summary of the members who attended each session and topic addressed by the group. Of the six meetings for base workers, the specific topic of four of the meetings was paper products that are used in the workplace. Studies conducted by the EPA have shown that paper products comprise the largest percentage of the solid waste stream for federal facilities. The specific topic of the other two meetings for base workers was the usage of plastic, glass, and aluminum in the workplace. These materials are similar because of the nature of their use as packaging material. Of the six meetings for housing residents, the specific topic of three of the meetings was the disposal of plastic, glass, and aluminum in the household. These materials are often used as packaging for food and beverages and are likely to be handled in a uniform manner by

Table 2. Summary of focus group sessions

Session	Members	Topic
1	Base Workers	Paper
2	Base Workers	Paper
3	Base Workers	Plastic, Glass, Aluminum
4	Housing Residents	Plastic, Glass, Aluminum
5	Base Workers	Plastic, Glass, Aluminum
6	Housing Residents	Paper, Yard and Food Waste
7	Base Workers	Paper
8	Housing Residents	Plastic, Glass, Aluminum
9	Housing Residents	Plastic, Glass, Aluminum
10	Housing Residents	Paper, Yard and Food Waste
11	Base Workers	Paper
12	Housing Residents	Paper, Yard and Food Waste

individual housing residents. The specific topic of the remaining three meetings was the disposal of paper, yard wastes, and food wastes in the household. These materials are all organic in nature and could potentially be composted, either in a backyard compost bin or a large scale industrial-type composting operation. Composting was included as a waste management option in these group discussions and in the questionnaires completed by the group members.

Each of the meetings followed the same format according to the script in Appendix E. The participants introduced themselves and the researcher proceeded to provide background information about the solid waste disposal problem that is the basis for this research. The available methods for solid waste management, which are source reduction, recycling, composting of yard and food waste, incineration, and landfilling were each introduced and generally defined. Group members were encouraged to provide their own ideas and inputs about each of the methods. The inputs were recorded on a chart so all group members could refer to them as needed.

After the discussion was completed, the social value factors were introduced. Each group member was provided with a written definition of the factors so there would be no ambiguity about their meaning. The written definitions are shown in Appendix F. Next, the questionnaire was administered. The entire questionnaire is included in Appendix G. It is divided into five parts, and was administered one part at a time. Each part was briefly explained before the members completed it. If any of the members had questions, they were addressed. When all members had completed the questionnaire, further discussion was encouraged. Members were asked to provide any other factors that determine why a particular waste management option may be used. At the end of the meeting, members were given the opportunity to provide written comments about the discussion group meeting.

Measuring Individual Preferences

The questionnaire was designed to generate quantitative data that could be analyzed through the analytic hierarchy process (AHP) to determine the preferences of the individuals who participate in the installation's waste management program. AHP was chosen as a method of analysis because of its ability to break a complex decision problem into a series of paired comparisons of objects with respect to a common goal or set of criteria (Harker, 1989:5). The questionnaire was divided into the following five parts: comparing criteria, convenience, feeling good about reducing waste, feeling good because you are leaving a good environment for future generations, and feeling good because funds from recycling go to support recreation programs on base or in military family housing. Each question was structured in the form of a pairwise comparison. The respondent chose the most important or preferred choice from two options, then indicated how much more important or preferred the choice was. Figure 1 shows the generic scale for measurement of importance or preference.

Numerical Value	Definition
1	Equally important or preferred
3	Slightly more important or preferred
5	Strongly more important or preferred
7	Very strongly more important or preferred
9	Extremely more important or preferred
2,4,6,8	Intermediate values to reflect compromise

Figure 1. Analytic Hierarchy Process Measurement Scale (Harker, 1989:9)

The specific numerical value scales presented in each part of the questionnaire did not include the intermediate values. They were omitted for the purpose of clarity and understandability. If a respondent asked about the option of using the intermediate values, they were told the values could be used.

For each group, a representative value for each pairwise comparison was determined by calculating the geometric mean of the responses. The geometric mean is an effective method of combining judgments because it preserves the reciprocal property in the combined pairwise comparisons (Saaty, 1989:63). Then the analytic hierarchy process was implemented with the Expert Choice software package to determine the appropriate overall weight for each of the criteria, and, with respect to each criterion, the appropriate weight for each of the waste management techniques.

Possible pairs. AHP does not require that all possible pairs be compared to determine the appropriate scores or weights. For example, if four criteria, *a, b, c,* and *d,* are being compared, there are 16 possible combinations of pairs. The possible combinations include redundant combinations, for example "compare *a* to *b*" and "compare *b* to *a*". AHP assumes that such combinations are reciprocal, if *a* is slightly more preferred than *b*, the value for *a* vs. *b* is 3 (see Figure 1) and the value for *b* vs. *a* is 1/3. If *n* is the number of alternatives under consideration, to completely fill in the matrix a total of $n(n-1)/2$ comparisons should be completed (Harker, 1989:15).

Comparing criteria. The questions in the first part were intended to determine the overall importance of each of the criterion--convenience, feeling good about reducing waste, feeling good because you are leaving a good environment for future generations, and feeling good because funds from recycling go to support recreation programs on base or in military family housing. Following is an example of the pairwise comparison questions in this part.

> **1. Which is more important to you?**
>
> a. convenience
>
> b. feeling good about reducing waste
>
> **How much more important is it?** ____________

The results of the analysis of the responses from this series of questions are used in the model to calculate the willingness to participate in a specific strategy of waste management techniques.

Convenience. The questions in the second part of the questionnaire were intended to determine which solid waste management technique was preferred if the only consideration was convenience. Three waste management techniques were compared: source reduction, recycling, and throwing waste in the trash. Throwing waste in the trash encompasses both incineration and landfilling because the action of throwing waste in the trash by an individual is the same whether the trash goes to an incinerator or a landfill. The focus groups that covered the topic of family housing paper, yard waste, and food waste included composting as a waste management technique in addition to source reduction, recycling, and throwing waste in the trash. Following is an example of the pairwise comparison questions in this part:

7. Which one of the following methods is more convenient?

a. source reduction

b. recycling

How much more convenient is it? __________

The results of the analysis of the responses from this series of questions are used in the model to calculate the value of a waste reduction method with respect to convenience.

Feeling good about reducing waste. The questions in the third part of the questionnaire were used to determine which solid waste management technique was preferred if only feeling good about reducing waste was considered. Each of the solid waste management techniques were included in the pairwise comparison questions. Following is an example of the pairwise comparison questions in this part:

11. Which of the following methods gives you more of a good feeling about reducing waste?

a. source reduction

b. incineration

How much more of a good feeling do you
get about reducing waste by using this method? ____________

The results of the analysis of the responses from this series of questions are used in the model to calculate the value of a waste reduction method with respect to feeling good about reducing waste.

Feeling good because you are leaving a good environment for future generations. The questions in the fourth part of the questionnaire were used to determine which solid waste management technique was preferred if only feeling good because you are leaving a good environment for future generations was considered. Each of the solid waste management techniques was included in the pairwise comparison questions. Following is an example of the pairwise comparison questions in this part:

20. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. recycling

b. landfilling

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? ________

The results of the analysis of the responses from this series of questions are used in the model to calculate the value of a waste reduction method with respect to feeling good about leaving a good environment for future generations.

Feeling good because funds from recycling go to support recreation programs on base or in military family housing. The questions in the fifth part of the questionnaire were used to determine what level of recreation programs would be preferred to encourage recycling. The recreation program options that were compared are: receiving shrubs, flowers, and landscaping material to beautify my work building; receiving a luncheon for my work area; having a picnic shelter constructed near my work building; and having a better park and athletic facilities on base. Following is an example of the pairwise comparison questions in this part:

23. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. receiving shrubs, flowers, and landscaping material to beautify my home

b. having a better park and athletic fields for my family

How much more of a good feeling about recycling does this program provide? __________

The results of the analysis of the responses from this series of questions are used in the model to calculate the value of a waste reduction method with respect to recreation programs.

Structuring the Problem

An effective method for structuring a problem is to break it down into individual components and present these components graphically in such a way that the influences of one component on another are clearly shown. This representation of a problem is known as an influence diagram (Clemen, 1991:34). An accurate influence diagram can only be achieved with careful, thorough, analysis of the problem. The influence diagram in this thesis is presented from the point of view of the decision maker, in this case, the installation environmental manager (EM).

The EM wants to design a solid waste management program that will achieve the highest possible willingness to participate from the individuals using the program. Social value factors that influence willingness to participate include convenience, feeling good about reducing waste, feeling good about leaving a good environment for future generations, and recreation incentives that can be funded from profits from the sale of recyclable material. Figure 2 shows the influence diagram to determine the solid waste management strategy that will provide the maximum willingness to participate, which is an indication of maximized social value for the participants.

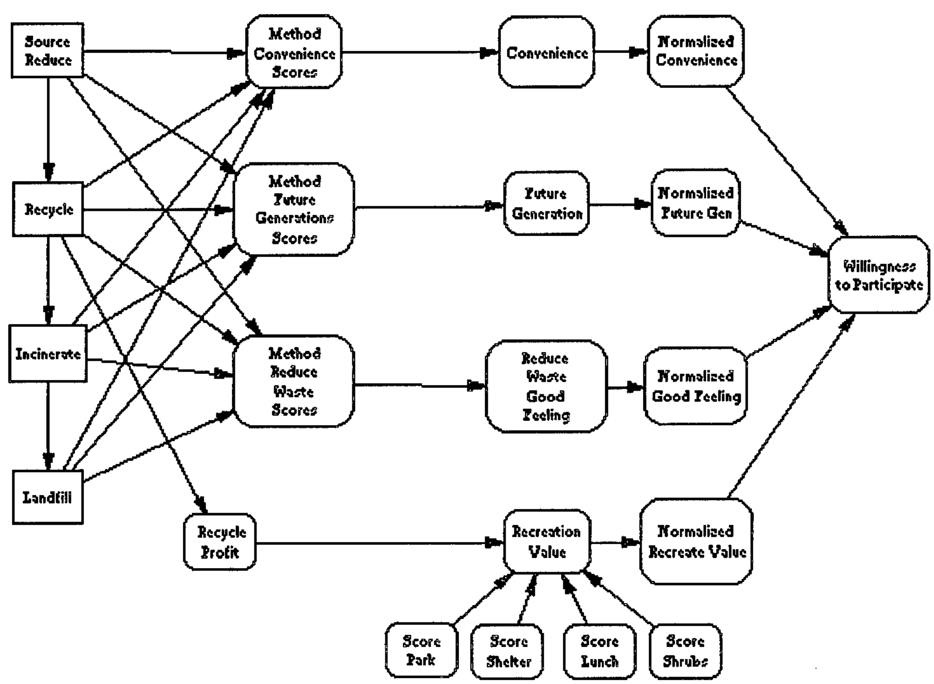


Figure 2. Influence Diagram

This model allows for certain categories of discarded material to be considered separately, depending on the method scores that are input by the analyst. By considering materials separately, a comprehensive solid waste management program can be tailored to the differences in materials. For example, the convenience for an individual to recycle paper may be higher than the convenience to recycle plastic, glass, and metal. The separate models allow for this differentiation among materials.

For base workers, the model analyzes paper or plastic, glass, and metal. Paper is ubiquitous in the workplace and comprises a large portion of the solid waste stream for federal facilities. Plastic, glass, and metal are typically used as containers or packaging and are traditionally handled and discarded in the same manner.

For housing residents, the model analyzes paper, yard waste, and food waste or plastic, glass, and metal. Paper is considered along with yard waste and food waste because all these materials are organic and can be easily composted. The decision to be made is how much of the particular material should be managed with each of the possible waste management techniques - source reduction, recycling, incineration, or landfilling. Composting is considered for housing paper and yard and food waste.

The decision to source reduce can be either 0 or 10%. The Environmental Task Force projects that up to 10% of waste can be reduced at the source (Boerschig and DeYoung, 1993:21). Base workers and family housing residents can make a conscientious effort to reduce the amount of material they use, but only to a limited extent. Source reduction is a viable technique for each of the waste materials.

The decision for the amount of material to recycle depends on the type of material that is being recycled. Tchobanoglous reports recovery factors for source-separated recycled materials as shown in Table 3.

Table 3. Recovery factors for source separated materials

	Percent Recovery	
Material	**Range**	**Typical**
Mixed Paper	40 to 60	50
Cardboard	25 to 40	30
Mixed Plastics	30 to 70	50
Glass	50 to 80	65
Tin Cans	70 to 85	80
Aluminum Cans	85 to 95	90

(Tchobanoglous, 1993:584)

For plastic, glass, and aluminum, the decision to recycle will range from zero to 70%. For paper, the decision to recycle will range from zero to 50%.

The amount of paper, yard waste, and food waste that can be composted ranges from zero to 40% for the residential portion of the installation. The EPA reports a recovery percentage range of 20% to 33% for yard waste and 31% to 38% for paper and paperboard products (USEPA, 1990:69).

The decision to incinerate ranges from zero to 70% and the decision to landfill ranges from 20% to 70%. Even the most efficient waste diversion programs will still leave some waste products that must be sent to a landfill, such as solid wastes that cannot be recycled and that are of no further use, the residual matter remaining after solid wastes have been separated for recycling, and the residual matter remaining after the combustion process (Tchobanoglous, 1993:16). A constraint function is built into the model which prevents more than 100% of any material being selected for the overall waste management strategy (DPL, 1995:211).

The value of convenience is influenced by the percentage of each waste management technique that is targeted for a particular material. Source reduction, recycling, and incineration have potentially different levels of convenience associated with them. The convenience for incineration and landfilling are the same, since the individual waste generator only has to discard the waste in the trash. There is no difference at that point whether the material goes to an incinerator facility or a landfill.

Each of the waste management methods has a convenience score, which was determined by analyzing the pairwise comparisons from the questionnaire. The value for convenience is a linear combination of the product of the percentage of the waste that is managed by each method and the convenience score for that method. The equation for convenience is shown in Equation 1.

$$\begin{aligned}\text{Convenience} = {} & (\text{Source Reduce} * \text{Score Source Reduce Convenience}) \\ & + (\text{Recycle} * \text{Score Recycle Convenience}) \\ & + (\text{Incinerate} * \text{Score Incinerate Convenience}) \\ & + (\text{Landfill} * \text{Score Landfill Convenience}) \qquad (1)\end{aligned}$$

Since the base worker or the housing resident does not perceive a difference in convenience for incineration and landfilling, the convenience scores for these methods are the same.

The values for both the good feeling from reducing waste and the good feeling from leaving a good environment for future generations are influenced by the percentage of each waste management method that is targeted for a particular material. Each method could potentially have a different influence on these two values, and has a score that was determined by analyzing the pairwise comparisons from the questionnaire.

The value for feeling good from reducing waste (reduce waste) is a linear combination of the product of the percentage of the waste that is managed by each method and the reduce waste score for that method. The equation for reduce waste is shown in Equation 2.

$$\begin{aligned} \text{Reduce Waste} = & (\text{Source Reduce} * \text{Score Source Reduce Reduce Waste}) \\ & + (\text{Recycle} * \text{Score Recycle Reduce Waste}) \\ & + (\text{Incinerate} * \text{Score Incinerate Reduce Waste}) \\ & + (\text{Landfill} * \text{Score Landfill Reduce Waste}) \end{aligned} \tag{2}$$

The value for feeling good from leaving a good environment for future generations (future generations) is a linear combination of the product of the percentage of the waste that is managed by each method and the future generations score for that method. The equation for future generations is shown in Equation 3.

Future Generations = (Source Reduce*Score Source Reduce Future Generations)

+ (Recycle*Score Recycle Future Generations)

+ (Incinerate*Score Incinerate Future Generations)

+ (Landfill*Score Landfill Future Generations) (3)

The previous three values will have a minimum numerical value of zero, and a potential maximum value that is less than 1. The values will be normalized in the model by dividing the actual value by the potential maximum value resulting in scores possibly ranging from 0 to 1. Normalizing the values facilitates performing a linear combination with the values later in the model.

The value of recreation incentives that can be funded from profits from the sale of recyclable material is influenced only by the percentage of material that is targeted for recycling. Two materials generate a profit for the recycling program -- paper and aluminum (Williams, 1996). The percentage of these materials that are recycled will determine the total profit that can be used for recreation programs and the level of program that will be provided. By analyzing the responses from the questionnaire, a recreation value score can be determined for each of the program levels that could be provided. Table 4 shows the correspondence of recycling level to potential recreation program, the estimated cost of one unit of each recreation program, and how many units would be needed to provide the program for the entire base.

Table 4. Recycling levels and associated recreation program costs

Recycling Level	**Recreation Program** (Base/Housing)	**Program Cost per Unit** (Base/Housing)	**Total Units Needed** (Base/Housing)
10 - 20%	Shrubs, Landscaping Material	$150/ 100	1000/ 2365
30%	Luncheon for workers/ Child Care for residents	500/ 500	700/ 95
40%	Picnic Shelter	10000/ 10000	500/ 10
50 - 70%	Park and Athletic Field	100000/ 100000	1/ 1

The value for recreation depends first on the level of recycling that will be accomplished for the material. The total profit received from recycling at this level will determine the percentage of the base that can receive the recreation program. The overall recreation value is calculated as the product of the percentage of the base that can receive the recreation program and the score received by that recreation program. A normalized recreation value is determined by dividing the overall recreation value by the potential maximum recreation value.

In the review of relevant literature covering the topic of social value, two key questions were identified that must be considered when investigating an environmental problem with the recognition that social value must be taken into account. The questions are:

1. Which actors can make an important difference by ameliorating, exacerbating, or preventing the problem?

2. For each type of actor, which actions have a large impact on the problem?
(Stern and Oskamp, 1987:1049)

It has been shown in this discussion that one major actor is the consumer of goods and services. In the context of this research, the actor is either the worker on base or the family member who lives in military housing. We have seen that the actions are either direct, such as throwing away trash; or indirect, such as source reduction techniques. In the context of this research, the action is the actor's participation in a particular solid waste management method, whether it be the conscientious effort to separate appropriate materials for recycling or the almost habitual reflex to throw away material that is no longer useful. Therefore, the assumption upon which this model is based is that the willingness to participate in any proposed strategy of waste management techniques is a good measure of the social value that the participants receive from that strategy.

The willingness to participate in a waste management program is determined by the program's convenience, how much of a good feeling a participant will get from reducing waste, how good a participant feels about leaving a good environment for future generations, and the recreation value provided because recycling profits can be used to fund recreation activities. Equation 4 shows the calculation for willingness to participate.

$$\begin{aligned}\text{Willingness to Participate} = {} & (\text{Convenience Weight*Normalized Convenience}) \\ & + (\text{Reduce Weight Weight*Normalized Reduce Weight}) \\ & + (\text{Future Generations Weight*Normalized Future Generations}) \\ & + (\text{Recreation Value Weight*Normalized Recreation Value}) \qquad (4)\end{aligned}$$

Further Detailed Analysis. The scores and weights were included in the influence diagram as known values. The single value was determined by finding the geometric mean of the individual responses from the questionnaires and using the analytic hierarchy process to determine the appropriate score or weight. This method does not take into account the potential for variability in the individuals' preferences. The scores and weights would be more accurately modeled as a distribution of possible values rather than one discrete value. This is know as modeling with uncertainty.

Before all the variables are modeled with uncertainty, it is useful to determine which variables have the greatest influence on decision outcome. Sensitivity analysis helps the analyst determine which variables matter in the decision. Insight about the important variables guides further analysis so that effort is not wasted by studying variables that will not change the decision. One sensitivity analysis technique is a tornado diagram, which shows how much the value of an alternative can vary with changes in a specific value (Clemen, 1991:116). All the scores and weights in the model can be evaluated in a tornado diagram to determine which variables warrant further uncertainty analysis.

The first step taken in the data analysis was to find the geometric mean of each of the questionnaire responses. After the sensitivity analysis is performed, a determination can be made as to which scores and weights should be modeled with more detail. For this part of the analysis, each set of questionnaire responses is analyzed individually. The criterion weights and method scores are determined for each individual who completed the questionnaire.

Now, instead of having one value for the score or weight that represents the entire group, there is a range of values that represents the individual preferences. This range of values can be modeled with a probability distribution, e.g., a triangular distribution or a uniform distribution. The uncertainty can be represented in the influence diagram and the decision analysis conducted again.

The result of the decision analysis process is a decision strategy that yields the maximum value for willingness to participate. This resulting value is unitless and can only be compared to other willingness to participate values generated with the same model. The resulting decision tree can be reviewed to determine the magnitude of the difference in value of willingness to participate for other decision strategies relative to the optimum decision policy. A decision policy may have a slightly lower willingness to participate, but could be more attractive for other reasons.

IV. Analysis and Findings

Introduction

The purpose of the decision analysis process developed in this research is to provide the Environmental Manager with an effective means of identifying which solid waste management strategy will provide the highest willingness to participate from the people using the program. The strategy that maximizes willingness to participate will give the participants the highest social value. The initial phase of the analysis process was to use the analytic hierarchy process (AHP) to determine the criteria weights and scores for each alternative with respect to the criteria. The AHP analysis was facilitated by using the Expert Choice software program (Expert Choice, 1995). Then, to identify the optimum decision and provide more insight about the potential range of decisions, a quantitative analysis of the decision support model was performed. This analysis was facilitated by using the DPL software program (DPL, 1995).

Values used in this analysis were obtained from research conducted at Wright-Patterson AFB. The members of the focus group discussions were either individuals who work on base or residents in military family housing. The data for profit from a recycling program was based on information from the Wright-Patterson AFB Environmental Management office.

Four separate decision models were developed for this research. This chapter will describe the analysis process for each of these models individually. The decision analysis models that will be described are:

1. Base workers for the category of plastic, glass, and aluminum management.
2. Base workers for the category of paper management.
3. Military family housing residents for the category of plastic, glass, and aluminum management.
4. Military family housing residents for the category of paper, yard waste and food waste management.

The complete analysis process included determining criteria weights and scores for each method with respect to the criteria, conducting an initial decision analysis, performing value sensitivity comparison, modeling the identified important variables with uncertainty, reconducting decision analysis, and determining if there are any dominant decision strategies.

Base Workers / Plastic, Glass, and Aluminum

Two focus group sessions, Group 3 and Group 5, were held with base workers to discuss the topic of plastic, glass, and aluminum waste management. The proceedings from the discussion in each of these meetings are included in Appendix H. A total of eight base workers participated in these two group discussions. For the first phase of the analysis, the individual questionnaire responses were combined by calculating the geometric mean of the responses for each questionnaire item. The geometric mean of the responses for each question was considered to be a representative value for the group. The geometric mean method is commonly used to combine the responses of members when each member has an equal say in forming the group opinion (Ramanathan and Ganesh, 1994:252). The raw questionnaire responses and the geometric mean for each question are included in Appendix I.

The aggregated questionnaire responses were evaluated using the analytic hierarchy process (AHP). The Expert Choice software program was used to perform the AHP evaluation. The result of the evaluation was a set of weights and scores that represents the preferences of each group as a whole. Each social value measure, or "criterion", has a weight which is an indication of how important the social value measure is to the group. A set of scores was generated for each waste management method with respect to each criterion. The scores indicate which waste management method is preferred if only one criterion is considered at a time. The value of each score or weight could range from zero to one, and the sum of the values for each set of individual weights scores with respect to each criterion will be one. A higher score or weight indicates higher preference or importance. The weights and scores for the two groups of base workers who discussed plastic, glass, and aluminum management are shown in Tables 5-9.

Table 5. Criteria weights for base workers for the category of plastic, glass, and aluminum

Group	Convenience	Future Generations	Reduce Waste	Recreation Value
3	.233	.394	.218	.155
5	.207	.427	.252	.115
Value Used in Analysis	.220	.411	.235	.135

Table 6. Scores with respect to convenience for base workers for the category of plastic, glass, and aluminum

Group	Source Reduce	Recycling	Incineration	Landfilling
3	.084	.117	.399	.399
5	.192	.093	.357	.357
Value Used in Analysis	.138	.105	.378	.378

Table 7. Scores with respect to future generations for base workers for the category of plastic, glass, and aluminum

Group	Source Reduce	Recycling	Incineration	Landfilling
3	.292	.512	.152	.045
5	.227	.548	.130	.094
Value Used in Analysis	.260	.530	.141	.070

Table 8. Scores with respect to reduce waste for base workers for the category of plastic, glass, and aluminum

Group	Source Reduce	Recycling	Incineration	Landfilling
3	.323	.487	.145	.045
5	.278	.509	.149	.064
Value Used in Analysis	.301	.498	.147	.055

Table 9. Scores with respect to recreation value for base workers for the category of plastic, glass, and aluminum

Group	Shrubs	Luncheon	Picnic Shelter	Park
3	.404	.054	.201	.340
5	.399	.082	.259	.259
Value Used in Analysis	.402	.068	.230	.300

The mean value between each of the weights and scores was computed and then used in the decision support model to determine the decision strategy of solid waste management methods that would maximize willingness to participate. This step of the decision analysis process was facilitated by using the DPL software program. DPL determines an expected value using a process similar to rolling back a decision tree (DPL, 1995:178). The expected value is the highest value of the potential outcomes (Clemen, 1991:70).

The result of this portion of the analysis is the following decision strategy for base workers for the management of plastic, glass, and aluminum waste: source reduce 10%, recycle 70%, incinerate 0%, and landfill 20%. This strategy has an expected value equal to 0.875. This value is unitless and can only be compared to other expected values generated with the same model.

The next step of the analysis process is to perform a value sensitivity comparison to determine which variables have the greatest influence on the decision outcome. A tornado diagram shows how much the value of an alternative can vary with changes in a specific value (Clemen, 1991:116). The DPL software program can generate tornado diagrams for values in the decision analysis model. The weights and scores in the model for base workers for the category of plastic, glass, and aluminum management were allowed to vary between the values calculated for the two groups. These values were shown above in Tables 5-9. Each of the values has an equal likelihood of uncertainty because they were each determined with the same questionnaire. The tornado diagram is included in Appendix J. Review of the tornado diagram indicates that changes in the following variables produce the highest change in the decision outcome and warrant further uncertainty analysis:

- Score for park
- Score for recycling with respect to future generations
- Weight of convenience
- Score for landfilling with respect to future generations
- Score for recycling with respect to convenience
- Score for recycling with respect to reduce waste
- Score for source reduction with respect to future generations
- Score for source reduction with respect to convenience.

These variables are considered "important variables".

For the initial analysis, the scores and weights were determined by finding the geometric mean of each of the questionnaire responses. However, the questionnaire responses actually fall within a range, based on the preferences of the individuals who participated in the group discussions. To determine this range, each set of questionnaire responses was analyzed individually using the Expert Choice software program. The result of this analysis was eight sets of scores and weights that represent the range of preferences of the individual group members.

The values for the important variables can be modeled with a statistical distribution. The set of data available is small -- there are only eight values in the set, so a conservative distribution should be used. The uniform distribution is conservative and represents an equal chance of any value between the minimum and maximum occurring (DPL, 1995:417). The uniform distribution will be used to model the values for the scores and weights that warranted further uncertainty analysis.

The next step in the analysis process was to revisit the decision support model and change the model to reflect the statistical distributions of the important variables. The decision strategy that maximizes willingness to participate can be determined again, and more detailed comparison can be made between different decision strategies to determine if one strategy dominates another strategy. This determination can be made by studying the cumulative risk profile, which is a graph of value of the outcome vs. the chance that the value of the outcome is less than or equal to that value. If one strategy has a higher value than another over the entire range of chance, that strategy is said to have deterministic dominance (Clemen, 1991:88). If the cumulative risk profiles do not cross and there is always space in between them, the profile that is farthest to the right has stochastic dominance over the profiles for other strategies (Clemen, 1991:91).

The result of performing the analysis with uncertainty is a set of decision strategies that can be compared and evaluated by reviewing the cumulative risk profiles for each strategy. Table 10 shows potential strategies for base workers for the management of plastic, glass, and aluminum waste.

Table 10. Potential decision strategies for base; plastic, glass, and aluminum

Strategy	**Source Reduce**	**Recycle**	**Incinerate**	**Landfill**	**Willingness to Participate**
1	10%	70%	0%	20%	0.841
2	0%	70%	10%	20%	0.813
3	0%	70%	0%	30%	0.803
4	10%	60%	10%	20%	0.799
5	0%	60%	20%	20%	0.772
6	10%	50%	20%	20%	0.758
7	0%	60%	0%	40%	0.752
8	0%	50%	30%	20%	0.730
9	0%	50%	0%	50%	0.700

The cumulative risk profiles that correspond to each of the strategies described above are shown in Figure 3. According to the risk profiles, Strategy 1 stochastically dominates other potential decision strategies.

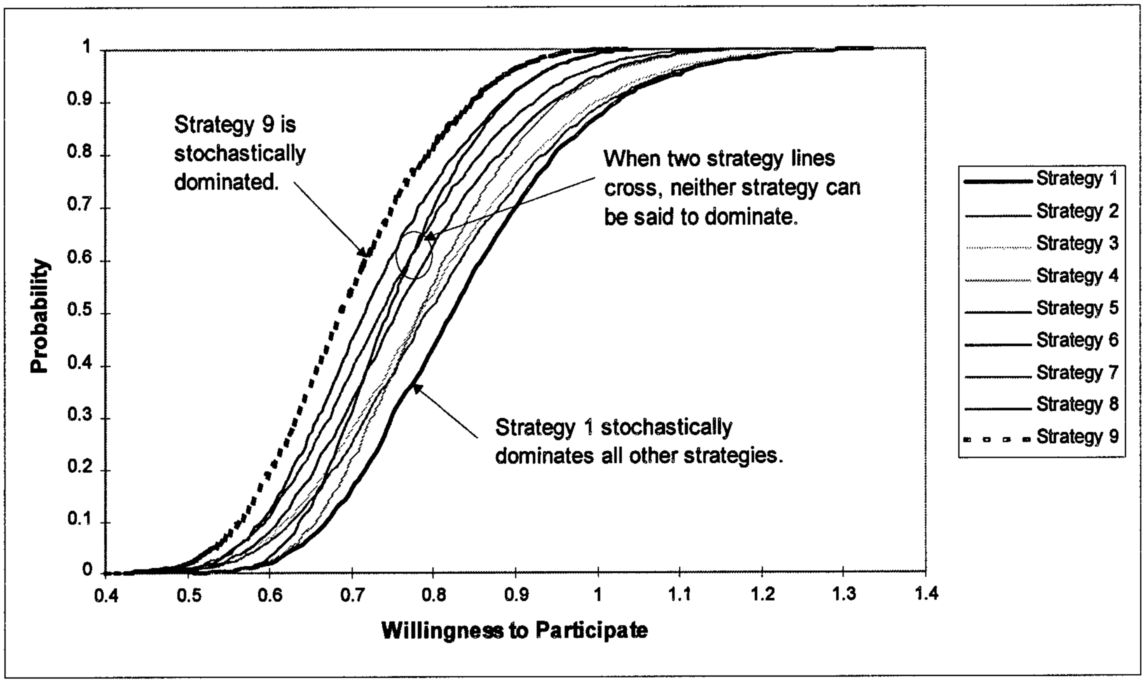


Figure 3. Cumulative risk profiles for the decision of how to manage base; plastic, glass, and aluminum

Base Workers / Paper

Four focus group sessions - Group 1, Group 2, Group 7, and Group 11, were held with base workers to discuss the topic of paper waste management. The proceedings from the discussion in each of these meetings is included in Appendix K. A total of 21 base workers participated in these four group discussions. For the first phase of the analysis, the individual questionnaire responses were combined by calculating the geometric mean of the responses for each questionnaire item. The raw questionnaire responses and the geometric mean for each question are included in Appendix L.

The aggregated questionnaire responses were evaluated using the analytic hierarchy process (AHP). The Expert Choice software program was used to perform the AHP evaluation. The result of the evaluation was a set of weights and scores that represents the preferences of each group as a whole. Each social value measure, or "criterion", has a weight which is an indication of how important the social value measure is to the group. A set of scores was generated for each waste management method with respect to each criterion. The scores indicate which waste management method is preferred if only one criterion is considered at a time. The weights and scores for the four groups of base workers who discussed paper waste management are shown in Tables 11-15.

Table 11. Criteria weights for base workers for the category of paper

Group	Convenience	Future Generations	Reduce Waste	Recreation Value
1	.213	.298	.270	.219
2	.302	.407	.168	.123
7	.128	.396	.314	.162
11	.134	.408	.218	.240
Value Used in Analysis	.134	.407	.270	.219

Table 12. Scores with respect to convenience for base workers for the category of paper

Group	Source Reduce	Recycling	Incineration	Landfilling
1	.132	.160	.354	.354
2	.181	.097	.361	.361
7	.425	.152	.211	.211
11	.228	.117	.328	.328
Value Used in Analysis	.181	.152	.354	.354

Table 13. Scores with respect to future generations for base workers for the category of paper

Group	Source Reduce	Recycling	Incineration	Landfilling
1	.440	.400	.113	.047
2	.623	.252	.082	.040
7	.498	.350	.107	.045
11	.556	.317	.088	.039
Value Used in Analysis	.498	.350	.107	.040

Table 14. Scores with respect to reduce waste for base workers for the category of paper

Group	Source Reduce	Recycling	Incineration	Landfilling
1	.384	.445	.109	.062
2	.626	.257	.066	.050
7	.462	.396	.090	.052
11	.670	.211	.083	.036
Value Used in Analysis	.626	.257	.083	.052

Table 15. Scores with respect to recreation value for base workers for the category of paper

Group	Shrubs	Luncheon	Picnic Shelter	Park
1	.278	.196	.249	.278
2	.228	.080	.204	.448
7	.327	.128	.135	.410
11	.341	.087	.210	.363
Value Used in Analysis	.327	.087	.210	.410

The value that was closest to the median in the each set of four scores and weights was determined and then used in the decision support model to determine the decision strategy of solid waste management techniques that would maximize willingness to participate. This step of the analysis process was facilitated using the DPL software program. DPL determines an expected value, which is the highest value of the potential outcomes (Clemen, 1991:70).

The result of this portion of the analysis is the following decision strategy for the management of paper waste: source reduce 10%, recycle 50%, incinerate 20%, and landfill 20%. This strategy has an expected value equal to 0.957.

The next step of the analysis process is to perform a value sensitivity comparison to determine which variables have the greatest influence on the decision outcome. A tornado diagram, which can be generated with the DPL software program, shows how much the value of an alternative can vary with changes in a specific value (Clemen, 1991:116). The weights and scores in the model for base workers for the category of paper management were allowed to vary between the lowest value in the set of four to the highest value in the set. These values were shown above in Tables 11-15. The tornado diagram is included in Appendix M. Review of the tornado diagram indicates that changes in the following variables made the greatest change in the decision outcome and warrant further uncertainty analysis:

- Score for recycling with respect to reduce waste
- Score for recycling with respect to future generations
- Score for park
- Score for source reduction with respect to reduce waste
- Weight of convenience
- Score for source reduction with respect to future generations.

These variables are considered "important variables".

For the initial analysis, the scores and weights were determined by finding the geometric mean of each of the questionnaire responses. However, the questionnaire responses actually fall within a range, based on the preferences of the individuals who participated in the group discussions. To determine this range, each set of questionnaire responses was analyzed individually using the Expert Choice software program. The result of this analysis was 21 sets of scores and weights that represent the range of preferences of the individual group members.

The values for the important variables can be modeled with a statistical distribution. In this case, the set of available data is small, so a conservative distribution should be used. The uniform distribution is conservative and represents an equal chance of any value between the minimum and maximum occurring (DPL, 1995:417). The uniform distribution will be used to model the values for the scores and weights that warranted further uncertainty analysis.

The next step in the analysis process was to revisit the decision support model and change the model to reflect the statistical distributions of the important variables. The decision strategy that maximizes willingness to participate can be determined again, and a more detailed comparison can be made between different decision strategies to determine if one strategy dominates another strategy.

The result of performing the analysis with uncertainty is a set of decision strategies that can be compared and evaluated by reviewing the cumulative risk profiles for each strategy. Table 16 shows potential strategies for base workers for the management of paper waste.

Table 16. Potential decision strategies for base; paper

Strategy	Source Reduce	Recycle	Incinerate	Landfill	Willingness to Participate
1	10%	50%	20%	20%	0.906
2	10%	50%	10%	30%	0.894
3	10%	50%	0%	40%	0.883
4	0%	50%	30%	20%	0.849
5	0%	50%	0%	50%	0.815
6	10%	40%	30%	20%	0.720
7	10%	30%	40%	20%	0.676
8	10%	20%	50%	20%	0.654

The cumulative risk profiles that correspond to each of the strategies described above are shown in Figure 4. According to the risk profiles, Strategy 1 stochastically dominates other potential decision strategies.

Military Family Housing / Plastic, Glass, and Aluminum

Three focus group sessions - Group 4, Group 8, and Group 9, were held with military family housing residents to discuss the topic of plastic, glass, and aluminum waste management. The proceedings from the discussion in each of these meetings is included in Appendix N. A total of nine military family housing residents participated in these group discussions. For the first phase of the analysis, the individual questionnaire

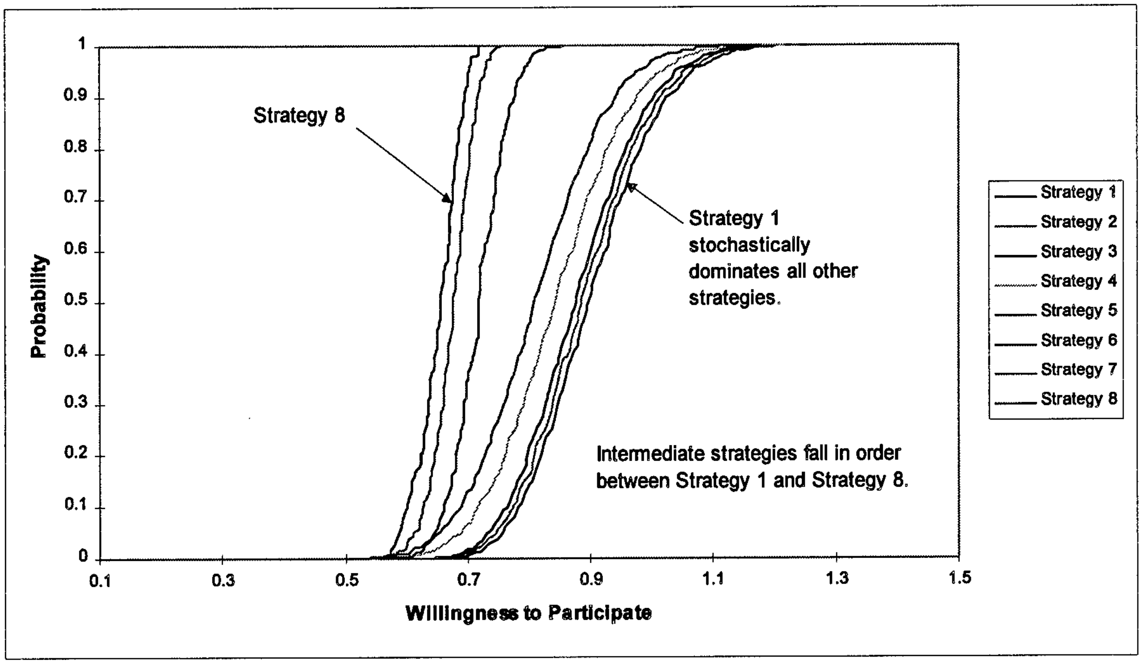


Figure 4. Cumulative risk profiles for the decision of how to manage base; paper

responses were combined by calculating the geometric mean of the individual responses for each questionnaire item. The raw questionnaire responses and the geometric mean for each question are included in Appendix O.

The aggregated questionnaire responses were evaluated using analytic hierarchy process (AHP), which was performed by the Expert Choice software package. The result of the evaluation was a set of weights and scores for each group. Each social value measure, or "criterion", has a weight which is an indication of how important the social value measure is to the group. A set of scores was generated for each waste management method with respect to each criterion. The scores indicate which waste management method is preferred if only one criterion is considered at a time. The weights and scores for the three groups of military family housing residents who discussed plastic, glass, and aluminum management are shown in Tables 17-21.

Table 17. Criteria weights for military family housing residents for the category of plastic, glass, and aluminum

Group	Convenience	Future Generations	Reduce Waste	Recreation Value
4	.270	.434	.160	.136
8	.641	.160	.120	.079
9	.356	.215	.084	.346
Value Used in Analysis	.356	.215	.120	.136

Table 18. Scores with respect to convenience for military family housing residents for the category of plastic, glass, and aluminum

Group	Source Reduce	Recycling	Incineration	Landfilling
4	.060	.121	.409	.409
8	.039	.136	.413	.413
9	.084	.090	.413	.413
Value Used in Analysis	.060	.121	.413	.413

Table 19. Scores with respect to future generations for military family housing residents for the category of plastic, glass, and aluminum

Group	Source Reduce	Recycling	Incineration	Landfilling
4	.323	.452	.171	.053
8	.503	.367	.090	.040
9	.384	.502	.049	.064
Value Used in Analysis	.384	.452	.090	.053

Table 20. Scores with respect to reduce waste for military family housing residents for the category of plastic, glass, and aluminum

Group	Source Reduce	Recycling	Incineration	Landfilling
4	.356	.455	.138	.050
8	.373	.475	.105	.048
9	.528	.354	.076	.041
Value Used in Analysis	.373	.475	.105	.0448

Table 21. Scores with respect to recreation value for military family housing residents for the category of plastic, glass, and aluminum

Group	Shrubs	Child Care	Picnic Shelter	Park
4	.175	.189	.107	.529
8	.266	.542	.054	.138
9	.279	.208	.137	.376
Value Used in Analysis	.266	.208	.107	.376

The median value among each set of three weights or scores was determined and then used in the decision support model to determine the decision strategy of solid waste management methods that would maximize willingness to participate. The DPL software program was used to facilitate this analysis and determine the expected value of the outcome.

The result of this portion of the analysis is the following decision strategy for the management of plastic, glass, and aluminum waste: source reduce 0%, recycle 70%, incinerate 10%, and landfill 20%. This strategy has an expected value equal to 0.755.

The next step of the analysis process is to perform a value sensitivity comparison to determine which variables have the greatest influence on the decision outcome. A tornado diagram, which can be generated with the DPL software, shows how much the value of an alternative can vary with changes in a specific value (Clemen, 1991:116). The weights and scores in the model for military family housing residents for the category of plastic, glass, and aluminum management were allowed to vary between the lowest and highest of the values generated by the three groups. These values were shown above in Tables 17-21. The tornado diagram is included in Appendix P. Review of the tornado diagram indicates that changes in the following variables caused the greatest change in the decision outcome and warrant further uncertainty analysis:

- Score for park
- Weight of convenience
- Weight of recreation value
- Score for recycling with respect to future generations
- Weight of future generations
- Score for recycling with respect to reduce waste
- Score for recycling with respect to convenience.

These variables are considered "important variables".

For the initial analysis, the scores and weights were determined by finding the geometric mean of each of the questionnaire responses. However, the questionnaire responses actually fall within a range, based on the preferences of the individuals who participated in the group discussions. To determine this range, each set of questionnaire responses was analyzed individually using the Expert Choice software program. The result of this analysis was nine sets of scores and weights that represents the range of preferences of the individual group members.

The values of the important variables can be modeled with a statistical distribution. The set of data available is small -- there are only nine values in the set, so a conservative distribution should be used. The uniform distribution will be used to model the values of the scores and weights that warranted further uncertainty analysis.

The next step in the decision analysis process was to revisit the decision support model and change the model to reflect the statistical distributions of the important variables. The decision strategy that maximizes willingness to participate can be determined again, and more detailed comparison can be made between different decision strategies to determine if one strategy dominates another strategy.

The result of performing the analysis with uncertainty is a set of decision strategies that can be compared and evaluated by reviewing the cumulative risk profiles for each strategy. Table 22 shows potential strategies for housing residents for the management of plastic, glass, and aluminum waste.

Table 22. Potential decision strategies for housing residents; plastic, glass, aluminum

Strategy	Source Reduce	Recycle	Incinerate	Landfill	Willingness to Participate
1	10%	70%	0%	20%	0.802
2	0%	70%	10%	20%	0.797
3	0%	70%	0%	30%	0.792
4	10%	60%	10%	20%	0.752
5	0%	60%	20%	20%	0.746
6	0%	60%	0%	40%	0.736
7	10%	50%	20%	20%	0.701
8	0%	50%	30%	20%	0.696
9	0%	50%	0%	50%	0.680
10	10%	40%	30%	20%	0.545

The cumulative risk profiles that correspond to each of the strategies described above are shown in Figure 5.

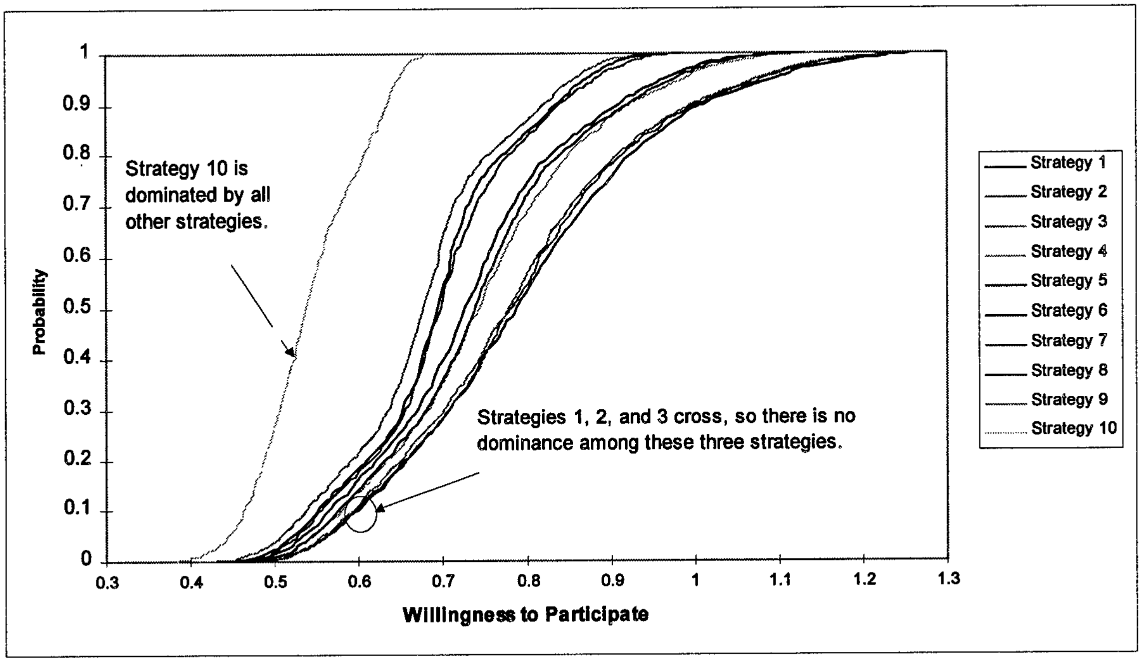


Figure 5. Cumulative risk profiles for the decision of how to manage family housing; plastic, glass, and aluminum

According to the risk profiles, there is no dominance among the first three strategies. In this case, the optimum strategy depends on the risk tolerance of the decision maker. If the decision maker has a low risk tolerance, which is also known as being risk adverse, then he or she would review the three potential strategies and use other means to determine the strategy to pursue. If the decision maker has a risk neutral or risk seeking approach, then Strategy 1 should be pursued. Strategy 1 provides a higher willingness to participate at higher levels of uncertainty.

Military Family Housing / Paper, Yard Waste, and Food Waste

Three focus group sessions - Group 6, Group 10, and Group 12, were held with military family housing residents to discuss the topic of paper, yard waste, and food waste management. The proceedings from the discussion in each of these meetings is included in Appendix Q. A total of 10 military family housing residents participated in these group discussions. For the first phase of the analysis, the individual questionnaire responses were combined by calculating the geometric mean of the responses for each questionnaire item. The raw questionnaire responses and the geometric means for each question are included in Appendix R.

The aggregated questionnaire responses were evaluated using analytic hierarchy process (AHP), which was performed by the Expert Choice software package. The result of the evaluation was a set of weights and scores for each group. Each social value measure, or "criterion", has a weight which is an indication of how important the social value measure is to the group. A set of scores was generated for each waste management method with respect to each criterion. The scores indicate which waste management method is preferred if only one criterion is considered at a time. The weights and scores for the three groups of military family housing residents who discussed paper, yard waste, and food waste management are shown in Tables 23-27.

Table 23. Criteria weights for military family housing residents for the category of paper, yard waste, and food waste

Group	Convenience	Future Generations	Reduce Waste	Recreation Value
6	.129	.602	.147	.123
10	.173	.297	.252	.278
12	.180	.428	.258	.133
Value Used in Analysis	.173	.428	.252	.133

Table 24. Scores with respect to convenience for military family housing residents for the category of paper, yard waste, and food waste

Group	Source Reduce	Recycling	Composting	Incineration	Landfilling
6	.158	.170	.081	.296	.296
10	.088	.113	.039	.380	.380
12	.148	.121	.061	.335	.335
Value Used in Analysis	.148	.121	.061	.335	.335

Table 25. Scores with respect to future generations for military family housing residents for the category of paper, yard waste, and food waste

Group	Source Reduce	Recycling	Composting	Incineration	Landfilling
6	.261	.388	.237	.083	.031
10	.328	.293	.262	.057	.060
12	.425	.277	.183	.071	.044
Value Used in Analysis	.328	.293	.237	.071	.044

Table 26. Scores with respect to reduce waste for military family housing residents for the category of paper, yard waste, and food waste

Group	Source Reduce	Recycling	Composting	Incineration	Landfilling
6	.330	.319	.227	.090	.035
10	.217	.357	.303	.062	.061
12	.298	.326	.186	.135	.055
Value Used in Analysis	.298	.326	.227	.090	.055

Table 27. Scores with respect to recreation value for military family housing residents for the category of paper, yard waste, and food waste

Group	Shrubs	Child Care	Picnic Shelter	Park
6	.152	.213	.277	.358
10	.069	.099	.255	.577
12	.095	.569	.053	.283
Value Used in Analysis	.095	.213	.255	.358

The median value among each set of three weights or scores was determined and then used in the decision support model to determine the decision strategy of solid waste management methods that would maximize willingness to participate. The DPL software program was used to facilitate this analysis and determine the expected value of the outcome.

The result of this portion of the analysis is the following decision strategy for the management of paper, yard waste, and food waste: source reduce 10%, recycle 50%, compost 20%, incinerate 0%, and landfill 20%. This strategy has an expected value equal to 0.905.

The next step of the analysis process is to perform a value sensitivity comparison to determine which variables have the greatest influence on the decision outcome. A tornado diagram, which can be generated with the DPL software, shows how much the value of an alternative can vary with changes in a specific value (Clemen, 1991:116).

The weights and scores in the model for military family housing residents for the category of paper, yard waste, and food waste management were allowed to vary between the lowest and highest of the values generated by the three groups. These values were shown above in Tables 23-27. The tornado diagram is included in Appendix S. Review of the tornado diagram indicates that changes in the following variables have the greatest effect on the value of the outcome and warrant further uncertainty analysis:

- Score for park
- Score for recycling with respect to future generations
- Score for child care
- Score for source reduction with respect to future generations
- Score for composting with respect to future generations
- Weight of future generations
- Score for composting with respect to reduce waste
- Weight of convenience.

These variables are considered "important variables".

For the initial analysis, the scores and weights were determined by finding the geometric mean of each of the questionnaire responses. However, the questionnaire responses actually fall within a range, based on the preferences of the individuals who participated in the group discussions. To determine this range, each set of questionnaire responses was analyzed individually using the Expert Choice software program. The result of this analysis was 10 sets of scores and weights that represent the range of preferences of the individual group members.

The values of the important variables can be modeled with a statistical distribution. The uniform distribution will be used since it is conservative and suitable for a small data set.

The next step in the decision analysis process was to revisit the decision support model and change the model to reflect the statistical distribution of the important variables. Now, the decision strategy that maximizes willingness to participate can be determined again, and a more detailed comparison can be made between different decision strategies to determine if one strategy dominates another strategy.

The result of performing the analysis with uncertainty is a set of decision strategies that can be compared and evaluated by reviewing the cumulative risk profiles for each strategy. Table 28 shows potential strategies for housing residents for the management of paper, yard waste, and food waste.

Table 28. Potential decision strategies for housing; paper, yard waste, food waste

Strategy	Source Reduce	Recycle	Composting	Incinerate	Landfill	Willingness to Participate
1	10%	50%	20%	0%	20%	0.875
2	0%	50%	30%	0%	20%	0.856
3	10%	30%	40%	0%	20%	0.856
4	10%	50%	10%	10%	20%	0.844
5	10%	50%	10%	0%	30%	0.836
6	10%	50%	0%	20%	20%	0.812
7	10%	50%	0%	0%	40%	0.796
8	10%	40%	30%	0%	20%	0.796
9	0%	50%	0%	0%	50%	0.738
10	0%	50%	0%	30%	20%	0.712
11	10%	20%	40%	10%	20%	0.658

The cumulative risk profiles that correspond to each of the strategies described above are shown in Figure 6. According to the risk profiles, there is no dominance among the first three strategies. In this case, the optimum strategy depends on the risk tolerance of the decision maker. If the decision maker has a risk neutral or risk seeking approach, then Strategy 1 should be pursued. If the decision maker is more willing to take risk, then Strategy 2 has the potential of returning a higher willingness to participate.

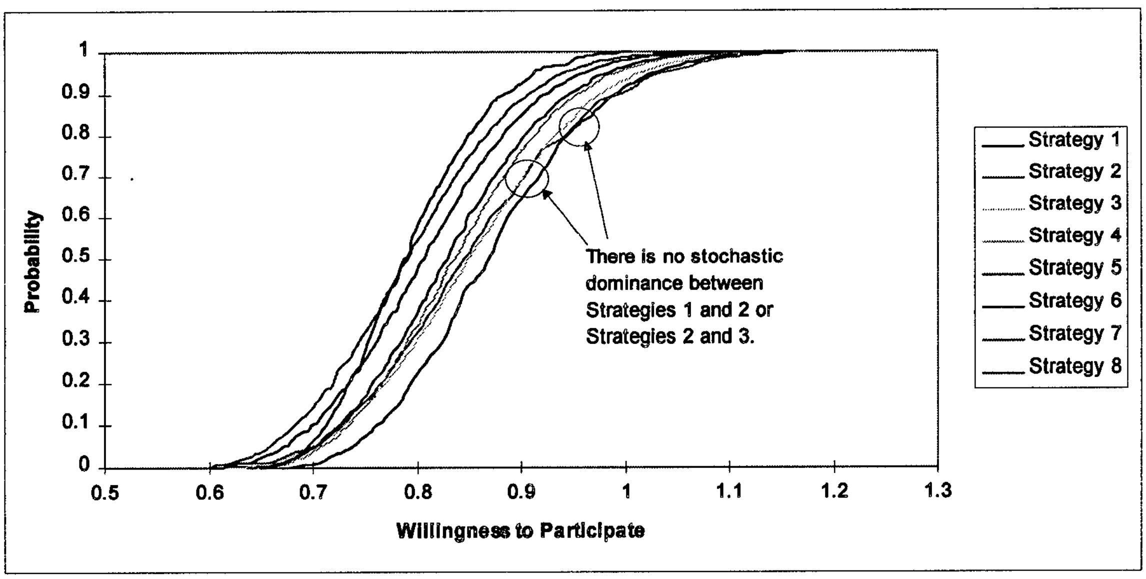


Figure 6. Cumulative risk profiles for the decision of how to manage family housing; paper, yard waste, and food waste

V. Conclusions and Recommendations

Overview

The primary objective of this research effort was to develop a decision support model that accurately portrayed individuals' social values regarding different solid waste management options. To accomplish this objective, the variables that influence conservation behavior and determine an individual's social value with respect to solid waste management were determined; a procedure to quantify and measure the attitudinal variables was developed; a decision support model that incorporated these variables into the overall determination of willingness to participate was structured; and data was obtained from individuals at Wright-Patterson AFB to determine the optimum strategy of solid waste management techniques.

Summary of Findings

Variables that influence conservation behavior and determine an individuals' social value were determined through a review of relevant literature covering this topic and validated in the focus group discussions. The variables used in this research were: convenience, the good feeling from reducing waste, the good feeling from leaving a good environment for future generations, and the incentives for recycling because profits can be used to fund recreation activities. Comparisons were made between these variables, also called "criteria", in the questionnaire that was completed by each participant in the focus group discussions.

Quantifying the attitudinal variables was accomplished by developing a questionnaire that was comprised of simple, pairwise comparisons that could be evaluated using the analytic hierarchy process (AHP). AHP is an appropriate method of analysis because of its ability to break a complex decision problem into a series of paired comparisons of objects with respect to a common goal or criterion (Harker, 1989:5). Evaluation of the questionnaires provided a set of scores for each of the waste management methods with respect to each criterion.

The questionnaire could be used at any military installation to provide a measure of the attitudinal variables about solid waste management at that installation. The measure for recreation value relies on comparisons of various programs that could be offered as incentives to participate in a recycling program. An Environmental Manager could tailor the programs mentioned in the survey to any that are specific to the installation. Conducting the analytic hierarchy process analysis can be facilitated by using the Expert Choice software program, which is available commercially.

Structuring the decision support model to incorporate attitudinal variables into the overall determination of willingness to participate was accomplished by building an influence diagram to represent the decision structure. The scores for each of the waste management methods with respect to each criterion were used in the linear equations (Equations 1-3) in the model to determine a value for the attitudinal variables. The criteria weights were used in Equation 4 to calculate the overall willingness to participate. Value sensitivity comparison was performed to determine which variables have the greatest influence on the decision outcome. The variables that were identified were modeled with uncertainty.

The results of performing the decision support model analysis with uncertainty provide interesting insights about which solid waste management program would provide the maximum willingness to participate. The insights will be explained separately for each of the decision analysis models described in Chapter 4.

Base workers for the category of plastic, glass, and aluminum management. Reviewing the cumulative risk profiles for potential waste management strategies indicated that the following decision strategy will maximize the participants' willingness to participate: source reduce 10%, recycle 70%, incinerate 0%, and landfill 20%. If the waste management program offered to base workers provided the opportunity to recycle 70% of the plastic, glass, and aluminum waste; provided information about techniques that could source reduce 10%; and landfilled the remaining 20% of the waste; the participants would receive the maximum social value from the program.

Base workers for the category of paper management. Reviewing the cumulative risk profiles for potential strategies for how much paper waste management indicated that the following decision strategy will maximize the participants' willingness to participate: source reduce 10%, recycle 50%, incinerate 20%, and landfill 20%. Base workers need awareness of techniques so that they may source reduce 10% of the paper currently used in the workplace; a recycling program that will recycle 50% of the paper; incineration is appropriate for 20% of the paper waste; the remaining 20% should be sent to a landfill.

Military family housing residents for the category of plastic, glass, and aluminum management. Reviewing the cumulative risk profiles for potential strategies for how to manage plastic, glass, and aluminum waste from family housing indicated that the Environmental Manager may want to pursue different strategies depending on his or her risk tolerance. If the Environmental Manager wants to avoid risk, then any of the strategies represented in Table 29 would provide almost the same willingness to participate.

Table 29. Risk averse strategies for managing family housing; plastic; glass, and aluminum

Strategy	**Source Reduce**	**Recycle**	**Incinerate**	**Landfill**
1	10%	70%	0%	20%
2	0%	70%	10%	20%
3	0%	70%	0%	30%

The highest expected value for any of the strategies was 0.802 for Strategy 1. The expected value for Strategy 2 was 0.797 and the expected value for Strategy 3 was 0.792.

Other factors may influence the Environmental Manager to choose one of the strategies over another. Strategy 3, which does not utilize source reduction or incineration may be easier for the Environmental Manager to implement. Strategy 1 may be preferred because it provides a higher willingness to participate, but with greater uncertainty.

Military family housing residents for the category of paper, yard waste, and food waste management. Reviewing the cumulative risk profiles for the strategies for managing paper, yard waste, and food waste from family housing indicates different strategies dependent upon the Environmental Manager's risk tolerance. Table 30 shows the two strategies that are likely to provide the highest willingness to participate.

Table 30. Potential strategies for management of family housing; paper, yard waste, and food waste

Strategy	Source Reduce	Recycle	Compost	Incinerate	Landfill
1	10%	50%	20%	0%	20%
2	0%	50%	30%	0%	20%

The highest expected value was 0.875 for Strategy 1. The expected value for Strategy 2 was 0.856. If the Environmental Manager is risk averse or risk neutral, then Strategy 1 should be pursued. One of the easiest methods of source reduction for yard waste is using a mulching mower. The grass clippings are left on the lawn to provide mulch and thatch which maintains a healthy lawn, which is better than bagging the clippings and sending them to a landfill.

Insights

Trends and patterns emerged among the different strategies for each of the waste management models. In all cases, the preferred strategy included recycling to the maximum extent allowed in the model. The Environmental Manager should provide a waste management program that will allow participants to recycle to the maximum extent possible. A recurring theme during the focus group discussions was the need for a convenient recycling program. Lack of awareness of the existing program was mentioned as a reason for not recycling to a great extent at the present.

With recycling held constant, primary tradeoffs in various strategies were between source reduction and incineration. As incineration increased, source reduction decreased. Focus group members expressed a lack of knowledge about the air pollution that results from incineration. In no case was there an across the board rejection of incineration because of a perceived potential harm to the environment. Discussions about source reduction were relatively limited and there did not seem to be an abundance of awareness about it.

Landfilling was the least preferred method for managing waste. There will always be some residual material, and the models reflect this by having the minimum option for landfilling equal to 20%.

Review of the weights assigned to each criterion (see Tables 4, 9, 14, and 19) indicates that leaving a good environment for future generations was weighted more heavily than convenience in 10 out of 12 groups. However, during the discussions, the overwhelming sentiment was that convenience is the most important criterion. Another potential influential variable that was identified in the discussions was receiving a tangible monetary benefit for recycling material.

Recommendations for Further Research

Awareness. A common sentiment expressed in the focus group discussions was the importance of awareness and education programs. Further research is needed in this area to determine the influence that awareness has on the variables of convenience, feeling good from reducing waste, feeling good from leaving a good environment for future generations, and the incentives provided because profits from recycling can be used to fund recreation programs.

The weights that were assigned to each of the variables based on the questionnaire responses (see Tables 5, 11, 17, and 23) provide interesting insight about which of the variables are most important to the people who participate in the waste management program. A methodology could be developed that tailors an awareness program to the most important variables. For example, since the results of this research indicate that leaving a good environment for future generations is most important, an awareness program should be developed that emphasizes the impacts that source reduction, recycling, incineration, and landfilling have on the environment for future generations.

Incorporating social value measures into a model that considers economic cost, waste diversion, and goal attainment. This research effort took a narrow focus and only considered social value to determine an optimum solid waste management program. Further research is needed to incorporate the results of this research into a model that considers the other important criteria - economic cost, waste diversion, and goal attainment.

This model was developed and analyzed using the DPL software program. This software is not commonly used by Environmental Managers (EM). For a model to be truly useful for any EM, a more common software package, such as Excel, should be used to perform the analysis.

Modeling the waste management scenario with a dynamic model. The decision analysis framework used in this thesis did not allow for cycles: that is changes in the outcome could not influence values used to calculate the outcome. However, a situation could exist where an increased willingness to participate generated increased revenues, both from sale of recyclable material and avoidance of landfill disposal costs. These funds could be used for awareness programs which may increase the willingness to participate. A dynamic modeling software, such as STELLA, allows for this cyclical process.

Research Summary

This thesis developed a methodology for incorporating social value considerations into the development of a comprehensive waste management program. The research identified the values that are important to the people that are participating in the program.

In order for a program to be successful, the attitudes of the participants must be taken into consideration.

The analysis ··f the decision support model indicated which solid waste management strategy would provide the highest willingness to participate. Different strategies were developed for that depend on which area of the base is being considered - either base facilities or military family housing. The strategies are also different depending on which waste material is being considered. When all the strategies are developed and implemented, then the installation will have a truly comprehensive program.

APPENDIX A

Letter for Randomly Chosen Housing Residents

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS, 88TH AIR BASE WING (AFMC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

04 SEP 1996

MEMORANDUM FOR HOUSING RESIDENT

FROM: 88 CEG/CEH
2000 Allbrook Drive, Suite 3
Wright-Patterson AFB OH 45433-5315

SUBJECT: Research Project

1. The Housing Office would like to take this opportunity to advise you that within the next few weeks you may receive a telephone call from Lt Camille Still, an Air Force Institute of Technology (AFIT) graduate student.

2. Lt Still is conducting research in the area of recycling and refuse reduction. She has requested a list of possible names and phone numbers of military families who may be interested in participating in a discussion group about household waste minimization efforts. Please understand that your participation is strictly voluntary. Lt Still plans to conduct several small group discussions between 10 and 25 September 1996. She will be contacting you at your duty section to inquire if you would be willing and available for one of these discussion groups. Your inputs would be valuable for the research effort to improve waste management strategies in the military family housing community.

3. Lt Still's research is sponsored by the base Environmental Management Office. Should you have any questions you are encouraged to call her at 255-3636, extension 6415.

4. Again, you are reminded that your participation is voluntary; however, the knowledge you may obtain through participation could be of value to you and your family.

Terry N. Mathews

TERRY N. MATHEWS, Chief
Family Housing Management Division

APPENDIX B

Telephone Recruiting Script

Hello, ______________________

My name is Lt Camille Still.

I am a student at the Air Force Institute of Technology, AFIT.

I'm doing a research project in the area of solid waste management.

I wonder if you would be interested in participating in a group discussion to talk about waste minimization efforts.

The meeting will be held on ______day, time______,

at the base environmental management office, building 89, area C, in their library.

It will last no longer than two hours.

Will you be interested in attending?

YES: I'd like to send you a confirmation letter, can I get your office symbol?

I will be sending you a letter in a few days to confirm the meeting.

Let me give you my name and voice mail number so you can call me if you have any questions, Lt Camille Still, and the number is 5-3636 ext 6415.

Thank you.

Appendix C: TELEPHONE LOG

Base Workers

Time	Name	Number	Result
27 August 1996			
1002	Mr. Fluty	5-5268	No Answer
1004	Mr. Fluty	5-5813 x329	Attendee
1009	CEOE	7-3904	Busy
1010	Mr. Fuller	5-4400 x208	Attendee
1015	MSgt Wilson	7-3904	Attendee
1020		5-5963	Busy
1021		7-3124	Wrong Number
1022	Maj Marcelis	7-3619	Attendee
1028		5-5963	Busy
1031	Farris Smith	7-2838	Out of Office Today
1034	Aaron Mouser	7-5996	Out of Office
1035	Steve Schultz	7-6813	Wrong Number
1036	Steve Schultz	7-1649	Voice Mail
1037	Capt Rebecca Schultz	5-5963	Out of Office
1039		7-1695	No Answer
1040	SSgt Thelen	7-8056	Out of Office Today
1042	Emma Pleasant	5-5687	Must Clear with Supervisor/ Preparing for ECAMP
1435	Emma Pleasant	5-2106	Attendee
1440	Steve Schultz	7-1649	Voice Mail
1441	Aaron Mouser	7-5996	Attendee, 19 Sep
1447	David Kelly	7-3318	Out of Office
1448	Jeffrey Garrett	7-2059	On Leave
1449	Mitchell Button	7-2162	No Answer
1454	Ken Weissman	5-5014	Out of Office
1500	TSgt Kevin Brown	5-0359	Not in Names Directory
1503	Robert Anderson	5-5133	No Answer
1506	Judith Clark	5-3365	Voice Mail
1508	MSgt McInnes	5-5740	Recommended Sgt Bill Schmidt, Will check schedule and call back
1513	Steve Shultz	7-1649	Attendee
1517	Capt Rebecca Schultz	5-5963	Attendee
1525	Richard Allen	5-4542	No Answer
1527	Charles Lovett	5-3808	No Answer

1530	Ronald Wampler	5-5410 x3367	Voice Mail
1532	TSgt Frahm	5-5432	Line is Busy
1535	Kevin Pope	5-3636 x4535	Not in Office
1537	TSgt Frahm	5-5432	Not in Office
1540	Gary Young	7-8192 x4614	Voice Mail
1544	Charles Lovett	5-3808	No Answer
1545	Paul Daulton	7-9026	Not in Office
1546	Richard Allen	5-4542	No Answer
1548	Mary Rinas	7-4815	Not Available
1552	Judith Clark	5-3365	Voice Mail
1553	Charles Lovett	5-3808 x316	No Answer
1557	Robert Anderson	5-5133	No Answer
28 August 1996			
837	Farris Smith	7-2838	Attendee
844	SSgt Thelen	7-8056	On Midshift
845	David Kelly	7-3318	Not Interested
850	Tom Green	7-6311	Voice Mail
851	Mitchell Button	7-2162	No Answer
852	Kenneth Weissman	5-5014	Attendee, 19 Sep
855	Robert Anderson	5-5133	No Answer
858	Judith Clark	5-3365	Not Interested
900	Ron Ditmer	5-6034	Not in Office
902	Richard Allen	5-4542	No Answer
905	Charles Lovett	5-3808 x3161	Voice Mail
907	Ronald Wampler	5-5410 x3367	Voice Mail
910	TSgt Frahm	5-5432	Line is Busy
911	Tom Green	7-6311	Voice Mail
912	Kevin Pope	5-3636 x4535	Attendee
1013	Tom Green	7-6311	Voice Mail
1014	Mitchell Button	7-2162	No Answer
1016	Robert Anderson	5-5133	No Answer
1018	Ron Ditmer	5-6034	Not There, Wrong Number?
1022	Richard Allen	5-4542	Not Interested
1023	Charles Lovett	5-3808 x3161	Voice Mail
1025	Ronald Wampler	5-5410 x3367	Voice Mail
1026	TSgt Frahm	5-5432	Will be TDY, call SSgt Shoulta, 7-3836
1030	SSgt Shoulta	7-3836	Attendee
1034	Gary Young	7-8192 x4614	Out of Office Today
1036	Paul Daulton	7-9026	Out of Office
1037	Mary Rinas	7-4815	Attendee

1041	Michael Johnson	7-3930 x324	Not in Office Today
1045	Michael Douglass	5-6905	Not There
1047	Russ Scherer	5-4513	Attendee
1328	Michael Douglass	5-6930	No Answer
1332	Paul Daulton	7-9026	Not in the Office
1333	Ronald Wampler	5-5410 x3367	Voice Mail
1334	Charles Lovett	5-3808 x3161	Voice Mail
1335	Ron Ditmer	5-6034	Not There
1336	Robert Anderson	5-5133	No Answer
1337	Mitchell Button	7-2162	Line is Busy
1339	Tom Green	7-6311	Attendee
1342	Mitchell Button	7-2162	Line is Busy
1343	Leanne Heagle	7-8309	Not in the Office
1344	Alice Hayes	5-0937	No Answer
1346	Mitchell Button	7-2162	Line is Busy
1347	Rick Lux	7-4287	Attendee
1352	MSgt Semmie Neely	5-6969	Answering Machine
1354	Mitchell Button	7-2162	No Answer
1356	Richard Young	7-4344	Left Message
1359	Sgt Barenrugge	7-6854	No Longer in Service
1402	Sgt Willis	7-6854	Left Message
1411	Lt Paul Toth	7-9078	Out of the Office
1413	Mitchell Button	7-2162	No Answer
1415	MSgt Semmie Neely	5-6969	Answering Machine
1415	Alice Hayes	5-0937	No Answer
1417	Lt Callahan	5-6058	Not in Names Directory
1417	HM3 J. Smith	5-6058 x235	Voice Mail
1421	Maj Jepson	5-2704	Attendee
1433	Sharon Sowards	879-2711	Wrong Number, call 879-2438
1435	Sharon Sowards	879-2438	Not Interested
1437	Meredith Spurr	7-2216	Attendee
1441	MSgt Neely	5-6969	Answering Machine
1442	Alice Hayes	5-0937	No Answer
1443	SSgt Burris	5-0823	Not in Names Directory
1447	Robinson	5-0339	Not on Base Anymore
1448	Larry Lewis	5-5270 x327	Not Interested
1451	Patricia Shapiro	5-4212	Line is Busy
1452	Wendell Jones	5-2065	Wrong Number
1457	Wendell Jones	5-4062	Not Interested
1459	David Schultz	5-0310	Attendee, 19 Sep
1504	Patricia Shapiro	5-4212	Line is Busy

1505	Alice Hayes	5-0937	No Answer
1505	MSgt Neely	5-6969	Answering Machine
1506	HM3 J. Smith	5-6058 x235	Voice Mail
1507	Mitchell Button	7-2162	No Answer
1508	Lt Paul Toth	7-9078	Voice Mail
1510	Leanne Heagle	7-8309	Line is Busy
1511	Robert Anderson	5-5133	No Answer
1511	Ron Ditmer	5-6034	Not There
1517	Charles Lovett	5-3808 x3161	Voice Mail
1518	Ronald Wampler	5-5410 x3367	Voice Mail
1519	Paul Daulton	7-9026	Attendee
1522	Michael Douglass	5-6905	Not There
1524	Leanne Heagle	7-8309	Not There
1525	Lt Paul Toth	7-9078	Voice Mail
29 August 1996			
1510	Richard Young	7-4344	Left Message
1513	Mitchell Button	7-2162	No Answer
1515	Robert Anderson	5-5133	No Answer
1517	Ron Dtimer	5-6034	Gone for rest of the day
1519	Charles Lovett	5-3808 x3161	Attendee
1523	SMSgt Zabel	7-7427	Not Interested
1525	Gary Young	7-8192 x4614	Voice Mail
1527	Michael Johnson	7-3930 x324	VoiceMail
1528	Lt Paul Toth	7-9077	Not There
1529	Lt Callaghan	5-6058	Not in Names Directory
1531	Michael Douglass	5-6930	No Answer
1532	Leanne Heagle	7-8309	Not Interested
1535	Sgt Willis	7-6854	Not in Office
1536	Alice Hayes	5-0937	No Answer
4 September 1996			
1339	Alice Hayes	5-0937	No Answer
1343	Mitchell Button	7-2162	No Answer
1353	Robert Anderson	5-5133	No Answer
1355	Ron Ditmer	5-6034	Out of Town, Back Next Week
1356	Gary Young	7-8192 x4614	Voice Mail
1358	Michael Johnson	7-3930 x324	Voice Mail
1400	Lt Paul Toth	7-9078	Voice Mail
1402	Michael Douglass	5-6930	No Answer
1403	MSgt Neely	5-6969	Retired
1403	SRA Nathan Smith	5-6969	Not in the Office
1405	Patricia Shapiro	5-4212	Talking on another Line

1407	John Price	5-2000	Not Interested
1409	Michelle Badgett	5-6815	Line is Busy
1410	Vincent Jacobucci	5-6075	Not in Names Directory
1412	Paul Matlow	5-4493	No Answer
1415	Joyce Salyers	5-7126	No Answer
1417	Paul Japs	5-4683	No Answer
1418	Robert Hull	5-2334 x3165	Voice Mail
1420	Joseph Dowdell	5-4859	No Longer Facility Manager
1421	Dave Sweet	5-2947 x201	In a meeting
1422	Tim Bausman	5-2357	Not Interested
1425	Larry Coulthard	5-2661	On leave this week
1426	Patricial Shapiro	5-4212	Attendee
1431	Michelle Badgett	5-6815	No Longer There
1437	James Stewart	5-5337	Not Interested
1442	Velma Kruse	5-6075	Not in names directory
1444	Gary Young	7-8192 x4614	Voice Mail
1447	Michael Johnson	7-3930 x324	Voice Mail
1450	SRA Nathan Smith	5-6969	Not in office
1451	Robert Hull	5-2334 x3165	Voice Mail
1456	Sgt Willis	7-6854	Try back in 15 min.
1502	Ronald Wampler	5-5410 x3367	Voice Mail
1504	Lt Paul Toth	7-9078	Attendee
1514	Sgt Willis	7-6854	Attendee
1521	Dave Sweet	5-2947 x201	Not in Office
1523	Steve Foster	5-2357	Line is Busy
5 September 1996			
927	Mitchell Button	7-2162	Wrong Number
929	Mitchell Button	7-7024	Voice Mail
931	Robert Anderson	5-5133	No Answer
932	Robert Anderson	5-2269	Not Interested
934	Gary Young	7-8192 x4614	Voice Mail
936	Michael Johnson	7-3930 x324	Voice Mail
937	Michael Douglass	5-6930	In a meeting, call after 1030
939	Alcie Hayes	5-0937	No Answer
941	ASC/YFMR	5-6075	Voice Mail
943	Paul Matlow	5-4493	No Answer
944	Joyce Salyers	5-7126	Not in office, try in 15 minutes
947	Steve Foster	5-2357	Line is Busy
948	Dave Sweet	5-2947 x201	Voice Mail
949	SRA Nathan Smith	5-6969	Not in Office
1013	Joyce Salyers	5-7126	Line is Busy

1015	Steve Foster	5-2357	Not in the Office
1017	John Bankford	7-8015	Not in the Office
1018	Dave Sweet	5-2947 x201	Not in the Office
1021	Dennis Hamilton	5-6320	Number not is Service
1022	Alice Furry	5-2972	May be interested at a later date
1024	SSgt Robert Taft	7-6667	No longer on base
17 September 1996			
1013	Alice Furry	5-2972	Voice Mail
1014	John Bankford	7-8015	Will be on leave until 20 Sep
1015	Steve Foster	5-2357	Not in the office
1016	Joyce Salyers	5-7126	Possible Attendee
1019	SRA Nathan Smith	5-6969	Voice Mail
1020	Alice Hayes	5-0937	No Answer
1021	Michael Douglass	5-6930	No Answer
1023	Michael Johnson	7-3930 x324	Not in the office
1024	Gary Young	7-8192 x4614	Line is busy
1025	Mitchell Button	7-7024	Voice Mail
1027	Larry Coulthard	5-2661	Not Interested
1028	Gary Young	7-8192 x4614	Not Interested
1029	Mr. Abbitt	7-3013 x4642	Attendee
1033	Michael Douglass	5-6930	No Answer
1035	SRA Balderrama	7-6667	Not Available
1036	Warren Richardson	7-4339	Call after lunch
1352	Steve Foster	5-2357	Not interested
1355	SRA Smith	5-6969	Not in the office
1356	Mitchell Button	7-7024	Not interested
1357	Warrren Richardson	7-4339	Not interested
1358	Norm Ketring	7-3578	No Answer
1359	Terry Burkart	7-4641	Wrong Number
1359	Keith Powell	7-7804	Wrong Number
1400	Jay Merrick	7-4932	Wrong Number
1401	Keith Allen	7-7292	Doesn't work there
1401	Mark McKenney	7-7292	Took message for facility manager
1404	Yvonne Reeves	879-5730	Got disconnected
1407	Norm Ketring	7-3578	Should be back in 10-15 minutes
1411	Ron Wampler	5-5410 x3367	Voice Mail
1420	Jim Conner	5-6075	Attendee
18 September 1996			
927	Ron Wampler	5-5410 x3367	Voice Mail

929	Norm Ketring	7-3578	Attendee
933	Yvonne Reeves	879-5730	Line is busy
934	Al Urolea	7-7292	Not Available, call back in 15 minutes
937	Jay Merrick	7-6803	Doesn't work there
938	Rosa Brown	7-4251	Not in the office
940	Bradford Denham	7-6363	No Answer
941	Keith Powell	5-1788	Doesn't work there
942	Terry Burkert	7-2650	Wrong number
943	Yvonne Reeves	879-5730	Line is busy
944	Maj Boaz	7-3619	call 7-2291
945	Maj Boaz	7-2291	On another line, call back
947	SRA Balderrama	7-6667	Next week is not convenient
949	Michael Douglass	5-6930	Attendee
953	Michael Johnson	7-3930 x324	Voice Mail
956	Alice Furry	5-2972	Left message
957	Al Urolea	7-7292	Left message
1003	Paul Matlow	5-4493	No Answer
1005	Paul Japs	5-4683	No Answer
1010	Ron Ditmer	5-6034	Not There
1014	Maj Boaz	7-2291	Out of the office
1016	Yvonne Reeves	879-5730	Doesn't work there
1017	Mary Rinas	7-4815	Rescheduled
1023	J. Smith	5-6058 x235	Voice Mail
1024	Jeffrey Garrett	7-2059	Next week is not convenient
1029	Paul Japs	5-6666 / 5-4683	No Answer
1033	Rebecca Schultz	5-5963	Line is Busy
1035	MSgt Wilson	7-3904	Dave Wampler will call
1044	Johnnie Golden	7-6506	Attendee
1052	Dave Lewis	5-0359 x400	Wont be able to attend
1104	Dave Lawrence	5-7719 x304	Voice Mail try on 19 Sep
1105	Sue Schmidt	5-7719 x308	Wrong Number
1106	Amy Mercado	5-7719 x427	Voice Mail
1107	Dave Brucker	5-7719 x453	No Answer
1109	Rebecca Schultz	5-5963	Line is busy
1328	Al Urolea	7-7292	Left Message
1330	Rosa Brown	7-4251	Not in the office
1332	Bradford Denham	7-6363	No Answer
1333	Rebecca Schultz	5-5963	Not in the office, try after 1530
1334	Amy Mercado	5-7719 x427	Will call back

1338	J. Smith	5-6058 x235	Voice Mail
1340	Maj Boaz	7-2291	Attendee
1347	Janet Davis	5-5337	Not at her desk
1350	Donna Snyder	5-3789	Voice Mail
1352	AL/HRG	5-9395	No Answer
1354	AL/HRG	5-3713	Try Lt Poley, 5-3871 or Jill Easterly
1356	Lt Poley	5-3871	Line is busy
1545	Ron Wampler	5-5410 x3367	Voice Mail
1547	Michael Johnson	7-3930 x324	Voice Mail
1548	Alice Furry	5-2972	Voice Mail
1349	Paul Matlow	5-4493	No Answer
1550	Paul Japs	5-6666 / 5-4683	No Answer
1552	Bradford Denham	7-6363	No Answer
1553	Rebecca Schultz	5-5963	Rescheduled
1556	Lt Poley	5-3871	Line is busy
1557	Donna Snyder	5-3789	Line is busy
1558	Janet Davis	5-5337	Not Interested
1559	J. Smith	5-6058 x235	Voice Mail
1600	Rosa Brown	7-4251	Attendee
1631	SSgt Thelen	7-8056	No Answer
1632	Jill Easterly	5-3871	Attendee
19 September 1996			
956	George Walters	5-4151 x434	Voice Mail
1000	Donna Snyder	5-3789	Line is Busy
1001	Al Urolea	7-7292	Attendee

Family Housing Residents

Time	Name	Number	Result
11 September 1996			
1019	Col Corcoran	5-0600	Voice Mail
1020	Col Cohen	7-9619	Voice Mail
1021	SSgt Freeman	7-5550	Will check schedule and call back
1027	TSgt Ligas	7-5020	Will check schedule
1032	SRA Graybeal	7-8860	Wrong Number
1033	SSgt Martin	228-9402	Try around 1300

1034	Amn Bridges	7-2035	Won't be at this number today
1036	Maj Jackson	5-6111 x245	Can't attend, call wife
1045	Mrs Jackson	878-6474	Call back
1047	MSgt Hyers	7-2777	Voice Mail
1048	Capt Boley	5-7777	Left Voice Mail Message
1051	TSgt Dennison	7-7510	Try Another Number
1052	TSgt Dennison	7-7609	Attendee
1055	Mrs Jackson	878-6474	Can't Attend
1438	SRA Laughrey	5-7619	Not in Office
1441	Petty Officer Martin	228-9402	Attendee
1447	Col Corcoran	5-0600	Call did not go through
1449	Col Corcoran	5-0600	Attendee
1454	MSgt Hyers	7-2777	Vocie Mail
1454	SRA Wolford	7-7057	Line is Busy
1455	SRA Ballinger	7-6516	Wrong Number
1456	SRA Ballinger	7-2177	Line is Busy
1456	LtCol Gardner	7-2068	Wrong Number
1457	MSgt Almeyda	7-8403	Wrong Number
1458	Capt Berg	5-7777 x2102	(513) 252-0877
1500	Capt Berg	252-0877	Left Message
1502	Maj Cox	5-6565	Wrong Number
1503	SSgt Winchester	7-2237	No Answer
1505	TSgt Tingley	7-4357	Not in the Office
1506	SSgt Bailey	7-1977	Not in the Office
1507	SSgt Ireland	7-6517	Wrong Number
1508	SSgt Ireland	7-2177	Call before 1340 tomorrow
1509	SRA Ballinger	7-2177	Not Interested
1511	MSgt Smith	256-4811	Wrong Number
1512	Maj Singer	5-5270 x342	Attendee
1519	Capt DeLoach	7-2441	Wrong Number
1520	Capt DeLoach	476-0736	Wrong Number
1521	SSgt Moore	732-0056	Wrong Number
1522	TSgt Whitaker	7-6516	Not Working Today
1523	Capt Carrouthers	5-9433	TDY, back on Monday
1524	SSgt Harmon	5-5194	Wrong Number
1524	MSgt Creel	5-8525	Line is Busy
1525	LtCol Wildman	7-6447	Has PCS'd

1525	SSgt Sarver	7-7233	Attendee
1533	TSgt Small	399-8520	Wrong Number
1534	Maj Shaw	7-5400	Not in the office today
1535	SSgt Foster	863-0646	Wrong Number
1536	MSgt Oram	5-2354	TDY, Back Friday
1537	SRA Bookey	7-0964	Line is Busy
1537	Maj McArthur	5-2244	Wrong Number
1539	SSgt Murphy	7-0722	Left the office for the day
1540	SRA Vanjoolen	5-7305	Line is Busy
1541	MSgt Hyers	7-2777	Voice Mail
1542	SRA Wolford	7-7057	Line is Busy
1543	SSgt Winchester	7-2237	No Answer
1545	MSgt Creel	5-8525	Gone for the day
1547	SRA Bookey	7-0964	Wrong Number
1548	SRA Bookey	7-8732	Not Available
1550	SRA Vanjoolen	5-7305	Left for the day
1554	MSgt King	7-7233	Not in the office
12 September 1996			
746	SRA Graybeal	7-5636	Will be in after 820
747	Amn Bridges	7-2035	Call 7-4700, can be reached by radio
748	MSgt Hyers	7-2777	Voice Mail
749	SRA Laughrey	5-7619	Attendee
801	SRA Wolford	7-7057	Not Interested
802	LtCol Gardner	7-6131	7-3301, call around 820
803	SSgt Winchester	7-2237	No Answer
804	TSgt Tingley	7-4357	Not Available
807	SSgt Bailey	7-1977	Not Interested
808	SSgt Ireland	7-2177	Not in the office
810	MSgt Creel	5-8525	Attendee
813	Maj Shaw	7-5400	Attendee
816	SSgt Foster	7-8734	Not in office today
818	SRA Bookey	7-8732	Attendee
823	Maj McArthur	5-9535	Wrong Number
824	SSgt Murphy	7-0722	Attendee
827	SRA Vanjoolen	5-7305	Not in the office
828	MSgt King	7-7233	Not in the office
830	A1C Erickson	7-1647	No Answer
831	SRA Graybeal	7-5636	Not in the office
832	LtCol Gardner	7-3301	Line is Busy

17 September 1996			
940	MSgt Wrede	7-3207	Not in the office
942	Maj Baer	7-8474	Attendee
945	Maj Tri	5-3737	Wrong Number
952	SSgt Licht	5-2816	Call back in 1-1 1/2 hours
954	MSgt Brown	7-6165	No Answer
1000	TSgt Bell	7-8740	Not in the office
1001	SRA Marrero	7-1411	Line is Busy
1002	LtCol Gardner	7-3301	Not in the office
1003	SRA Graybeal	7-5636	Attendee
18 September 1996			
1401	MSgt Creel	5-8525	Rescheduled
1403	Petty Officer Martin	228-9402	Rescheduled
1405	SRA Laughry	5-7619	Not in today
1407	MSgt Wrede	7-3207	Not in the office, try at 1500
1408	SSgt Licht	5-2816	Not in the office, try at 1430
1409	MSgt Brown	7-6165	No Answer
1410	TSgt Bell	7-8740	Attendee
1413	SRA Marrero	7-1411	On Leave
1415	LtCol Gardner	7-3301	Can't Attend
1420	A1C Erickson	7-1647	No Answer
1424	SSgt Freeman	7-5550	Not in the office
1425	MSgt Hyers	7-2777	Voice Mail
1427	Capt Craig Berg	252-0877	Left Message
1428	SSgt Winchester	7-2237	No Answer
1429	TSgt Tingley	7-4357	Can't Attend
1431	SSgt Ireland	7-2177	Not in the office, call tomorrow
1434	TSgt Whitaker	7-6516	Not in the office, call in the morning

1435	Capt Carrothers	5-9433	Not in the office try around 1600
1437	SSgt Foster	7-8734 / 7-0745	Not Interested
1439	MSgt Oram	5-2354 x2530	Voice Mail
1441	SRA Vanjoolen	5-7305 / 7-6266	Attendee
1446	MSgt King	7-7233	On leave, back on Monday
1447	SSgt Licht	5-2816	Attendee
1451	SSgt Watson	7-4805	Not in the office
1452	SRA Rose	7-3043	Not Interested
1454	SSgt Monroe	7-6058	Attendee
1500	TSgt Durham	393-4532	Wrong Number
1501	MSgt Wolfe	7-5121	No Answer
1507	Maj Hirka	7-7289	Line is Busy
1508	A1C Brown	7-6516	Line is Busy
1510	SRA Jung	7-7721	Wrong Number
1511	Lt Hartman	7-8707	Wrong Number
1512	SSgt Rough	7-1004	Away until Monday
1515	MSgt Wrede	7-3207	Not in the Office
1516	TSgt Thuma	7-5118	Line is Busy
1517	A1C Morey	7-8686	Not in the office, try tomorrow
1517	Maj Brankline	7-8719	Not in the office, try later today
1519	Lt Thomas	5-3166 x 3098	Voice Mail
1520	Maj Hinton	5-6565	Not in names directory
1522	SSgt Piddock	7-2345	No Answer
1523	HM2 Michael Holmes	5-6058 x203	Voice Mail
1525	SRA Keeton	7-4093	Wrong Number
1526	SRA Keeton	7-0720	Not Interested

1529	Amn Haney	7-9183	Not in the office
1530	SSgt Lemay	7-9349	Wrong Number
1531	SSgt Lemay	7-9935	Attendee
1536	TSgt Lemke	7-7007	Voice Mail
1537	TSgt Meadows	7-8752	Not there
1538	Maj Hayes	7-6560	Could be wrong number
1539	Maj Hirka	7-7289	TDY, back Friday
1540	A1C Brown	7-6516	Check number in orderly room, 7-6830
1542	TSgt Thuma	7-5118	Line is Busy
1604	MSgt Brown	7-6165	No Answer
1605	A1C Erickson	7-1647	No Answer
1607	SSgt Freeman	7-5550	Line is Busy
1608	MSgt Hyers	7-2777	Voice Mail
1609	SSgt Winchester	7-2237	Wrong Number
1610	Capth Carothers	5-9433	Attendee
1615	MSgt Oram	5-2354	TDY until Monday
1617	SSgt Watson	7-4805	Not there
1618	Maj Brankline	7-8719	No Answer
1619	Lt Thomas	5-3166 x3098	Voice Mail
1620	SSgt Piddock	7-2345	No Answer
1621	HM2 Holmes	5-6058 x203	Voice Mail
1622	Amn Haney	7-9183	Try back in 5 min
1623	TSgt Lemke	7-7007	Attendee
1626	TSgt Thuma	7-5118	Line is Busy
1628	Amn Haney	7-9183	Not Available
19 September 1996			
1005	MSgt Wrede	7-3207	Line is Busy
1006	A1C Morey	7-8686	Not Interested
1007	TSgt Thuma	7-5118	Line is Busy
1008	HM2 Holmes	5-6058 x203	Voice Mail
1009	SSgt Piddock	7-2345	No Answer

1010	Lt Thomas	5-3166 x3098	Voice Mail
1012	Maj Brankline	7-8719	No Answer
1013	MSgt Hyers	7-2777	Voice Mail
1014	SSgt Freeman	7-5550	Not Interested
1016	SSgt Ireland	7-2177	Line is Busy
1017	TSgt Whitaker	7-6516	Not Available
1020	A1C Erickson	7-1647	No Answer
1021	MSgt Brown	7-6165	No Answer
1023	MSgt Wolfe	7-5121	No Answer
1026	TSgt Meadows	7-8670	Not Available
	SSgt Piddock	7-5973	On leave this week
1538	George Walters	5-4151 x434	Attendee
20 September 1996			
947	MSgt Wolfe	7-6121	Not in the office
948	A1C Erickson	7-0152	Voice Mail
950	MSgt Hyers	7-2777	Voice Mail
951	Maj Brankline	7-8719	Not in the office, left message
952	Lt Thomas	5-3166 x3098	Voice Mail
953	HM2 Holmes	5-6058 x203	Voice Mail
955	TSgt Thuma	7-5118	Line is Busy
956	MSgt Wrede	7-3207	Not at his desk
957	SSgt Harmon	5-6151	Wrong Number
958	Maj Tri	5-5527	No Answer
959	SSgt Harmon	5-4173 x2553	Attendee
1005	SRA Tina Jung	7-6720	Not at her desk
1006	Maj Hinton	5-3636 x6499	Voice Mail
1007	Maj Hays	7-7886	Try back after 1130
1008	Maj Cox	5-3636 x6581	Voice Mail
1009	SRA Laughry	5-7619	Try back after 1130

1124	MSgt Wolfe	7-6121	Not interested
1126	MSgt Hyers	7-2777	Voice Mail
1127	SRA Jung	7-6720	Try back after 1300
1129	Maj Tri	5-5527	Wrong Number
1132	Maj Tri	5-1469	Voice Mail
1209	MSgt Hyers	7-2777	Left voice mail message
1211	Lt Thomas	5-3166 x3098	Left voice mail message
1212	TSgt Thuma	7-5118	Line is busy
1214	Maj Hays	7-7886	Left message
1216	Maj Tri	5-1469	Voice Mail
1321	SRA Jung	7-6720	No Answer
1323	SRA Laughry	5-7619	Left message
23 September 1996			
803	MSgt Hyers	7-2777	Voice Mail
804	Lt Thomas	5-3166 x3098	Voice Mail
805	TSgt Thuma	7-5118	Line is busy
806	Maj Hays	7-7886	Not interested
807	Maj Tri	5-1469	Voice Mail
808	SRA Jung	7-6720	Not in the office
817	SSgt Piddock	7-5973	On leave this week
818	MSgt Oram	5-2354	Not in the office
819	SSgt Rough	7-1004	No Answer
820	MSgt King	7-7233	Not Interested
1653	MSgt Hyers	7-2777	Voice Mail
1654	Lt Thomas	5-3166 x3098	Voice Mail
1657	Amn Haney	7-9183	Not working today
1658	HM2 Holmes	56058 x203	Voice Mail

APPENDIX D

Letter for Group Participants

5 Sep 96

MEMORANDUM FOR [Base Worker]

FROM: AFIT/ENV Box 4415

SUBJECT: Solid Waste Discussion Group

1. Thank you for accepting the invitation to attend the discussion group which will be held at the Environmental Management office, Area C, Building 89, library room (located at the end of the hall on the left), on Thursday 26 Sept at 0900. The session will last no longer than two hours.

2. The discussion group includes only a limited number of people, so the success and quality of our discussion is based on the cooperation of the people who attend. Because you have accepted the invitation, your attendance at the session is anticipated and will assist in making the research project a success.

3. At the session we will be discussing waste minimization efforts in the workplace and we would like to get your opinions on this subject. The results of this research effort could potentially be used to aid base decision makers in developing improved waste management strategies.

4. The discussion group will be led by the researcher, Lt Camille Still, a student in the Air Force Institute of Technology's Engineering and Environmental Management masters degree program. If you have any questions, please call her at 5-3636 ext. 6415.

CLARE R. MENDELSOHN
Chief, Waste Management Branch
Base Environmental Management

JACK M. KLOEBER, JR., LTC, USA
Assistant Professor of Operations Research
Air Force Institute of Technology

19 Sep 96

MEMORANDUM FOR [Housing Resident]

FROM: AFIT/ENV Box 4415
2950 P Street
Wright Patterson AFB OH 45433

SUBJECT: Solid Waste Discussion Group

1. Thank you for accepting the invitation to attend the discussion group which will be held at the Environmental Management office, Area C, Building 89, library room (located at the end of the hall on the left), on Thursday 26 Sept at 1300. The session will last no longer than two hours.

2. The discussion group includes only a limited number of people, so the success and quality of our discussion is based on the cooperation of the people who attend. Because you have accepted the invitation, your attendance at the session is anticipated and will assist in making the research project a success.

3. At the session we will be discussing household waste minimization efforts and we would like to get your opinions on this subject. The results of this research effort could potentially be used to aid base decision makers in developing improved waste management strategies for our housing community.

4. The discussion group will be led by the researcher, Lt Camille Still, a student in the Air Force Institute of Technology's Engineering and Environmental Management masters degree program. If you have any questions, please call her at 255-3636 ext. 6415.

JACK M. KLOEBER, JR., LTC, USA
Assistant Professor of Operations Research
Air Force Institute of Technology

APPENDIX E:

Focus Group Discussion Moderator Script

Hello, I'd like to thank you all for taking the time to attend this meeting. I'm Lt Camille Still. I'm a masters degree student, working on a thesis in the area of solid waste management. This is ____________________________ who will be assisting me today during our discussion.

Let's start with a short exercise so we can get to know a little bit about each other. I'd like to have each person pair up with someone else, and interview them. Your job is to find out these things: Where they work at on base, Their hometown, and Their favorite vacation spot. In five minutes, we'll go around the room and then you can introduce your partner.

Now, I'd like to tell you about my project and why I've asked you all to participate in this discussion. You may have heard about the waste disposal problems that our nation is facing. We continue to throw away large amounts of garbage, our landfills are filling up, and it is becoming more difficult and expensive to build new landfills. Environmental managers have to create programs to solve the waste disposal problem and reduce the amount of trash we send to a landfill. However, these environmental managers are usually scientists or engineers, people with a technical background, and they try to solve the problem with only technical solutions.

Unfortunately, these programs ignore the simple fact that when an individual has an item that is no longer useful, it is often simply a personal decision they make whether to throw the item away, or try to find another option such as reuse or recycling.

The purpose of our discussion today is to look into the areas of people's attitudes and why they make the decisions they do. I think if we can incorporate these ideas into the decisions an environmental manager makes about solid waste management, we can have a more successful program.

Now, you may be thinking, we are going to talk about garbage today, and I know we throw away many different things. To keep the length of our discussion today reasonable, I want everyone to concentrate on one type of material: paper.

Now, with this material in mind, there are many different options for reducing the amount we throw away. We'll talk about four ways to manage waste: recycling, source reduction, incineration and landfilling.

The first waste management option I want to talk about is recycling. Recycling involves separating your discarded material from the general waste so it can be processed by the recycling center. The separation may be complicated, with many bins for each individual item, or it may be simply keeping all of one type of item separated from other waste items. Special preparation may be required, such as removing clips or staples or keeping glossy paper separate from other paper. Does anyone here have other ideas or examples about paper recycling?

Another waste management option is source reduction. Source reduction includes either deciding not to use the item at all, or finding another use for it instead of discarding it.

For example, you can use the unused side of a piece of paper to write notes, or to print draft copies of a document instead of using a fresh piece of paper. You may decide to send someone an e-mail message instead of writing a note or letter. An office may decide to circulate a copy of the newspaper instead of each person getting their own individual copy. Does anybody here have other ideas about what source reduction is all about?

Incineration may occur after waste material is collected and transferred to an incineration facility. Issues regarding incineration are: could there be potentially valuable materials, such as aluminum or metals that are incinerated? is there dangerous air pollution? Incineration does reduce the volume of waste material that is discarded by 75%, so if you throw away a garbage can full of material and it goes to an incinerator, then only 1/4 of the initial amount will end up in a landfill. This is a good way to make our landfills last longer. That is just a brief outline about incineration. What other ideas come to your mind?

Landfilling of material occurs when we take our garbage to a landfill and bury it. But, we don't have room for landfills everywhere. A lot of people believe that trash in a landfill just goes away, but it really stays there for several decades. Water that flows underground could pick up harmful pollutants that are in the trash. But, landfilling is a relatively inexpensive way to discard our waste material. Does anyone have any other ideas about landfilling?

Now that we have shared our ideas about four different options available for dealing with our discarded material, lets try to consider what makes a person choose one of the options or how a person would feel about that option. Just as we are each individuals, there are potentially hundreds of reasons that lead us to take certain actions. But for the interest of my research, I'd like to concentrate on four criteria: Convenience, feeling good about reducing waste, feeling good because you are leaving a good environment for future generations, and feeling good because funds from recycling go to support recreation activities on base.

Here is a sheet that gives explanations for each of the criteria

Take a couple of minutes to look over the explanations. [PAUSE]

Are there any questions about the way the criteria are explained?

We've talked for a while about the different waste management options, now I'd like you to complete the first section of a five part questionnaire. The entire questionnaire has 27 questions. This first section has 6 questions. **If you have any questions while you are completing the questionnaire, please do not hesitate to ask. It is very important to clarify for the whole group if something is confusing.**

questionnaire part I.

Your answers to the previous questions will be used to determine how much emphasis to put on each of the criteria when making decisions about the overall program. Now we can go on to making comparisons among the different waste disposal methods with respect to each of the criteria. It may sound complicated, but actually, you will be answering simple questions as before. As you compare each waste disposal method, please keep in mind and refer back to the ideas that we generated earlier about each method.

First, lets concentrate on convenience. This section of the questionnaire has three questions. Please remember, **If you have any questions while you are completing the questionnaire, please do not hesitate to ask. It is very important to clarify for the whole group if something is confusing.**

questionnaire part II.

The next criteria to think about is feeling good about reducing waste. This is the third section of the questionnaire, and it has six questions. **Please do not hesitate to speak up if you have any questions while you are completing the questionnaire. It is very important to clarify for the whole group if something is confusing.**

questionnaire part III

The fourth section deals with what you think about feeling good because you are leaving a good environment for future generations. This section has six questions. . **If you have any questions while you are completing this section, please do not hesitate to ask. It is very important to clarify for the whole group if something is confusing.**

questionnaire part IV

We are going to use a different procedure for our last criteria, feeling good because funds from recycling go to support recreation activities on base, because since we are only looking at recycling, there are no comparisons to make between the other methods. These questions ask you to compare between different programs that could be provided with profits from a recycling program. **Please do not hesitate to speak up if you have any questions while you are completing this last section. It is very important to clarify for the whole group if something is confusing.**

Now, all the questionnaires are finished. As I said at the beginning, I've limited the questions today to the four criteria, convenience, feeling good about reducing waste, feeling good about leaving a good environment for future generations, and feeling good because profits from a recycling program go to support recreation programs on base. There are probably many other reasons to explain why people do different things with their garbage. Does anyone have other ideas about reasons why a person may use any of the waste disposal methods?

Again, I'd like to thank everyone for participating in the discussion today. Please take a few minutes to provide comments on this sheet, or if you'd like, take the sheet with you and send it to me through distribution. I also have e-mail, and I've put my address on the sheet.

APPENDIX F:

Definitions of Social Value Factors

Please consider the following ideas and definitions when making decisions about each of the criteria.

Convenience describes how easy it is for you, in terms of time and trouble, to use a method to reduce trash or dispose of trash. Convenience also depends on the amount of space in the work area is required to use the method.

Feeling good about reducing waste describes if using the method makes you feel like you are decreasing landfill use or helping to solve a national problem.

Feeling good because you are leaving a good environment for future generations describes if using the method makes you feel like you are saving natural resources, not using so much land area for burying trash, or reducing pollution in our environment.

Feeling good because funds from recycling go to support recreation programs on base: Military installations have the option of using a portion of the profits from a recycling center for recreation programs.

APPENDIX G: Questionnaire

SOLID WASTE QUESTIONNAIRE, PART I

COMPARING CRITERIA

The first set of questions deals with making comparisons about the importance of the four specific criteria. Circle the letter, either a. or b., to indicate your response.

Then use the following scale to answer the question "How much more important is it?" Fill in the blank following each question with the numerical value that best defines the importance.

Numerical Value	Definition
1	Either choice is **equally** important to me
3	One choice is **slightly more** important to me than the other
5	One choice is **strongly more** important to me than the other
7	One choice is **very strongly more** important to me than the other
9	One choice is **extremely more** important to me than the other

1. **Which is more important to you?**

   a. convenience

   b. feeling good about reducing waste

   How much more important is it? __________

2. **Which is more important to you?**

   a. convenience

   b. feeling good because you are leaving a good environment for future generations

   How much more important is it? __________

3. **Which is more important to you?**
   a. convenience
   b. feeling good because funds from recycling go to support recreation activities on base

   How much more important is it? __________

4. **Which is more important to you?**
   a. feeling good about reducing waste
   b. feeling good because you are leaving a good environment for future generations

   How much more important is it? __________

5. **Which is more important to you?**
   a. feeling good about reducing waste
   b. feeling good because funds from recycling go to support recreation activities on base

   How much more important is it? __________

6. **Which is more important to you?**
   a. feeling good because you are leaving a good environment for future generations
   b. feeling good because funds from recycling go to support recreation activities on base

   How much more important is it? __________

SOLID WASTE QUESTIONNAIRE, PART II

CONVENIENCE

This set of questions deals with making comparisons among the different waste disposal methods based on convenience. **Only think about convenience as you make your choices.** Please refer back to the group ideas about each method as you make the comparisons. Circle the letter, either a. or b., to indicate your response.

Then, use the following scale to answer the question "How much more convenient is it?" Fill in the blank following each question with the numerical value that best defines your convenience.

Numerical Value	Definition
1	Either method is **equally** convenient for me
3	One method is **slightly more** convenient for me than the other
5	One method is **strongly more** convenient for me than the other
7	One method is **very strongly more** convenient for me than the other
9	One method is **extremely more** convenient for me than the other

7. Which one of the following methods is more convenient?

a. source reduction

b. recycling

How much more convenient is it? __________

8. Which one of the following methods is more convenient?

a. source reduction

b. throwing waste in the trash

How much more convenient is it? __________

9. Which one of the following methods is more convenient?

a. recycling

b. throwing waste in the trash

How much more convenient is it? __________

SOLID WASTE QUESTIONNAIRE, PART III

FEELING GOOD ABOUT REDUCING WASTE

This set of questions deals with making comparisons among the different waste disposal methods based on the good feeling that you get when you reduce waste. **Only think about this type of good feeling as you make your choices.** Please refer back to the group ideas about each method as you make the comparisons. Circle the letter, either a. or b., to indicate your response.

Then, use the following scale to answer the question "How much more of a good feeling do you get about reducing waste by using this method?" Fill in the blank following each question with the numerical value that best defines the good feeling that you get when you reduce waste.

Numerical Value	Definition
1	Either method gives me an **equally** good feeling about reducing waste
3	One method gives me **slightly more** of a good feeling about reducing waste
5	One method gives me **strongly more** of a good feeling about reducing waste
7	One method gives me **very strongly more** of a good feeling about reducing waste
9	One method gives me **extremely more** of a good feeling about reducing waste

10. Which one of the following methods gives you more of a good feeling about reducing waste?

a. source reduction

b. recycling

How much more of a good feeling do you get about reducing waste by using this method? __________

11. Which one of the following methods gives you more of a good feeling about reducing waste?

a. source reduction

b. incineration

How much more of a good feeling do you get about reducing waste by using this method? __________

12. Which one of the following methods gives you more of a good feeling about reducing waste?

a. source reduction

b. landfilling

How much more of a good feeling do you get about reducing waste by using this method? __________

13. Which one of the following methods gives you more of a good feeling about reducing waste?

a. recycling

b. incineration

How much more of a good feeling do you get about reducing waste by using this method? _________

14. Which one of the following methods gives you more of a good feeling about reducing waste?

a. recycling

b. landfilling

How much more of a good feeling do you get about reducing waste by using this method? _________

15. Which one of the following methods gives you more of a good feeling about reducing waste?

a. landfilling

b. incineration

How much more of a good feeling do you get about reducing waste by using this method? _________

SOLID WASTE QUESTIONNAIRE, PART IV

FEELING GOOD BECAUSE YOU ARE LEAVING A GOOD ENVIRONMENT FOR FUTURE GENERATIONS

This set of questions deals with making comparisons among the different waste disposal methods based on feeling good because you are leaving a good environment for future generations. **Only think about this type of good feeling as you make your choices.** Please refer back to the group ideas about each method as you make the comparisons. Circle the letter, either a. or b., to indicate your response.

Use the following scale to answer the question "How much more of a good feeling do you get because you've left a good environment for future generations by using this method?"

Numerical Value	Definition
1	Either method gives me an **equally** good feeling about leaving a good environment for future generations
3	One method gives me **slightly more** of a good feeling about leaving a good environment for future generations
5	One method gives me **strongly more** of a good feeling about leaving a good environment for future generations
7	One method gives me **very strongly more** of a good feeling about leaving a good environment for future generations
9	One method gives me **extremely more** of a good feeling about leaving a good environment for future generations

16. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. source reduction

b. recycling

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? __________

17. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. source reduction

b. incineration

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? __________

18. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. source reduction

b. landfilling

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? __________

19. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. recycling

b. incineration

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? __________

20. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. recycling

b. landfilling

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? __________

21. Which of the following two methods gives you more of a good feeling about leaving a good environment for future generations?

a. incineration

b. landfilling

How much more of a good feeling do you get about leaving a good environment for future generations by using this method? __________

SOLID WASTE QUESTIONNAIRE, PART V

FEELING GOOD BECAUSE FUNDS FROM RECYCLING GO TO SUPPORT RECREATION PROGRAMS ON BASE

In this set of questions, the comparison is between different recreation programs that could potentially be provided through profits from a recycling program. Consider each program, then compare them based on which one would give you a better feeling because funds from recycling would be used to support that program. Circle the letter, either a. or b., to indicate your response.

Use the following scale to answer the question "How much more of better feeling about recycling does this program provide?"

Numerical Value	Definition
1	Either program gives me an **equally** good feeling about recycling
3	One program gives me **slightly more** of a good feeling about recycling
5	One program gives me **strongly more** of a good feeling about recycling
7	One program gives me **very strongly more** of a good feeling about recycling
9	One program gives me **extremely more** of a good feeling about recycling

22. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. receiving shrubs, flowers, and landscaping material to beautify my work building

b. having a picnic shelter constructed near my work building

How much more of a good feeling about recycling does this program provide? __________

23. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. receiving shrubs, flowers, and landscaping material to beautify my work building

b. having a better park and athletic fields on base

How much more of a good feeling about recycling does this program provide? __________

24. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. receiving shrubs, flowers, and landscaping material to beautify my work building

b. receiving a luncheon for my work area

How much more of a good feeling about recycling does this program provide? __________

25. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. receiving a luncheon for my work area

b. having a picnic shelter constructed near my work building

How much more of a good feeling about recycling does this program provide? __________

26. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. receiving a luncheon for my work area

b. having a better park and athletic fields on base

How much more of a good feeling about recycling does this program provide? __________

27. Which of the following programs would give you a better feeling about recycling if you knew the profits from recycling would be used to provide the program?

a. having a picnic shelter constructed near my work building

b. having a better park and athletic fields on base

How much more of a good feeling about recycling does this program provide? __________

APPENDIX H

Proceedings from Focus Group Discussions

Base Workers / Plastic, Glass, Aluminum

GROUP DISCUSSION
SUMMARY

Group 3, Base Workers
Plastic, Glass, and Aluminum
10 Sep 96, 9am

Recycling
- Pressure from younger people to be more responsible
- If it were done right, as a part of a process or system, then it would be easy
- Janitors clean recycle boxes
- Metal is supposed to go through DRMO
- Educate people to separate materials
- Need dumpsters / containers for separation of materials
- No commitment from base
- Glass and cardboard recycling are labor intensive
- What about labware glass and plastic?
- People are willing to recycle
- People are forced into recycling because of conscious
- Bottle bills are incentives
- What do we recycle, and why is it important
- Convenience is important
- Recycling toner cartridges
- Recycling will save more in the long run

Source Reduction
- There are some workplace-specific requirements for packaging from manufacturers

Incineration
- Scrubbers help maintain air quality
- EPA permit issues

Landfilling
- EPA requirements for landfills, drainage, capping, monitoring
- Community perception
- What does it cost in the long run?

Other Ideas

- Education
- Storage bins
- Lip service by leadership
- Peer pressure
- Culture change
- Manpower issues
- Young kids have better ethic
- Segregation issues
- Infrastructure needs to be there
- Need simple program
- Grass roots and overall system
- Economic issues
- We are running out of materials; resource limitations; conservation of resources
- Cost reduction
- What point do we reach where we can't sustain life
- South America used to be green, now 50% brown; rainforests supply 3% of the world's oxygen supply
- Peer pressure
- We're spoiled (quality of life)
- Styrofoam -- if people didn't buy it; they wouldn't make it
- Simple choices; we chose convenience
- It takes commitment from a lot of people
- Plastic is an oil product

Ideas Recorded on Charts

1) Recycling
   - Economic issues (markets)
   - Need system to follow through on people's efforts
   - Education pays dividends
   - Convenience is important motivator
   - Saves money in long run
   - Frustrating if you see recyclable material going in the dumpster
   - Service organizations collect material
   - Equipment investment
   - People want to do the right thing

2) Source Reduction

- Good choice is to avoid use
- More a corporate (market) decision, rather than a personal decision
- Different rules for hazardous materials

3) Incineration

- Plastic has high energy value
- Politically controversial; air emission problems
- Scrubbers reduce emissions
- Waste-to-energy facilities

4) Landfilling

- May be inexpensive in the short term, but expensive in the long term
- Long term costs
- Construction requirements, can be expensive

GROUP DISCUSSION
SUMMARY

Group 5, Base Workers
Plastic, Glass, and Aluminum
19 Sep 96, 1pm

Recycling

- Successful program must be easy to use
- Minimize amount of sorting
- Aluminum recycle bins are easy to use
- Sorting should be responsibility of recycling center
- People don't want to take labels off
- People hide that they've thrown something away
- Perception of ease
- Things people think is recycled really isn't
- Impurities may cost money
- Communities pay for recycling
- Offices want to recycle their own cans and keep the money
- Use something that is convenient
- Bins aren't available for all materials

Source Reduction

- Government provides cups, plates, napkins, flatware for offices; if they stopped, then we would use less; this is expensive
- Size of packages (cost, ease, risk)
    - Ease of using large containers (weight)
    - Is there alternative use for container
    - Cheaper to buy in bulk
    - Risk of large container
    - Always trade-offs
- Reusable packages
- Tracking requirements
- Base doesn't deal with glass or plastic (they don't provide recycling containers)

Incineration

- Plastics used as fuel in process; create toxic fumes
- What do you do with facility if it closes
- Must comply with clean air requirements

- Sometimes goals conflict
- Coordination of environmental statutes; conflict because of directives
- Base burns coal; could they burn our waste (alternative fuel, old tires)

Landfilling

- Bigger / deeper hole
- Use satellite imagery to find areas with low water table
- Improve landfill technology / use technology to find place for landfill
- Neighborhoods and people oppose it
- Large heavy trucks
- Rock quarries - very deep
- Ocean dumping - transports pollution
- Composting as fertilizer
- Garbage isn't just organic materials

Other Ideas

- Mandatory requirements -- look at all the time required because of regulations; MILSPEC
- Convenience is most important
- Management needs to fund positions specific to these problems
- Incorporate EM into job positions, dangerous
- Everything is so complicated
- Regionalize it, expand environmental management
- Have bins available
- Make it available and user friendly
- Labs are different from industrial complex
- Get information out -- why are you doing it
- No fluff, just truth
- Different environmental philosophy
- Relate things to costs -- costs for landfilling, costs for incineration, ...
- Recycled content material is more expensive
- Reduced packaging items are more expensive
- What you do needs to make sense

APPENDIX I

Raw Questionnaire Responses

Group 3, Base Workers
Plastic, Glass, Aluminum
10 Sep 96, 9am

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	3	3	0.2	5	7
	1	0.2	0.2	3	0.2	5
	9	9	9	9	9	9
	0.2	0.142857	0.2	0.333333	3	7
	5	0.333333	0.2	1	0.2	3
Geometric Mean =	1.933182	0.76214	0.736022	1.124746	1.401131	5.809061

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	9	5	0.142857
	0.142857	0.2	0.2
	0.2	0.111111	0.111111
	0.2	0.111111	0.333333
	0.2	0.142857	0.333333
Geometric Mean =	0.400357	0.281374	0.203934

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	7	7	9	9	7	5
	0.2	0.2	1	5	7	7
	0.333333	3	9	9	7	9
	5	9	9	7	9	5
Geometric	0.333333	5	5	5	5	9
Mean =	0.950979	2.852938	5.156316	6.765573	6.881789	6.765573

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	9	9	9	7		
	0.142857	0.142857	1	5		
	0.2	3	3	7	9	9
	3	5	7	7	9	5
Geometric	0.333333	7	7	7	7	9
Mean =	0.76214	2.667269	4.21029	6.544439	8.276773	7.398636

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	5	5	9	9	9	5
	5	5	5	1	5	0.2
	3	0.2	7	7	7	0.142857
	3	3	3	3	5	5
Geometric	0.333333	0.142857	9	7	9	0.142857
Mean =	2.371441	1.164659	6.108504	4.21029	6.765573	0.633512

Group 5, Family Housing Residents
Plastic, Glass, Aluminum
19 Sep 96, 1pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.2	1	0.142857	0.333333	0.333333	3
	5	0.111111	7	7	7	7
Geometric	3	0.333333	3	0.333333	5	3
Mean =	1.44225	0.333333	1.44225	0.919641	2.268031	3.979057

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	5	7	0.2
	0.142857	0.2	0.2
Geometric	3	0.2	0.2
Mean =	1.289232	0.654213	0.2

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	5	5	5	5	5	5
	0.111111	0.333333	0.333333	7	7	9
Geometric	1	9	9	9	7	3
Mean =	0.822071	2.466212	2.466212	6.804092	6.257325	5.129928

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	1	3	3	3	3	0.333333
	0.142857	0.2	0.333333	7	7	5
Geometric	1	7	9	9	7	3
Mean =	0.522758	1.613429	2.080084	5.738794	5.277632	1.709976

Part V. Recreation Value

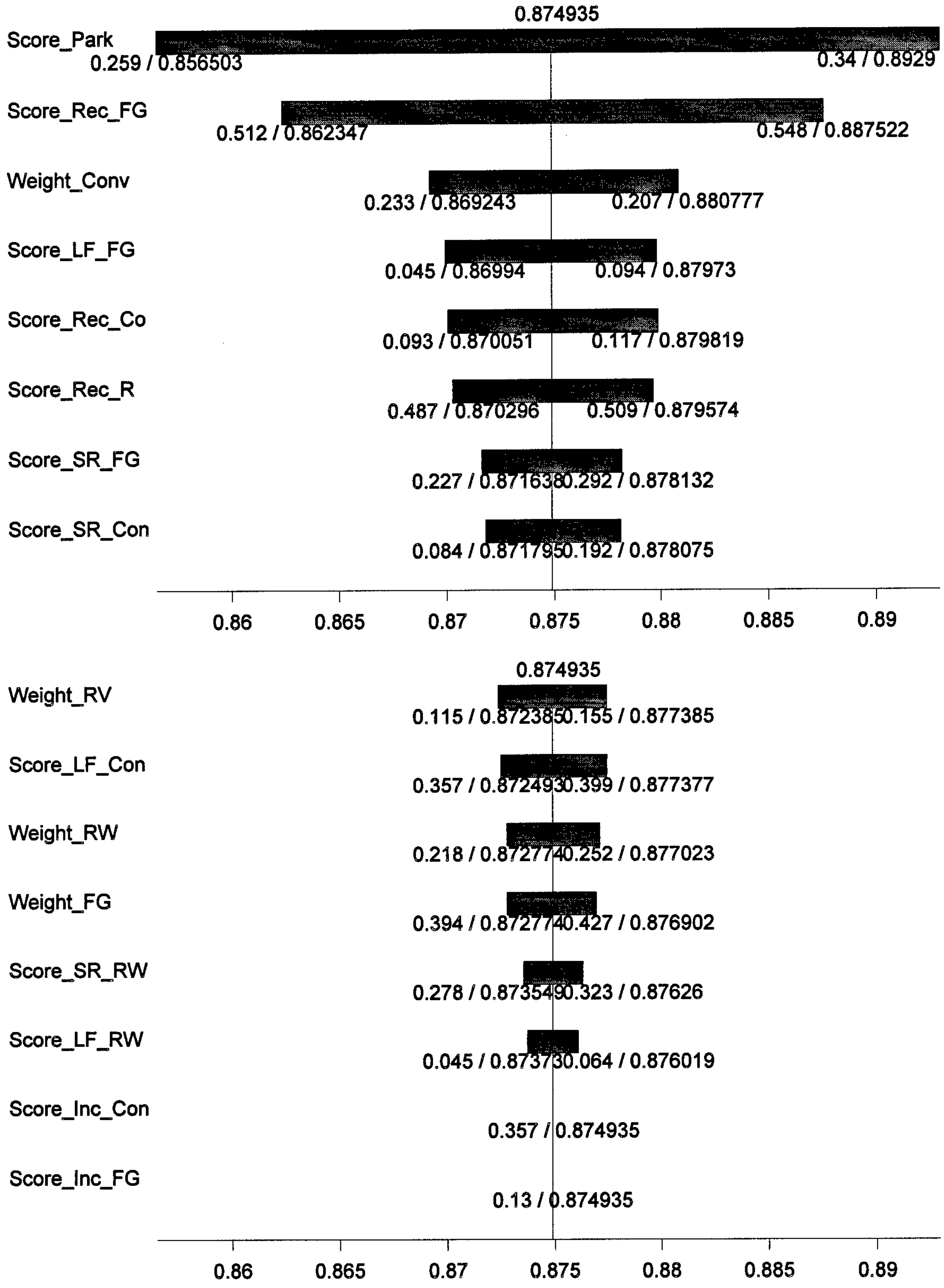
A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	0.333333	0.333333	5	5	5	0.2
	5	5	5	1	1	1
Geometric	1	3	7	5	5	3
Mean =	1.185631	1.709976	5.593445	2.924018	2.924018	0.843433

APPENDIX J

Tornado Diagram

Base Workers / Plastic, Glass, Aluminum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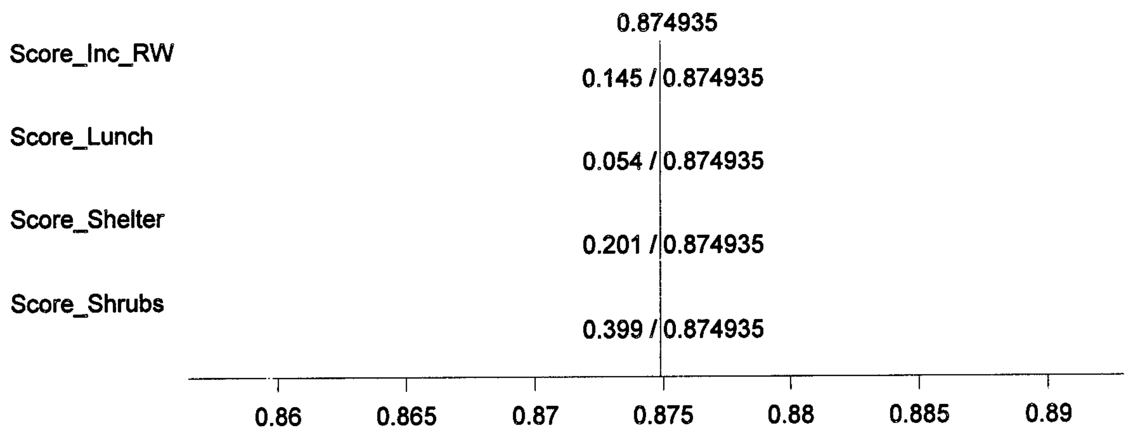
Score_Park
0.259 / 0.856503
0.34 / 0.8929
Score_Rec_FG
0.512 / 0.862347
0.548 / 0.887522
Weight_Conv
0.233 / 0.869243
0.207 / 0.880777
Score_LF_FG
0.045 / 0.86994
0.094 / 0.87973
Score_Rec_Co
0.093 / 0.870051
0.117 / 0.879819
Score_Rec_R
0.487 / 0.870296
0.509 / 0.879574
Score_SR_FG
0.227 / 0.871638
0.292 / 0.878132
Score_SR_Con
0.084 / 0.871795
0.192 / 0.878075
0.86
0.865
0.87
0.875
0.88
0.885
0.89
0.874935
Weight_RV
0.115 / 0.872385
0.155 / 0.877385
Score_LF_Con
0.357 / 0.872493
0.399 / 0.877377
Weight_RW
0.218 / 0.872774
0.252 / 0.877023
Weight_FG
0.394 / 0.872774
0.427 / 0.876902
Score_SR_RW
0.278 / 0.873549
0.323 / 0.87626
Score_LF_RW
0.045 / 0.87373
0.064 / 0.876019
Score_Inc_Con
0.357 / 0.874935
Score_Inc_FG
0.13 / 0.874935
0.86
0.865
0.87
0.875
0.88
0.885
0.89


0.874935
Score_Inc_RW
0.145 / 0.874935
Score_Lunch
0.054 / 0.874935
Score_Shelter
0.201 / 0.874935
Score_Shrubs
0.399 / 0.874935
0.86
0.865
0.87
0.875
0.88
0.885
0.89

APPENDIX K

Proceedings from Focus Group Discussions

Base Workers / Paper

GROUP DISCUSSION
SUMMARY

Group 1, Base Workers
Paper
9 Sep 96, 9am

Recycling
- Individuals don't have concept -- what is in it for me
- Perception problem, people who deal with paper all the time
- Develop more efficient ways to recycle
- Quality perceptions
- Most want to contribute, make it user friendly
- Management influence
- Time
- Recycling surcharge
- Turn paper into insulation
- Charge waste disposal to organization
- Bottle bill deposit
- Incentivise instead of penalize
- Not only see money come back for recycling, should see actual recycled products being used
- Have a competition among groups for amount of waste reduced

Incineration
- Political issue
- Contractors want to make a profit

Landfilling
- Paper should be more biodegradable
- Use less toxic inks
- Records storage issues
- Pay by the bag for disposal

Other Ideas
- Negative incentives
- Different Products that can be made from recycled material
- Tangible reminders in the workplace
- Results

- See how paper production impacts environment
- Where does command emphasis fit into the motivation spectrum
- Awareness: trees required, erosion problems, natural habitats
- Trees used to produce paper are in tree farms
- Command emphasis - encouragement
    - Makes a big difference
    - Inefficient supply system
    - More visible if program is to work
    - Need to see management doing it
    - Commanders don't encourage innovation
- Get portion of profits back
- Concern is about regulations, not how to make the program successful
- Base doesn't do anything that may cause a problem
- Let people know there are similar problems / learn from each other
- AFIT Training course for the unit environmental coordinators

<u>Ideas Recorded on Charts</u>

1) Recycling
    - Industrial vs. home
    - Several recycling companies out there
    - Many different types of programs
    - Economic concerns
    - Quality of recycled paper
    - Airborne dispersal of fibers (environmental impact)
    - Co-generation is better (incineration)
    - Available markets
    - Lose money on recycling
    - Who transports recyclable material to recycling center?
    - Education program
    - Research needed for products and markets (insulation)
    - Tangible reminders
    - Affirmative procurement
    - Purchase surcharge
    - Incentives vs. penalties

2) Source Reduction
    - New technologies remove need for paper, i.e. digitized (computer) information
    - Incentives help; rewards (+$) or punishment (-$)
    - Motivation techniques
    - Change components of paper to make it biodegradable?

3) Incineration

- Air permits, tests, inspections; high cost to reduce air pollution
- Cogeneration - produce energy from burning waste
- "Not in my backyard"; political and public concerns about burning
- Profit motive from incinerator operators or contractors

4) Landfilling

- Charge fee per bag
- Incentives to reduce landfill waste
- Send garbage to other towns

GROUP DISCUSSION
SUMMARY

Group 2, Base Workers
Paper
9 Sep 96, 1pm

Recycling
- Enforcement in Germany is strong motivator
- More effective enforcement
- Positive financial or negative incentives
- No big incentive program on base
- Localized MWR benefits
- European fast food restaurants have color coded trash bins to separate waste material

Source Reduction
- Main incentive comes from doing things more efficiently; reducing paper use is an added benefit

Other Ideas
- Cutback on janitorial service yields less waste; people don't want to see full trash cans
- Various levels of command interests
- Disconnects between command policy and real world
- Costs associated with solid waste
- Publicity about cost of waste disposal
- Analogy to energy use

Ideas Recorded on Charts
1) Recycling
    - Individual assigned disposal containers
    - Affirmative procurement
    - Recycle shredded classified
    - Edible paper
    - Rewards
    - Incentives and disincentives
    - How much money comes back to the unit
    - Policy requirements to separate material
    - Simple is better

- Europe is way ahead of the US
- Government oversight

2) Source Reduction
   - Computer information
   - Electronic forms help (only print what you need)
   - Education about alternate programs
   - Technology must reach everybody
   - E-mail often creates extra paper
   - Economic considerations
   - Cut back on printing extra copies of orders
   - Ease back on required copies of official documents

3) Incineration
   - Concerns about atmosphere
   - Energy from burning
     - Requires waste segregation
     - Requires testing, quality control
   - Regulatory oversight
   - "Not in my backyard"

4) Landfilling
   - Passes the buck to future generations
   - Problem doesn't go away
   - Send to other states / countries

GROUP DISCUSSION
SUMMARY

Group 7, Base Workers
Paper
24 Sep 96, 1pm

Recycling

- When you generate large computer printouts, save and use unused side for drafts
- E-mail hard copies
- Computers generate more paper
- Confusion about phone books, put it with newspaper
- Cardboard recycling -- no information
- Education -- stop people from throwing it away
- Recycling program needs to pick up cardboard

Source Reduction

- Use boxes to send items back
- No hard copies of e-mail
- Excess packaging -- work with vendors
- Keep and store computer box
- Vehicle integrated management system
    - Why print monthly lists for vehicle control officers?
- Need tangible incentive for using less
- Don't print so many draft copies

Incineration

- Styrofoam containers, not good packaging
- Cost of taking metal out of waste (circuit boards)
- Burn classified material
- NAIC - pelletize classified shredded material, then taken to heat plant
- Waste petroleum sold for alternative fuels
- Public furor at concrete plant in Fairborn
- Good use for used oil, makes sense
- Base uses coal, natural gas in two boilers -- cost reduction and cleaner burning

Landfilling

- Less cost now, but true cost is higher
- How do you control what goes into landfill?
- Controls are inadequate, especially at home
- Any effort to reclaim landfill for further use?
- Leaching into water sources
- Sometime we'll run out of land
- Garbage barge, ocean dumping

Other Ideas

- Use recycling profits to come up with more efficient waste disposal
- Use funds for education
- Convenience
    - Gradually people start using recycle bins
    - Getting services to empty them, people need to do management of the process, it breaks down
- Cost reduction, high on the list, operating costs reduction
- Shop rags (cloth): first got uncontrolled availability, switched to paper, now they are issued out per person per week. Encourages people to only use the amount needed, reduces the amount of waste
- Commander emphasis -- they are involved, hear little from commander
- Copiers are limited to amount of paper
- Not everyone gets copies of agenda at meeting
- Education about incineration vs. landfill
    - Air pollution
    - What is available, what to do with items

Ideas Recorded on Charts

1) Recycling
    - Print on both sides
    - Phone books, quantity, and color paper
    - Availability of cardboard recycling
    - No pick up of boxes

2) Source Reduction
    - No hard copies of e-mail
    - Storage in cardboard boxes
    - Re-use of boxes

- Packaging, not just one item per box
- Check papers before printing

3) Incineration
   - Cost of separation
   - Classified material burning
   - Burning alternative fuels

4) Landfilling
   - Consider long term costs
   - No control over wastes landfilled
   - Reclamation of landfills
   - Running out of space

GROUP DISCUSSION
SUMMARY

Group 11, Base Workers
Paper
26 Sep 96, 9am

Recycling

- Classified material has to be burned
- Payback for recycling paper isn't good
- Consider life cycle cost; how much does it cost to dispose of waste
- Not required to separate materials; labor intensive at collection center
- Corporate America is paid to make money
- There will come a day when there is no place to put trash
- 40% diversion is maximum that recycling could ever achieve
- Plastics are terrible, process requires chemicals
- Rather see e-mail; not use paper; even works for classified with a special system
- Can you recycle colored, printer paper? Depends on the type of ink
- Have seen a tremendous cut in paper products
- Can you recycle glossy magazines?

Source Reduction

- Printers, lots of charts per page
- Regulations on CD-ROM, on-line, microfiche is hazardous to produce
- Projectors instead of overheads
- Electricity cost
- Look at procedures, what is required to process I.D. card, contractors need one letter per person; now use a blanket letter
- Libraries don't have space for NPL documents; they could use CD-ROM

Incineration

- The thought of incinerators; people's perceptions are negative
- Restrictions have come to be extreme
- Ohio is going overboard; Clean Air Act requirements
- Good for paper
- In the 1950's, people separated waste materials
- More public information
- Cement kilns are state of the are, good method for hazardous waste
- Closed Moraine incinerator because of dioxins
- Depends on what you burn, can use scrubbers for plastic material
- Costly method; three stage burner $350K; total cost $570K
- Filters and waste systems turn into hazardous waste (smaller quantities)
- What is safe standard, really?
- States what to be tighter than EPA; to do this in attainment area is silly

Landfilling

- Cost effective
- Cost of disposing of shingles has tripled because of environmental impacts
- Certain places; there is no threat to groundwater
- Have to build them right, where they can't come in contact with water
- Very expensive
- They always find places to dump solid waste in emergencies
- Landfilled material doesn't decompose
- If you could keep toxics out of landfills, we could go back to less strict laws
- "Not in my backyard"
- Rather landfill material than dump it in ocean
- We ship wastes now; have each county be responsible for their own waste
- No leaves and grass in landfill

Other Ideas

- Love canal
- See landfills; factories
- Old factories should be recycled
- Remodel old homes, rather than tearing them down
- Laws, public should be more aware; have more knowledge
- Companies should be responsible for what they produce and waste
- Environmental laws force smaller companies out of business; OSHA is strict
- Old habits are hard to break
- Incentives should be publicized
- Perception of commander - wants to keep base beautiful
- People need to think about future, where will you put waste then
- We plant trees, then do not provide required upkeep, now they are eyesores

Ideas Recorded on Charts

1) Recycling
    - Poor payback for paper recycling
    - Separation is labor intensive
    - Waste stream reduction is small
    - Colored ink or paper?
    - Magazines can't be recycled

2) Source Reduction
    - Use e-mail (even okay for classified), CD-ROM, microfiche
    - Multiple charts on one page
    - Forms, regulations available on-line
    - Use projectors, not handouts
    - Procedure changes

3) Incineration
    - Excessive restrictions
    - Public perceptions
    - Education
    - Proper equipment
    - Scrubbers, clean but costly

4) Landfilling

- Cost is increasing
- Use quarries
- Must be placed and built correctly
- Natural disasters create waste
- Little decomposition
- Better than ocean dumping
- County management
- No grass or leaves

APPENDIX L

Raw Questionnaire Responses

Group 1, Base Workers
Paper
9 Sep 96, 9am

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.2	0.2	0.2	7	5	5
	0.333333	0.333333	0.333333	3	3	3
	7	7	7	0.333333	3	3
	3	3	3	0.333333	3	3
	3	7	5	3	0.333333	5
	1	1	1	1	1	1
	0.2	0.2	0.142857	5	0.142857	0.142857
Geometric	0.2	0.111111	0.2	0.111111	0.142857	3
Mean =	0.800136	0.826517	0.817765	1.185027	0.989412	2.030794

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	0.333333	0.2	0.2
	0.333333	5	5
	5	0.111111	0.111111
	0.142857	0.111111	1
	5	0.2	1
	0.111111	0.111111	0.111111
	0.333333	0.2	0.333333
Geometric	9	9	0.333333
Mean =	0.776577	0.386097	0.438691

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.333333	5	5	7	7	5
	0.333333	0.333333	5	5	3	3
	3	7	7	3	7	5
	0.333333	5	5	3	7	5
	0.111111	9	9	9	9	0.111111
	5	5	5	3	3	5
	0.333333	5	7	5		
Geometric	7	7	7	7		
Mean =	0.784888	4.172532	6.104879	4.833011	5.503385	2.43478

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.2	5	5	7	7	3
	0.2	3	5	5	5	3
	3	3	5	5	7	5
	5	7	7	5	7	7
	0.2	9	9	9	5	9
	5	5	5	7	7	5
	3	7	9	7		
Geometric	7	7	7	7		
Mean =	1.372607	5.372976	6.299704	6.367121	6.257325	4.919495

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	3	3	3	1	1	1
	5	0.2	5	5	5	0.2
	0.142857	7	0.142857	4	4	4
	5	0.142857	3	0.333333	7	0.142857
	1	3	0.333333	0.333333	0.333333	3
	0.142857	0.142857	7	7	7	0.142857
	1	3	0.333333	0.2	0.2	3
Geometric	5	5	0.2	5	3	5
Mean =	1.289672	1.183813	1	1.409242	1.934336	0.962195

Group 2, Base Workers
Paper
9 Sep 96, 1pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	3	0.333333	0.333333	0.333333	0.333333
	0.2	0.2	3	0.333333	5	7
	5	5	5	0.142857	7	9
	0.142857	0.111111	5	0.142857	7	9
Geometric	7	7	3	0.2	0.2	0.333333
Mean =	1.245731	1.184664	2.371441	0.214446	1.748296	2.290172

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	1	0.333333	0.333333
	0.333333	0.333333	0.2
	7	7	0.142857
	7	0.142857	0.111111
Geometric	1	0.333333	1
Mean =	1.748296	0.517282	0.254047

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	5	5	5	3	5	5
	7	7	7	5	7	3
	5	7	7	7	7	1
	5	9	9	7	7	0.142857
Geometric	3	7	9	7	9	5
Mean =	4.828651	6.881789	7.236528	5.524298	6.881789	1.606914

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	5	5	5	5	5	5
	5	7	7	7	7	3
	7	7	7	7	5	1
	9	9	9	7	7	7
Geometric	3	5	9	5	9	5
Mean =	5.431007	6.433921	7.236528	6.118526	6.433921	3.499708

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	0.2	0.2	0.2	3	3	3
	0.2	0.2	7	5	7	0.333333
	7	7	7	1	1	1
	7	0.111111	7	7	9	0.111111
Geometric	3	0.142857	5	3	9	0.142857
Mean =	1.425199	0.338504	3.214096	3.159818	4.427319	0.436648

Raw Questionnaire Responses

Group 7, Base Workers
Paper
24 Sep 96, 1pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.2	0.2	0.2	0.333333	0.333333	3
	0.333333	0.2	0.2	5	3	3
	3	1	3	1	3	3
	5	1	0.333333	5	9	7
Geometric	0.2	0.142857	0.2	0.2	5	7
Mean =	0.7	0.4	0.4	1.1	2.7	4.2

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	3	0.333333	0.333333
	3	5	5
	5	0.142857	0.142857
	9	9	7
Geometric	5	3	0.333333
Mean =	4.6	1.5	0.9

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.333333	5	5	5	5	0.333333
	0.2	5	5	5	5	5
	1	7	7	7	7	5
	9	9	9	9	9	7
Geometric	9	5	9	7	7	3
Mean =	1.4	6.0	6.8	6.4	6.4	2.8

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	5	5	5	5	3
	0.333333	3	5	5	5	3
	1	7	7	7	7	7
	9	9	9	9	9	7
Geometric	5	7	9	5	7	5
Mean =	2.1	5.8	6.8	6.0	6.4	4.7

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	3	3	3	3	3	3
	3	0.2	0.2	0.2	3	0.333333
	1	0.2	5	7	7	0.142857
	9	9	9	0.142857	9	0.111111
Geometric	5	0.2	3	0.333333	5	5
Mean =	3.3	0.7	2.4	0.7	4.9	0.6

Group 11, Base Workers
Paper
26 Sep 96, 9am

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.2	0.2	0.142857	0.142857	0.142857	0.142857
	3	3	3	0.2	3	5
Geometric	0.142857	0.2	0.333333	1	3	3
Mean =	0.4	0.5	0.5	0.3	1.1	1.3

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	9	7	7
	5	0.142857	0.142857
Geometric	1	0.111111	0.111111
Mean =	3.6	0.5	0.5

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	7	7	7	3	3	5
	7	9	9	7	7	3
Geometric	7	9	9	9	9	9
Mean =	7	8.3	8.3	5.7	5.7	5.1

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	1	5	5		5	5
	7	9	9	7	7	3
Geometric	5	9	9	9	9	9
Mean =	3.3	7.4	7.4	7.9	6.8	5.1

Part V. Recreation Value

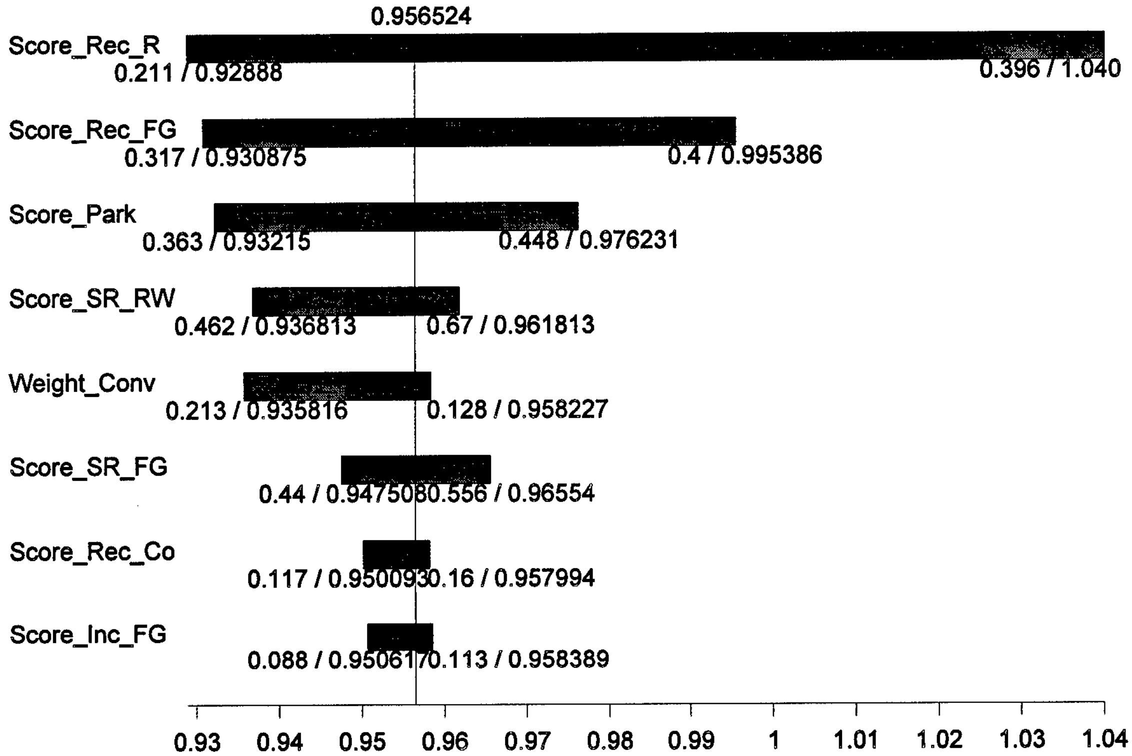
A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	5	5	5	3	5	0.2
	1	0.333333	5	3	7	0.2
Geometric	1	1	1	3	3	3
Mean =	1.7	1.2	2.9	3.0	4.7	0.5

APPENDIX M

Tornado Diagram

Base Workers / Paper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0.396 / 1.040
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0.4 / 0.995386
Score_Park
0.363 / 0.93215
0.448 / 0.976231
Score_SR_RW
0.462 / 0.936813
0.67 / 0.961813
Weight_Conv
0.213 / 0.935816
0.128 / 0.958227
Score_SR_FG
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Score_Rec_Co
0.117 / 0.9500930.16 / 0.957994
Score_Inc_FG
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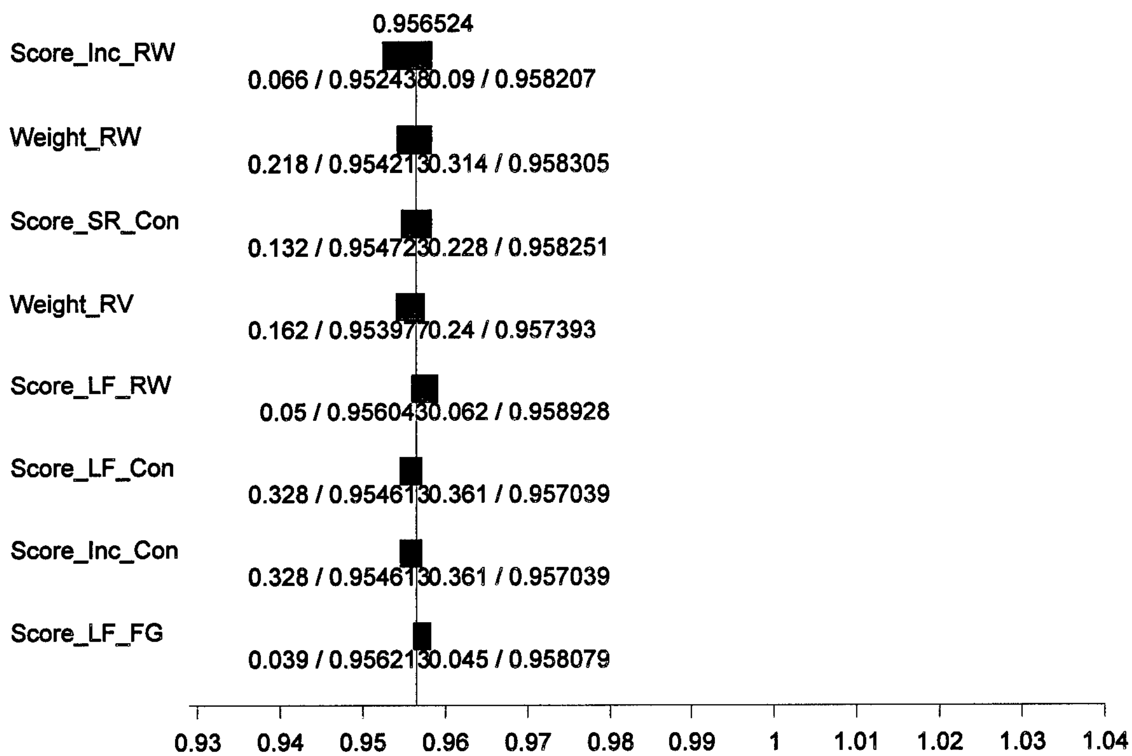
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Score_LF_RW
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Score_Inc_Con
0.328 / 0.9546130.361 / 0.957039
Score_LF_FG
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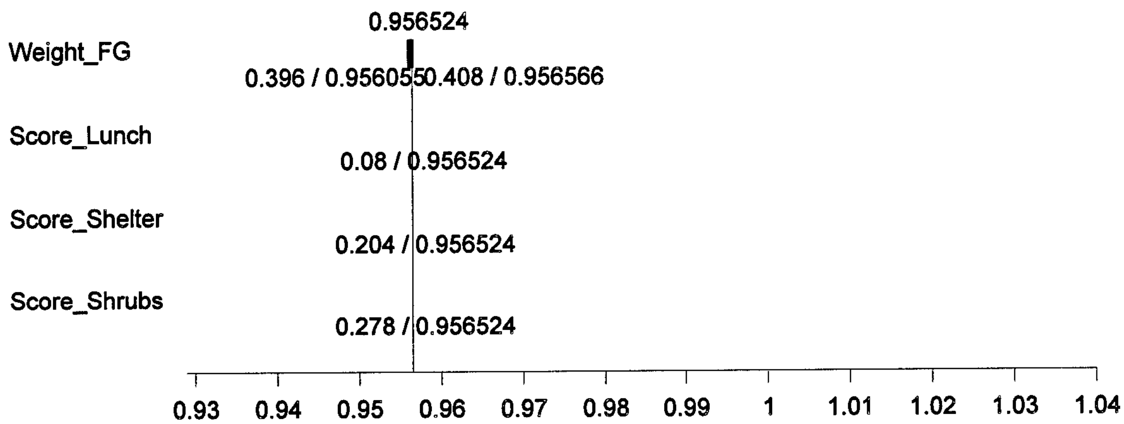
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Weight_FG
0.396 / 0.956055
0.408 / 0.956566
Score_Lunch
0.08 / 0.956524
Score_Shelter
0.204 / 0.956524
Score_Shrubs
0.278 / 0.956524
0.93
0.94
0.95
0.96
0.97
0.98
0.99
1
1.01
1.02
1.03
1.04

APPENDIX N

Proceedings from Focus Group Discussions

Military Family Housing / Plastic, Glass, Aluminum

GROUP DISCUSSION
SUMMARY

Group 4, Family Housing Residents
Plastic, Glass, Aluminum
17 Sep 96, 12pm

Recycling
- Specific instructions, well organized
- Following specific instructions; started in 1993
- Various levels of participation
- One bin, other communities have several bins
- Simple
- Bins are easier than bags
- Rain is a problem
- More frequent awareness updates
- Print on the side of the bin - what is recyclable
- Recyclable logo on product
- Each base has different policy, market factors
- Get people to want to pitch in
- Do we get financial benefit
- What is done with recycling?
- Look at participation, motivation factors
- Bigger bins, "toter" type bins, different color
- Economically attractive

Source Reduction
- 80% food containers
- Reusable containers, bulk items
- Change in industry
- Industry is changing the way people think and use products
- Refillable containers
- Biodegradable containers
- Eat less

Incineration
- Digging up landfills and incinerating it
- Energy source, burning tires, control pollution
- Economically attractive

- Air pollution, public opposition
- Need education, control emissions, smell, odor
- People would be in favor if there was more awareness
- Sounds good in terms of reduction
- It costs to incinerate; need a way to recoup costs
- Businesses want to make money

Landfilling

- Ski slopes, recreation, golf courses, near inner city
- Strip mines, quarries, gravel pits
- Liners, clay, keep water from running through it

Other Ideas

- Hassle
- Too many trash bags to carry
- $5 / 3 bags; forces people to recycle
- Education is important
- See what it is doing, recycled products
- Saturn automobiles
- Tell people -- here is how we benefit; like AAFES dollars going back to MWR
- Schools
- Make recycling more convenient than throwing stuff away
- Unless you have internal motivation, you don't do it
- Extra effort adds to likelihood of going into trash
- Recycle bin like trash bin
- Ease to customer is difference
- Long range impacts are theoretical, you are not feeling impacts today
- Once we are used to a routine, discipline
- What are immediate consequences for not recycling
- Local waste management; waste reduction goals
- Volume incentives, visually appealing, monetary impact
- Incentive program; a percentage of benefit was paid for by recycling
- Survey, funds available for variety of things
- Need to see impact and benefit

GROUP DISCUSSION
SUMMARY

Group 8, Housing Residents
Plastic, Glass, and Aluminum
24 Sep 96, 6pm

Recycling

- Best is one bin
- Hassle and inconvenient for several bins
- Convenience is of highest importance
- Drop-off locations don't work
- Sorting is too inconvenient
- Combine and put it at curb
- One container isn't big enough
- People put excess recyclable material in plastic bags--may be thrown away
- Using plastic bags creates another waste
- Full size "toter" for recycling materials
- Increase number of plastics that are taken
- Put all plastic in the recycling bin
- Publicity; more information; fliers, pamphlets (system needs to be better)
- Label on container that indicates recyclable material
- Make it simple and convenient to do
- If people have to call for information, they won't

Source Reduction

- Laundry detergent -- concentrated, smaller containers
- Substitution for products
- It has to be convenient, taking water jugs back is inconvenient
- Concentrated juice doesn't taste the same
- Less packaging from manufacturers
- Computer software has excess packaging

Incineration

- Good if you can get energy back
- Clean air is a big concern
- People don't care about volume of waste
- Loss of material isn't big deal, not cost effective to separate
- "Not in my backyard"

Landfilling

- Should be last thing, try all other options first
- Compost landfilled material if you can
- Landfill completely encloses material - no decomposition
- Amend current rules and regulations
- Entombment is bad
- Send it to the moon

Other Ideas

- Convenience is ultimate
- Monetary incentives
- Time is money
- The questionnaire assumes that people have at least some environmental conscious

Ideas Recorded on Charts

1) Recycling
    - One bin - convenience
    - Drop-off's don't work
    - Too small, need another "toter"
    - Accept more plastics
    - Publicize recyclable materials

2) Source Reduction
    - Substitute products
    - Packaging from manufacturers

3) Incineration
    - Energy recovery
    - Cleanliness of process
    - Too costly to separate

4) Landfilling
    - Last resort
    - Compost landfill material
    - Revise regulations, operations

GROUP DISCUSSION
SUMMARY

Group 9, Family Housing Residents
Plastic, Glass, Aluminum
25 Sep 96, 9am

Recycling
- Pull out glossy from newspaper
- If it is easy people will do it; no one wants to put in effort
- Easier to do it here; no drop-offs
- Three bins is not too much more difficult
- Separating from one bin to two is inconvenient
- Compactor in the home
- Take out trash "toter", then carry other bin
- They tell you to recycle, but don't give you instructions
- Information comes with so much other stuff
- Send reminders
- Does recycling program take brown grocery bags?
- Throw away cardboard and paper, should use reusable, sturdy containers
- Deposits on cans
- Household hazardous waste should be picked up

Source Reduction
- Reusable packaging
- Minimizing source is good, people don't think about it
- Biodegradable
- Everything goes back into use eventually
- Convenience is key to everything
- Remember to take things back
- Reuse bags for recycling material
- Manufacturers should be responsible for reducing packaging
- Tradeoffs -- using plates and washing them vs. throwaway paper plates

Incineration
- Air pollution is big problem, scrubbers minimize pollution, what is expense?
- Is it cost effective
- Seems superior to landfilling
- May be less costly, if you can recycle material, why burn it?

- Burn things in a wood stove
- Reduces size, but you are wasting resources and why pollute the air?
- Still have questions about it
- How many cities use it, what is investment?
- Is waste ash more toxic than trash?
- Base has an incinerator in Area B

Landfilling

- Could material be used for construction material?
- Use in structures
- If we can recycle material - we should
- Most things can be recycled in one form or another
- Retraining people
- Jobs for people to separate waste at facilities, or equipment to separate
- Pay for materials recovery
- How much would you be willing to pay to throw away everything?
- Do people pay extra to have recyclables collected?
- Things come out of ground, putting it back isn't bad
- Some things cost more to separate than to just discard
- You don't know what is thrown away, i.e. oil?
- You can only screen so much, toxics are a problem

Other Ideas

- If air could be cleaned enough, then incineration is superior method
- Personal preference among different recreation incentives
- Feeling good about reducing waste and future generations; not a lot of difference between these, they are tied close
- Convenience
- Cost efficiency
- Standardizing recycling material makes it easier
- If you burn stuff you can never use it again
- Landfilled material may be used again later; recycling is best
- Getting manufacturers to make products that are recyclable, cost is hidden in price of item
- People want monetary gain, return something back

Ideas Recorded on Charts

1) Recycling
- Must be easy to do
- One bin, curbside is easiest
- Instructions are unclear
- Grocery sacks
- Incentives to recycle
- Household hazardous waste

2) Source Reduction
- Reusable packaging

3) Incineration
- Cleaner process
- Personal incineration -- wood stoves
- How much is incineration actually used
- Danger of residue / ash

4) Landfilling
- Use compacted material
- Separate waste prior to landfilling
- What goes on?
- Cost effective

APPENDIX O

Raw Questionnaire Responses

Group 4, Family Housing Residents
Plastic, Glass, Aluminum
17 Sep 96, 12pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	0.333333	5	0.333333	3	5
	5	3	9	0.333333	9	9
	1	0.2	1	1	1	7
Geometric	3	0.333333	0.111111	0.333333	0.2	0.333333
Mean =	2.59002	0.508133	1.495349	0.438691	1.524398	3.201086

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	3	0.2	0.2
	0.142857	0.111111	0.2
	0.111111	0.142857	0.2
Geometric	0.2	0.333333	0.333333
Mean =	0.312394	0.180361	0.227244

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	3	3	5	5	5
	9	9	9	7	7	3
	0.142857	0.2	7	7	9	7
Geometric	0.333333	5	9	5	5	3
Mean =	1.064844	2.279507	6.422085	5.91608	6.299704	4.212866

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	5	5	5	3	3	3
	9	9	9	7	7	3
	0.142857	0.2	7	7	9	7
Geometric	0.2	0.333333	5	5	5	5
Mean =	1.064844	1.316074	6.299704	5.206811	5.544443	4.212866

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = free child care

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	5	0.2	0.2	3	3	0.2
	7	0.142857	0.111111	0.142857	3	0.111111
	5	3	7	0.2	0.2	0.2
	0.111111	0.111111	3	9	9	0.111111
Geometric Mean =	2.099901	0.312394	0.826517	0.937182	2.006221	0.149071

Group 8, Family Housing Residents
Plastic, Glass, Aluminum
24 Sep 96, 6pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	4	3	5	0.333333	3	4
	9	9	7	0.333333	0.333333	1
Geometric	6	6	4	6	4	8
Mean =	6	5.5	5.2	0.9	1.6	3.2

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	0.2	0.2	0.333333
	0.111111	0.111111	0.142857
Geometric	0.111111	0.111111	0.166667
Mean =	0.1	0.1	0.2

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.25	4	5	5	5	3
	6	6	6	5	6	4
Geometric	0.166667	8	9	9	9	6
Mean =	0.6	5.8	6.5	6.1	6.5	4.2

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	5	6	7	5	7	4
	7	7	9	7	7	3
Geometric	0.166667	9	9	9	9	6
Mean =	1.8	7.2	8.3	6.8	7.6	4.2

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = child care for special events

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	4	3	0.166667	0.142857	0.142857	0.333333
	9	7	5	0.2	0.333333	1
Geometric	9	0.166667	0.111111	0.111111	0.142857	0.142857
Mean =	6.9	1.5	0.5	0.1	0.2	0.4

Group 9, Family Housing Residents
Plastic, Glass, Aluminum
25 Sep 96, 9am

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	1	3	1	0.142857		1
Geometric	5	3	1	0.333333	0.2	0.333333
Mean =	2.2	3.0	1.0	0.2	0.2	0.6

Part II. Convenience

A = source reduction
B = recycling
C = throwing waste in the trash

	A vs B	A vs C	B vs C
	9	0.142857	0.2
Geometric	0.2	0.2	0.333333
Mean =	1.3	0.2	0.3

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	5	9	7	9	5	5
Geometric	1	9	9	9	9	3
Mean =	2.2	9.0	7.9	9.0	6.7	3.9

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = incineration
D = landfilling

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.333333	9	5	9	5	0.2
Geometric	1	9	9	9	9	3
Mean =	0.6	9.0	6.7	9.0	6.7	0.8

Part V. Recreation Value

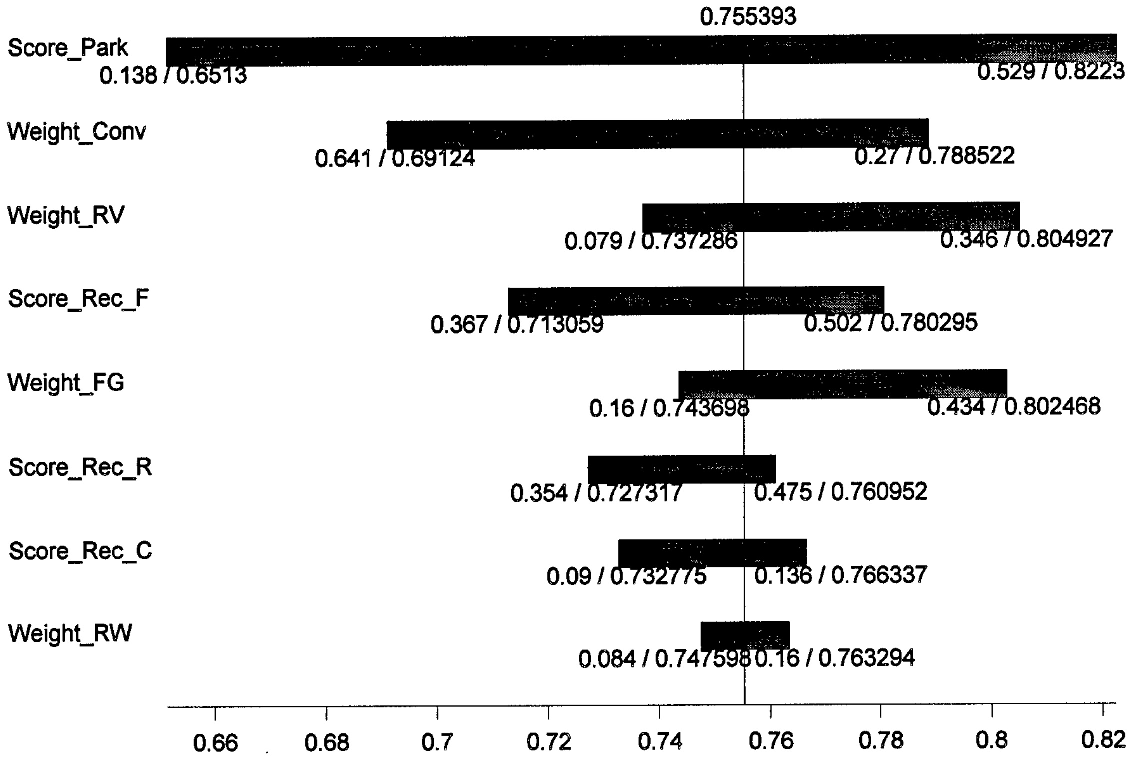
A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = child care for special events

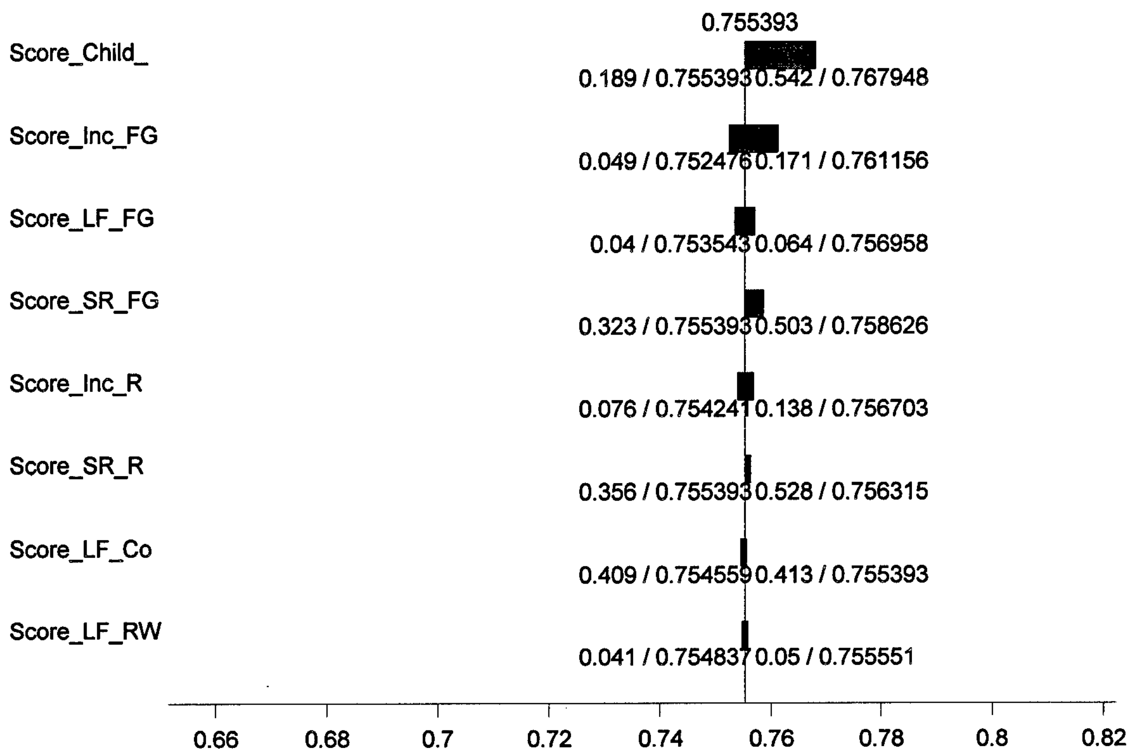
	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	7	1	0.2	0.2	3	0.2
Geometric	1	1	3	3	3	1
Mean =	2.6	1.0	0.8	0.8	3.0	0.4

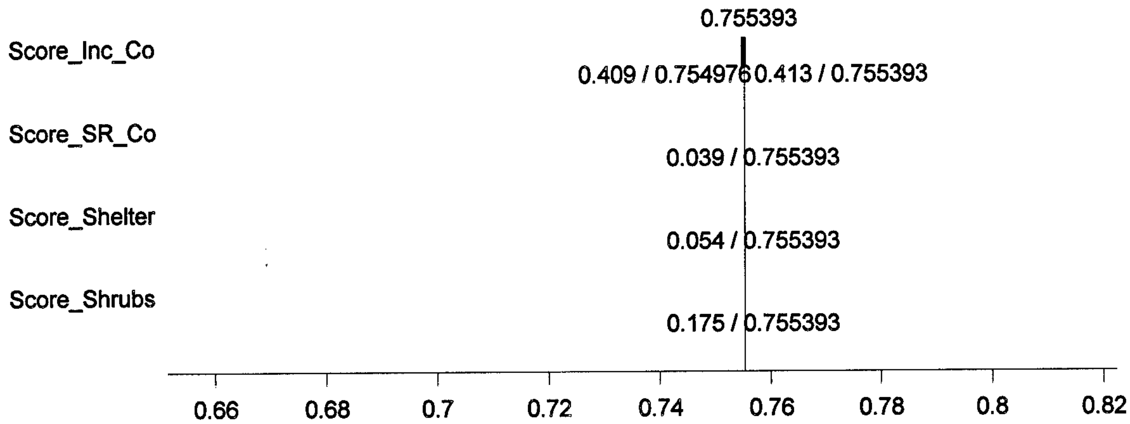
APPENDIX P

Tornado Diagram

Family Housing Residents / Plastic, Glass, Aluminum


0.755393
Score_Park
0.138 / 0.6513
0.529 / 0.8223
Weight_Conv
0.641 / 0.69124
0.27 / 0.788522
Weight_RV
0.079 / 0.737286
0.346 / 0.804927
Score_Rec_F
0.367 / 0.713059
0.502 / 0.780295
Weight_FG
0.16 / 0.743698
0.434 / 0.802468
Score_Rec_R
0.354 / 0.727317
0.475 / 0.760952
Score_Rec_C
0.09 / 0.732775
0.136 / 0.766337
Weight_RW
0.084 / 0.747598
0.16 / 0.763294
0.66
0.68
0.7
0.72
0.74
0.76
0.78
0.8
0.82


0.755393
Score_Child_
0.189 / 0.755393
0.542 / 0.767948
Score_Inc_FG
0.049 / 0.752476
0.171 / 0.761156
Score_LF_FG
0.04 / 0.753543
0.064 / 0.756958
Score_SR_FG
0.323 / 0.755393
0.503 / 0.758626
Score_Inc_R
0.076 / 0.754241
0.138 / 0.756703
Score_SR_R
0.356 / 0.755393
0.528 / 0.756315
Score_LF_Co
0.409 / 0.754559
0.413 / 0.755393
Score_LF_RW
0.041 / 0.754837
0.05 / 0.755551
0.66
0.68
0.7
0.72
0.74
0.76
0.78
0.8
0.82


0.755393
Score_Inc_Co
0.409 / 0.754976
0.413 / 0.755393
Score_SR_Co
0.039 / 0.755393
Score_Shelter
0.054 / 0.755393
Score_Shrubs
0.175 / 0.755393
0.66
0.68
0.7
0.72
0.74
0.76
0.78
0.8
0.82

APPENDIX Q

Proceedings from Focus Group Discussions

Military Family Housing / Paper, Yard Waste, Food Waste

GROUP DISCUSSION
SUMMARY

Group 6, Family Housing Resident
Paper, Yard Waste, Food Waste
24 Sep 96, 9am

<u>Recycling</u>

- Large containers in housing, put it at curb the same day as trash
- Container is too big
- Cardboard has to be sorted -- corrugated; tend to just throw it away, what is the difference?
- Everything in one container
- Do you need to take labels off of glass? Inconvenience
- Should be mandated, tell them you have to do it
- Big toter for recycling
- Drop off sites centrally located in housing areas
- Newspapers composted in a garden
- Community won't take garbage if it contains recyclables, or they charge extra for it
- When it is as simple and convenient as throwing away garbage, then people will do it
- People don't use bins
- If it's that important, take labels off at central facility; creates jobs

<u>Composting</u>

- Too many restrictions in housing for backyard composting
- Garden area for housing
- Gets thrown away
- Page Manor -- can't do it unless you take it somewhere; you have to rake your lawn, but where do you put waste?
- Can mulch dry leaves
- Leaves in a landfill don't decompose
- Standards for housing: yards neat, grass cut
- Put in another bin
- Self-contained bin
- Insufficient space in housing

<u>Source Reduction</u>

- Sunday papers are large
- Put papers on computer

- Bundle up papers and recycle them downtown
- Mulch yard waste

Incineration

- Is ash used in concrete? Concrete is stable
- Ideal home would have a mini-incinerator at home; throw in paper
- Hospital has a small incinerator for biohazards; parasitic acid, 45 deg C; breaks down material, it is no longer biohazard; adds to solid waste
- Incineration pollution may not be that bad
- Good idea, manual labor to pre-sort recyclables
- Energy production

Landfilling

- We should deal with it instead of burying it for future generations
- Land can be used in the future
- Collect methane -- power generation; takes a couple of decades
- Landfill on base; had to be covered each evening, compacted it first; they get full
- Diapers are more convenient; no time for service or washing them themselves

Other Ideas

- Make it law, mandatory for our generation
- Charge by the pound for pick-up (by the bag)
  - Makes you think about source reduction
  - Pressure on manufacturers to use less packaging
- Low profile, separated in compartments, on wheels, it should be more convenient, 1/2 the height of "toter"
- Save aluminum, make effort because you know you get paid
- Recycle as a fundraiser
- Conform or be charged extra
- Just received bins a few months ago
- Housing office has bins stored, they should be distributed
- Out of site - out of mind, people just want to get rid of garbage

Ideas Recorded on Charts

1) Recycling
   - Restriction on material
   - Inconvenience in preparing material
   - Bin too small for all the material
   - Central drop-offs in housing areas
   - Penalties for not recycling
   - Separate at central location

2) Composting
   - Restrictions in base housing
   - Mulch clippings, spread over yard
   - Compost bins

3) Source Reduction
   - Computerized newspaper
   - Mulching, composting

4) Incineration
   - How is ash used?

5) Landfilling
   - Cap landfills to prevent pollution
   - Collect gaseous emissions
   - Should deal with waste
   - Most convenient method

GROUP DISCUSSION
SUMMARY

Group 10, Military Family Housing Residents
Paper, Yard Waste, Food Waste
25 Sep 96, 12pm

Recycling

- Bins are for outside, you need your own indoor container
- Kitchen is too small, no room for separate bin
- Inconvenient
- Not big enough
- The contractor sells aluminum and keeps money
- If you want to recycle a lot, bin is too small
- You have to take two separate things to curb; at Page Manor, too long too walk
- Other things could be recycled, but are not in the program
- Want to recycle more
- Concern about recycling because of kids
- Mulching lawn mower
- Never got a pamphlet, no information
- Bin with information on it -- no confusion
- Cardboard is added
- Does it have to be in bin?

Composting

- People won't do it on their own
- Not enough motivation
- If you own your own house, you have more flexibility
- Block composting operation
- You have to have proper nitrogen-carbon ratio
- Lots of education required
- Some yards have big trees, lots of leaves, more than you have capacity for
- Composting compacts waste
- Common areas account for more area in Page Manor
- Collection program for yard waste
- You could enforce it on base
- Perceived benefit, convenience for you

Source Reduction

- Buy recycled content items
- Returnable bottles
- Boycott McDonalds
- Excess packaging
- Take your own bag to the grocery store
    - Other countries take their own bag
    - We don't want to be inconvenienced
    - We buy in larger quantities, we don't go daily
    - Unfortunate side effect of capitalism
    - Profitable to provide convenience
- Most people want convenience in the short term
- No awareness about method
- Society - more is better
- Build things that can be reused
- Waste from diapers; they are convenient, disposable
- Printing documents with mistakes
- Packaging on toys is incredible

Incineration

- Air pollution, plastics, batteries, paint
- Need some improvement --dioxin formation
- May be answer for some of our waste
- Waste-to-energy
- Need to limit what you burn
- Electronic equipment is a problem

Landfilling

- Limited space is biggest problem
- A lot of area out west
- "Not in my backyard"
- Send it into space
- Recreational areas, golf courses, ski areas
- Optimized landfill design, compact material
- Caps and liners
- If we did everything else, we would reduce impact on landfill
- In the long run, what is effect?
- Methane collection
- If we want material to degrade, we need to design landfills differently

Other Ideas

- Knowing that other people are doing it
- **Awareness -- put signs up by gates
- Education/awareness
- Pressure from kids
- Make it more convenient, or pay people to do it
- People have to have a stake in it and see benefits
- Incentivize it for people
- Future concerns are difficult to address
- Awareness that recycling is important
- Means to do it
- Hierarchy, Maslow, most people are at lower level, to motivate people--money, convenience, force people to do it
- There has to be a personal, direct cost to you
- Pay people to recycle

Ideas Recorded on Charts

1) Recycling
   - Bins outside vs. inside storage; convenience, protection of materials while they are stored
   - Rollable "toter" vs. bin that must be carried
   - Multiple bins outside for different materials
   - Where does money go? There is no perceived benefits
   - Combine trash and recycle containers, convenience
   - Housing materials too restricted; there is a lack of information about the program
   - Mulching lawn mowers

2) Composting
   - Crowded -- nuisance to neighbors in family housing
   - Odor, appearance
   - Mulching lawnmower
   - More would do it if a kit or container were provided
   - If you own your home, more likely to recycle
   - Block compost site - more balanced mix
   - Space required is more than available
   - Pick up / clean up day; basewide collection

3) Source Reduction
- Buy recycled content items
- Packaging, use / buy less
    - Take own bags to store
    - Diapers
    - Paper printing -- proofread
- Desire for convenience, society is materially oriented
- Publicize, awareness
- Build for reuse

4) Incineration
- Toxics from content, batteries, paint, plastic
- Turn in days -- advertise
- Energy output
- Select only non-recyclable materials; non-toxic

5) Landfilling
- Gas capture
- Deteriorate waste -- change to harmless material
- Odor improvements

GROUP DISCUSSION
SUMMARY

Group 12, Housing Residents
Paper, Yard Wastes, Food Wastes
26 Sep 96, 1pm

Recycling

- Can't recycle colored paper
- Is glossy paper the only thing that can't be recycled?
- Directions were limited as to what was recyclable
- More explanation is needed
- Food waste is put in the garbage disposal
- Other bases have recycling programs
- Curbside recycling with one bin is good idea
- If you have to take it somewhere, people won't do it
- Habit, people always throw things away
- Perception, people are lazy and don't want increased work
- It is work to take labels off
- Have never had items in the recycling bin left there by collection personnel
- The process can't be made much easier
- Recyclables are picked up on the same day as trash
- We are recycling nearly everything possible
- Some places recycle styrofoam

Composting

- Too many base regulations
- Attracts pests and rodents
- Garbage disposals break down too often
- How would compostable material be collected basewide?
- Once per year take your yard waste in
- Mulching lawnmower puts grass back into ground

Source Reduction

- Don't use it or reuse it
- Decrease use of it
- Excess packaging is a problem
- Take your own shopping bags to the store
- Get what you need for a couple of days
- Refill your water bottles
- Refill packaging, shampoo containers

Incineration

- Minimize, eliminate air pollution, or there will be opposition
- Energy from burning
- Really expensive to build and operate
- Permits are expensive
- Burn it or bury it, how else do you get rid of it

Landfilling

- How can they make material degrade
- Be strict about what you can put in a landfill
- Don't allow recyclable items
- Too troublesome to break large items apart and recycle

Other Ideas

- Profit -- getting money back
- People collect aluminum
- More people would recycle if they knew they got money back
- What percentage of people use recycling center or facilities
- Base makes $100K/year from recycling, where does money go?
    - Upkeep and maintenance of family support programs
- Bins have been in place for a few months
- If we take time to recycle, shouldn't people who recycle have priority over civilians?
- The price for family pool passes was lower this year
- Money is the biggest motivator
- Coupons for things on base, like free haircut, movie passes, dry cleaning

Ideas Recorded on Charts

1) Recycling
    - What is recyclable?
    - Chemicals in the ink on paper
    - People don't always separate properly
    - Curbside, one bin is good method
    - Habit/Convenience
    - Everything is taken, nothing is ever left in bin

2) Composting
    - Limited by regulation
    - Possible rodent infestation

- How is it done at base level?
- Mulching lawnmower

3) Source Reduction
   - Re-use or decrease use of item
   - Use own shopping bags
   - Refill water bottles, other containers

4) Incineration
   - Need to reduce/eliminate emissions
   - Energy recovery
   - Very expensive to build/operate

5) Landfilling
   - Change landfills to allow more decomposition
   - Monitor waste put into landfill

APPENDIX R

Raw Questionnaire Responses

Group 6, Family Housing Residents
Paper, Yard Waste, Food Waste
24 Sep 96, 9am

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	0.333333	3	0.333333	3	3
	0.142857	0.111111	0.142857	0.111111	0.142857	9
	1	0.333333	3	0.333333	3	5
Geometric	0.753947	0.23112	1.08738	0.23112	1.08738	5.129928
Mean =	0.8	0.2	1.1	0.2	1.1	5.1

Part II. Convenience

A = source reduction
B = recycling
C = composting
D = throwing waste in the trash

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	5	0.333333	5	0.111111	0.111111
	0.2	0.2	3	5	1	1
	1	3	0.333333	3	0.333333	0.333333
Geometric	0.8	1.4	0.7	4.2	0.3	0.3
Mean =	1.2		1.4		3.0	3.0

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = composting
D = incineration
E = landfilling

	A vs B	A vs C	A vs D	A vs E	B vs C	B vs D	B vs E	C vs D	C vs E	D vs E
	9	3	9	9	1	5	9	7	9	3
	0.333333	3	0.333333	7	5	7	7	7	7	9
Geometric	1	3	3	3	3	3	5	5	5	3
Mean =	1.4	3.0	2.1	5.7	2.5	4.7	6.8	6.3	6.8	4.3

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = composting
D = incineration
E = landfilling

	A vs B	A vs C	A vs D	A vs E	B vs C	B vs D	B vs E	C vs D	C vs E	D vs E
	9	9	9	9	3	9	9	9	9	3
	0.142857	0.142857	0.142857	9	9	9	7	7	9	9
Geometric	1	3	5	5	1	5	5	5	5	5
Mean =	1.1	1.6	1.9	7.4	3.0	7.4	6.8	6.8	7.4	5.1

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = luncheon for work area

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	0.333333	0.333333	0.333333	3	3	3
	5	0.2	0.142857	5	5	7
Geometric	3	0.333333	0.333333	0.333333	3	0.333333
Mean =	1.7	0.3	0.3	1.7	3.6	1.9

Group 10, Family Housing Residents
Paper, Yard Waste, Food Waste
25 Sep 96, 12pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	1	0.333333	0.2	0.2	3	3
	5	5	0.333333	0.333333	0.2	0.2
	0.111111	0.2	0.333333	3	7	3
Geometric	1	1	1	1	1	1
Mean =	0.9	0.8	0.4	0.7	1.4	1.2

Part II. Convenience

A = source reduction
B = recycling
C = composting
D = throwing waste in the trash

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	3	0.2	5	0.2	0.2
	3	3	0.111111	3	0.111111	0.111111
	0.2	5	0.142857	7	1	0.142857
Geometric	0.333333	5	0.2	5	0.2	0.2
Mean =	0.9	3.9	0.2	4.8	0.3	0.2

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = composting
D = incineration
E = landfilling

	A vs B	A vs C	A vs D	A vs E	B vs C	B vs D	B vs E	C vs D	C vs E	D vs E
	3	3	3	3	3	5	5	3	3	3
	1	1	3	1	1	3	3	3	3	1
	0.2	0.2	9	9	0.2	9	9	9	9	3
Geometric	0.2	0.2	5	5	5	7	7	7	5	0.2
Mean =	0.6	0.6	4.5	3.4	1.3	5.5	5.5	4.9	4.5	1.2

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = composting
D = incineration
E = landfilling

	A vs B	A vs C	A vs D	A vs E	B vs C	B vs D	B vs E	C vs D	C vs E	D vs E
	3	3	5	5	3	5	5	3	3	3
	0.333333	0.333333	3	3	1	3	3	3	3	1
	5	5	9	9	0.2	9	7	9	7	0.333333
Geometric	1	0.333333	5	5	5	7	7	7	5	1
Mean =	1.5	1.1	5.1	5.1	1.3	5.5	5.2	4.9	4.2	1.0

Part V. Recreation Value

A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = child care for special events

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	0.2	0.2	0.142857	5	5	0.333333
	1	0.2	0.2	3	5	0.2
	0.142857	0.142857	0.333333	7	7	0.333333
Geometric	0.333333	0.2	3	5	5	0.2
Mean =	0.3	0.2	0.4	4.8	5.4	0.3

Group 12, Family Housing Residents
Paper, Yard Waste, Food Waste
26 Sep 96, 1pm

Part I. Comparing Criteria

A = convenience
B = feeling good about reducing waste
C = leaving a good environment for future generations
D = support recreation activities on base

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	0.333333	0.333333	0.333333	1	3	3
	1	1	1	0.333333	0.333333	5
Geometric	1	0.333333	5	1	5	5
Mean =	0.7	0.5	1.2	0.7	1.7	4.2

Part II. Convenience

A = source reduction
B = recycling
C = composting
D = throwing waste in the trash

	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D
	3	5	0.333333	3	0.333333	0.333333
	0.2	5	0.333333	5	1	0.333333
Geometric	5	5	0.142857	1	0.2	0.2
Mean =	1.4	5.0	0.3	2.5	0.4	0.3

Part III. Feeling Good About Reducing Waste

A = source reduction
B = recycling
C = composting
D = incineration
E = landfilling

	A vs B	A vs C	A vs D	A vs E	B vs C	B vs D	B vs E	C vs D	C vs E	D vs E
	3	3	5	5	3	5	3	3	5	1
	1	3	3	5	3	3	3	1	1	3
	0.2	0.333333	1	9	1	1	9	1	9	9
Geometric Mean =	0.8	1.4	2.5	6.1	2.1	2.5	4.3	1.4	3.6	3.0

Part IV. Leaving a Good Environment for Future Generations

A = source reduction
B = recycling
C = composting
D = incineration
E = landfilling

	A vs B	A vs C	A vs D	A vs E	B vs C	B vs D	B vs E	C vs D	C vs E	D vs E
	3	3	7	7	3	5	5	5	3	1
	3	3	5	5	3	3	5	3	3	1
	1	3	3	9	1	5	9	5	9	9
Geometric Mean =	2.1	3.0	4.7	6.8	2.1	4.2	6.1	4.2	4.3	2.1

Part V. Recreation Value

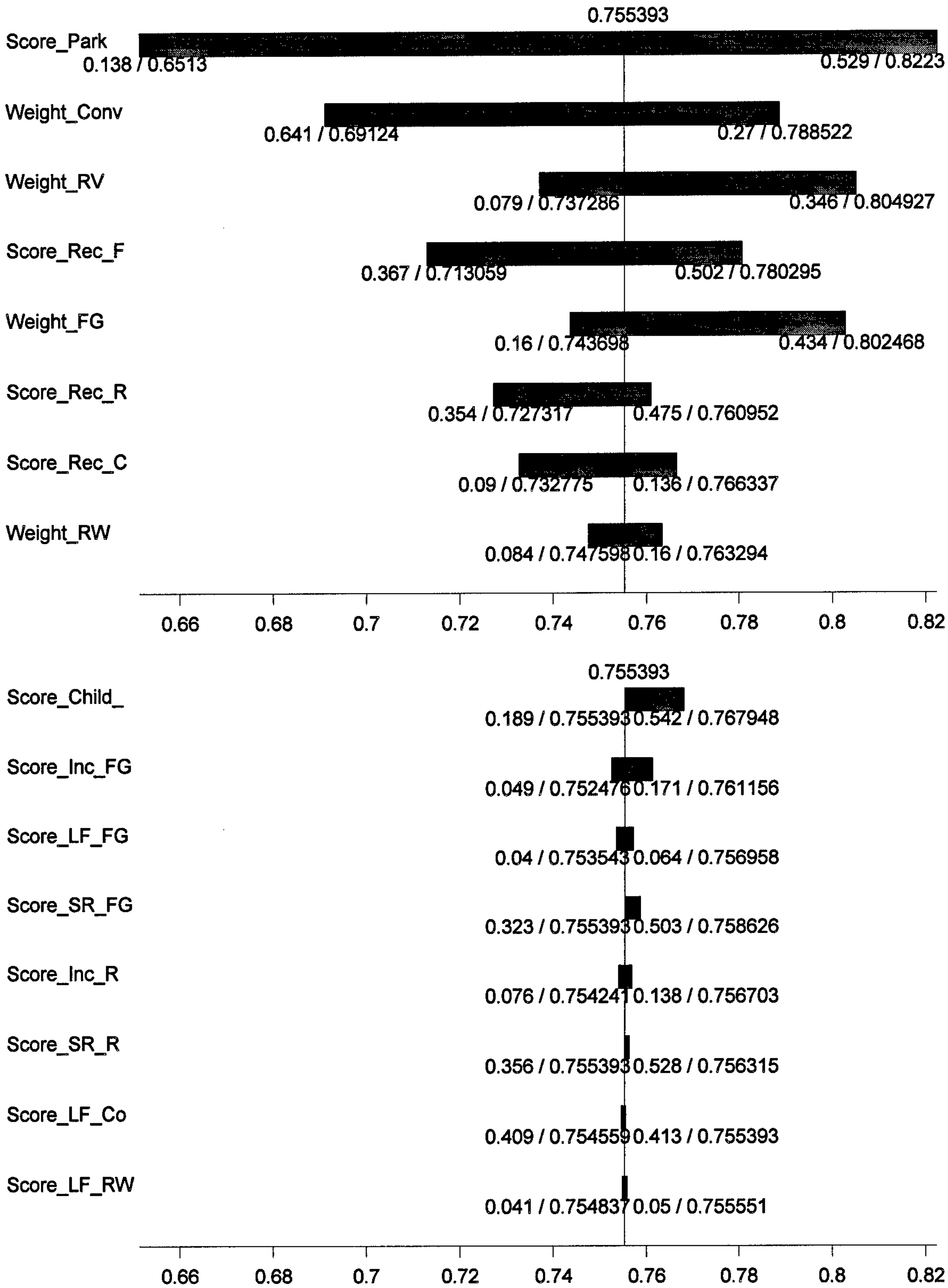
A = shrubs, flowers, and landscaping material
B = picnic shelter
C = better park and athletic fields
D = child care for special events

	A vs B	A vs C	A vs D	B vs D	C vs D	B vs C
	3	0.333333	0.333333	0.2	3	0.2
	5	0.142857	0.111111	0.111111	0.111111	0.142857
	1	0.333333	0.111111	0.111111	0.142857	0.2
Geometric Mean =	2.5	0.3	0.2	0.1	0.4	0.2

APPENDIX S

Tornado Diagram

Family Housing Residents / Paper, Yard Waste, Food Waste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0.529 / 0.8223
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0.641 / 0.69124
0.27 / 0.788522
Weight_RV
0.079 / 0.737286
0.346 / 0.804927
Score_Rec_F
0.367 / 0.713059
0.502 / 0.780295
Weight_FG
0.16 / 0.743698
0.434 / 0.802468
Score_Rec_R
0.354 / 0.727317
0.475 / 0.760952
Score_Rec_C
0.09 / 0.732775
0.136 / 0.766337
Weight_RW
0.084 / 0.747598
0.16 / 0.763294
0.66
0.68
0.7
0.72
0.74
0.76
0.78
0.8
0.82
0.755393
Score_Child_
0.189 / 0.755393
0.542 / 0.767948
Score_Inc_FG
0.049 / 0.752476
0.171 / 0.761156
Score_LF_FG
0.04 / 0.753543
0.064 / 0.756958
Score_SR_FG
0.323 / 0.755393
0.503 / 0.758626
Score_Inc_R
0.076 / 0.754241
0.138 / 0.756703
Score_SR_R
0.356 / 0.755393
0.528 / 0.756315
Score_LF_Co
0.409 / 0.754559
0.413 / 0.755393
Score_LF_RW
0.041 / 0.754837
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0.74
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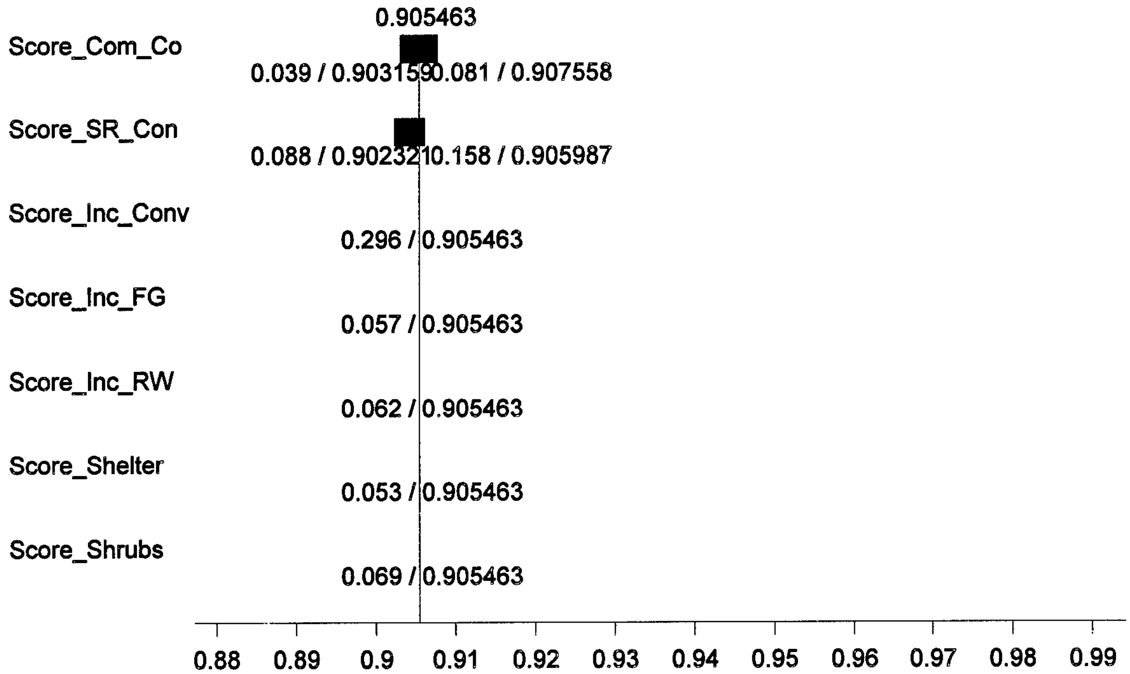
0.82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Score_Com_Co
0.039 / 0.903159
0.081 / 0.907558
Score_SR_Con
0.088 / 0.902321
0.158 / 0.905987
Score_Inc_Conv
0.296 / 0.905463
Score_Inc_FG
0.057 / 0.905463
Score_Inc_RW
0.062 / 0.905463
Score_Shelter
0.053 / 0.905463
Score_Shrubs
0.069 / 0.905463
0.88
0.89
0.9
0.91
0.92
0.93
0.94
0.95
0.96
0.97
0.98
0.99

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Vita

Captain Camille M. Still [redacted]
She graduated from Kearney High School in 1987 and entered undergraduate studies at the University of Missouri in Rolla, Missouri. She graduated with a Bachelor of Science degree in Civil Engineering and received her USAF commission in May 1992. She served as a Maintenance and Traffic Engineer with the Missouri Highway and Transportation Department before entering active duty at Altus AFB, Oklahoma in February 1993.

While at Altus AFB, Captain Still was a Project Manager; the Chief of Environmental Analysis, Plans, and Programs; and the Chief of Maintenance Engineering. She entered the Air Force Institute of Technology School of Engineering in May 1995.

Permanent Address: [redacted]

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13. ABSTRACT *(Maximum 200 words)*
Environmental managers make difficult decisions regarding management of solid waste generation and disposal. The primary waste management alternatives are source reduction, recycling, composting, incineration, and landfilling. Often, waste management policies are based entirely on technical considerations and ignore that actual disposal practices depend on individuals' attitudes and behaviors. This research formulated a decision analysis model that incorporated social value measures to determine the waste management strategy that maximizes the individuals' willingness to participate. The social values that are important and that were considered in the decision support model were convenience, feeling good about reducing waste, feeling good about leaving a good environment for future generations, and the value of recreation programs that can be provided with profit from a recycling program. Focus group discussions were conducted where participants discussed their ideas about each of the waste management alternatives and completed a questionnaire which was made up of pairwise comparisons which were evaluated using the analytic hierarchy process. The results of the research were strategies for waste management policy that would maximize individuals' willingness to participate. Recycling was the preferred method; source reduction, incineration and composting were the next best alternatives; and landfilling was the least preferred alternative.

14. SUBJECT TERMS
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